A DICTIONARY OF CHEMICAL SOLUBILITIES

INORGANIC

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A DICTIONARY OF CHEMICAL SOLUBILITIES

INORGANIC

FIRST EDITION

BY

ARTHUR MESSINGER COMEY, PH.D.

SECOND EDITION

ENLARGED AND REVISED

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PREFACE TO FIRST EDITION

For many years a need has been felt by chemists for a book which shall collect into convenient form for ready reference the various data concerning the solubility of chemical substances that have been published from time to time in chemical periodicals and elsewhere.

The first mention that can be found of such a plan was made in 1731, when Peter Shaw delivered Chemical Lectures in London, as may be seen from the following:—

Extracts from Peter Shaw's Chemical Lectures, publickly read at London in 1731 and 1732. London. Second Edition, London 1755. 8vo.

Page 97. Experiment I.—That Water as a Menstruum dissolves more of one body and less of another.

[He shows that two ounces of water dissolve two ounces of Epsom salt, five drachms of common salt, and eight grains of cream of tartar. Only in the latter case much remained undissolved until boiled.]

"It might be proper for the further Improvement of Chemistry and Natural Philosophy to form a Table of the Time and Quantity wherein all the known Salts are dissolvable in Water. . . . Such a Table regularly formed might ease the Trouble of refining Salts, by shewing at once without future Trial or Loss of Time how much Water each Salt required to dissolve it for Clarification, Filtration, or Crystallization. It would likewise supply us with a ready and commodious Way of separating any Mixture of Salts, by shewing which would first shoot out of the Mixture upon Crystallization. . . . The same Table might also direct us to a ready and commodious Method of separating two Salts without waiting for Crystallization. . . ."

It was many years, however, before the scheme suggested by Peter Shaw was put into execution. Professor F. H. Storer published the first work that undertook to carry out the idea in its entirety, in 1864, in a book, which he entitled "First Outlines of a Dictionary of Solubilities of Chemical Substances," and which contained a compilation of nearly all the data on the subject published before 1860. It was at once recognized as a most valuable contribution to chemical literature; but for many years it has been difficult to obtain this work, as the limited edition which was published was soon wholly exhausted. Since then nothing has appeared on the subject except the brief tabulations found in various reference books, and no attempt has been made to cover the whole subject.

It is needless to state that the growth of chemical science since the publication of Professor Storer's book has been so enormous that that work has lost, at least to a great extent, the practical value it possessed thirty years ago. This growth has been indeed so great, and the data which have accumulated since 1860 so far surpass the earlier in volume, that a simple revision of Professor Storer's book was impracticable, and it therefore seemed best to start afresh.

With the facilities offered by the various scientific libraries at Harvard University, the Massachusetts Institute of Technology, and other libraries in Boston, it has been possible to collect nearly all the data relating to the subject. For the work before 1860 Professor Storer's work has been found invaluable.

The method pursued has been to form a preliminary list of compounds with more or less data by consulting the two most complete works on inorganic chemistry—Gmelin-Kraut's "Handbuch der anorganischen Chemie" and Graham-Otto-Michaelis's "Lehrbuch." These statements have been verified and elaborated by consulting the original memoirs in all the periodicals devoted to chemical literature which were obtainable. The "Jahresbericht der Chemie" also has been used extensively in tracing references, but the original memoirs have always been consulted and references given to them when possible.

It has been found impracticable to draw any distinction as to reliability between the various data given by different observers. It was manifestly impossible to attempt to verify experimentally the statements of those who have carried on the researches, for the most assiduous labor of many could only cover a small portion of the attested facts. Therefore, even when two statements are directly contradictory, both have been given with the authority for each. The only exception to this has been made when more recent discoveries have shown beyond any reasonable doubt the falsity of previous work. In this way some of the older manifestly inaccurate work has been omitted. In a majority of cases the more recent work may be considered to be the more accurate, but this is not the invariable rule. A Synchronistic Table of the more common periodicals is given in the Appendix, whereby it is easy to determine the date of the publication of a research to which reference is made.

It may be objected by the practical chemist that most of the work previous to 1850 might well have been omitted, but a great deal of this work possesses at least a historical value, and often furnishes facts which have not since been verified. Much of the earlier work, when obviously of less importance, has been printed in smaller type.

The aim has been to include in this volume all analyzed inorganic substances, that is, all substances which do not contain carbon, but exception has been made in the case of CO_2, CO, CS_2, the carbonates, cyanides, ferro-cyanides, etc., which are here included.

The work has been brought up to March, 1894, when this volume went to press, and the results of researches published since that time are not included in the present edition.

It is hoped that this book will fill to some extent the want that has been felt by chemists for a compilation of this nature. While it has been attempted to make the book as free from errors as possible, nevertheless it is naturally impossible to avoid many mistakes, and the compiler will be very grateful to those who may call his attention to any errors or omissions.

A. M. C.

CAMBRIDGE, MASS., Aug., 1895.

PREFACE TO SECOND EDITION

DURING the twenty-five years which have elapsed since the publication of the first edition of this dictionary, a very large amount of work has been published in chemical periodicals, containing data concerning the solubility of inorganic chemical compounds. As it was impossible for the compiler of the first edition to devote the time necessary for the collecting of the published data, it was necessary to employ assistance, and Dr. Dorothy A. Hahn, Professor of Chemistry, Mt. Holyoke College, was engaged for this work Dr. Hahn has collected the larger part of the material in this book, which work in spite of its arduous and tedious nature, she has performed in a most painstaking manner.

The compilation and arrangement of the data collected by Dr. Hahn, which devolved upon the original author, took much time. This, together with difficulties in printing, caused by the general conditions after the war, has delayed the publication until the present year, although the work was begun in 1916, and it has only been brought up to January 1st of that year.

Since the publication of the first edition of this work, Dr. Atherton Seidell has brought out two editions of his book, entitled "Solubilities of Inorganic and Organic Substances," which covers quite a different field, as he considers only quantitative data and those only for the commoner substances. Dr. Seidell has followed the plan in most cases where there are several available solubility determinations of a substance, of selecting and averaging the more reliable results, and embodying them in tables. Although this undoubtedly facilitates ready reference, it has seemed better to adhere to the original plan of the first edition, and to publish all the data in the form of the original authorities with references and dates, so that the user may be at liberty to use his own judgment in selection. Some few of the tables arranged by Dr. Seidell, however, have seemed to possess decided advantages over any other published data and they have been incorporated in the present volume. It is desired also to acknowledge indebtedness to Dr. Seidell's work for certain other tables where the original sources were not available to the present compilers.

The same plan and arrangement used in the first edition has been followed with certain elaboration, however, of the arrangement of data on the solubility of two or more salts in a solvent, which is explained in the Explanatory Preface.

Data published since the first edition on the cobalt and chromium ammonia compounds and those of the platinum group have been omitted, as it seemed that solubility data on those compounds possessed very little general interest.

As stated in the preface of the first edition, while every possible attempt has been made to avoid errors, it is manifestly impossible to avoid many mistakes in a work of this nature, and the compiler will be glad to have his attention called to any errors or omissions.

WILMINGTON, Del., Jan., 1921. A. M. C.

EXPLANATORY PREFACE

In order to reduce this volume to a convenient size the subject-matter has been abbreviated and condensed as far as seemed compatible with clearness; but it has been the aim not to use any abbreviations which are not at once intelligible without consulting the explanatory table. The more common chemical formulæ have been universally used, thereby saving a large amount of space without detracting from ready intelligibility to chemists.

The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling-points; other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances.

Owing to the great increase of data, published during the last twenty years, on the simultaneous solubility of two or more salts in a given solvent, it has been found necessary to plan some arrangement, whereby such data can easily be found, and the plan adopted is as follows: The data for the solubility of two salts in a solvent is placed under the salt which comes first according to the alphabetical arrangement in this dictionary, and the order of the data on various salts under the same heading follows the alphabetical order of the salts considered. Thus the data on the solubility of $NH_4Cl+BaCl_2$, $NH_4Cl+CuCl_2$, and $NH_4Cl+PbCl_2$, and $NH_4Cl+(NH_4)_2SO_4$ are placed under Ammonium Chloride and arranged in the given order. Certain exceptions have been made to this rule, where the data directly concerns the solubility of a salt in a solution of another salt, in which case, it is placed under the former. Numerous cross references, however, are given, which it is hoped will avoid confusion.

In many cases no definite distinction can be drawn between the phenomena of solution and decomposition. At present the theory of solution is in a confused state, and until what really takes place when a substance dissolves is thoroughly understood no distinct line can be drawn. The whole subject is unsettled at the present time; for while many chemists believe in the so-called "dissociation" theory, yet the "hydrate" theory is not without its supporters. It is not my intention to discuss the theoretical side of the question, which has been so well treated in many recent works. It is, however, obvious that the phenomena are essentially different, when, for example, sodium carbonate is dissolved in water, in which case the original salt is deposited on evaporation, and when iron is dissolved in sulphuric acid, and the solution deposits a sulphate of iron. Yet it is still the custom to speak of iron as soluble in sulphuric acid, although it would be much more accurate to say that the sulphuric acid was decomposed by the iron. It has thus been found impracticable to draw a sharp line between solu-

tion and decomposition, and the term "soluble" has in general been used where a solution of some sort is formed by the action of the solvent.

The matter of alphabetical arrangement of chemical compounds, in the present somewhat confused state of chemical nomenclature, has been a difficult question to decide. The plan followed has been practically that of the standard Dictionaries of Chemistry, whereby the compounds of metals with one of the non-metallic elements have been classified under the metals, while the salts of the other acids (the oxygen acids so called and some few others) have been arranged alphabetically under the acids. Thus barium chloride is found under barium, while barium chlorate is found under chloric acid. No exception has been made in the case of the rare metals, as is usually the custom in Dictionaries of Chemistry. Double salts are to be found under the word which comes first alphabetically; thus, "common alum," potassium aluminum sulphate, is found under aluminum sulphate as aluminum potassium sulphate (under sulphuric acid), but ammonia chrome alum is found under ammonium sulphate as ammonium chromium sulphate. In the same way the double sulphate and chromate of potassium is found under potassium chromate (chromic acid), and not under potassium sulphate (sulphuric acid). The double chloride of ammonium and magnesium is found under ammonium chloride (ammonium), while the double chloride of potassium and magnesium is found under magnesium chloride (magnesium). An exception is made, however, in the case of double compounds of salts of oxygen acids with salts containing a single non-metallic element, in which case they are always found under the oxygen acid. Thus the double sulphate and chloride of lead, $PbSO_4$, $PbCl_2$, is found under lead sulphate (sulphuric acid), and not under lead chloride (lead).

The above method in some cases widely separates analogous compounds, but it was found to be the only practical way to a strictly alphabetical arrangement, which is so necessary in a book containing so many very short articles.

The ammonia addition-products furnished another difficulty. While their nature is more or less definitely understood in the cobalt, platinum, etc., compounds, and a definite nomenclature is in general use, there is an absolute lack of anything of the kind in the less definite compounds. It is good usage to speak of cuprammonium compounds, but how shall we designate the analogous cadmium compounds? "Cadmammonium" has not yet received the sanction of chemists, and $AlCl_3$, NH_3 is a still worse case for naming. I have, therefore, not attempted to name these compounds, but classified them all under the salts to which the ammonia is added, affixing the word ammonia, thus: aluminum chloride ammonia, cadmium chloride ammonia, and also cupric chloride ammonia for the salt now almost universally known as cuprammonium chloride.

The ammonia compounds of cobalt, chromium, mercury, and the platinum metals are arranged alphabetically according to their universally accepted names, a list of which is given under each of those elements.

It has further been necessary to settle arbitrarily the question whether a substance should be considered as a double salt or a salt of a compound acid con-

taining one of the metals. For example, "fluosilicates" (or silicofluorides, as some may prefer) is the general name for the double fluorides of SiF_4 and a metal, but this unanimity in usage gradually disappears as the basic elements become more nearly alike, so that it is impossible to draw a line between such compounds and a compound such as the double chloride of magnesium and potassium, for which indeed the name "potassium chloromagnesate" has been proposed. The aim has been in all these cases to follow the best usage rather than make an absolutely homogeneous system of nomenclature out of the existing confusion.

In the matter of formulæ no attempt at uniformity has been made. Thus in the case above some chemists write the formula of the double chloride of magnesium and potassium as $KMgCl_3$, others as $KCl, MgCl_2$. The form here used has been in most cases that of the author from whom the data are taken.

The prefixes mono, di, tri, ortho, pyro, etc., have in general been disregarded in the alphabetical arrangement, and have been printed in italics. Exceptions to this have been made, however, in the cobalt, chromium, etc., ammonium compounds, and in a few others, as dithionic, perchloric, etc., acids. Cross references have been used, so as to prevent any confusion arising from lack of uniformity in this respect.

In the Appendix will be found formulæ and tables for the conversion of the degrees of various hydrometer scales into specific gravity, and a Synchronistic Table of the Periodicals to which references are most frequently made.

ABBREVIATIONS

abs.—absolute.
atmos.—atmosphere.
b.-pt.—boiling-point.
comp.—compound.
conc.—concentrated.
corr.—corrected.
cryst.—crystallised, crystalline
decomp.—decompose, decomposes, decomposition, etc.
dil.—dilute.
eutec.—eutectic.
insol.—insoluble.
M.—a univalent Metal.
Min.—Mineral.
mol.—molecule.
m.-pt.—melting-point.
ord.—ordinary.
n.—normal.
ppt., pptd., etc.—precipitate, precipitated, etc.
pt.—part.
sat.—saturated.
sl.—slightly.
sol.—soluble
sp. gr.—specific gravity.
supersat.—supersaturated.
t° = temperature in Centigrade degrees.
temp.—temperature.
tr. pt.—transition point.
vol.—volume.

ABBREVIATIONS OF REFERENCES

A.—Annalen der Pharmacie, edited by Liebig and others, 1832–39; continued as Annalen der Chemie und Pharmacie, 1840–73; continued as Justus Liebig's Annalen der Chemie, 1874–1915+. 406 vols.

A. ch.—Annales de Chimie et de Physique. Paris. 1st series, 1789–1816, 96 vols.; 2nd series, 1817–40, 78 vols., 3rd series, 1841–63, 69 vols.; 4th series, 1864–73, 30 vols.; 5th series, 1874–83, 30 vols.; 6th series, 1884–93, 30 vols., 7th series, 1893–1903, 30 vols.; 8th series, 1904–13, 30 vols.; 9th series, 1914+, 3 vols.

Acta Lund.—Acta Universitatis Lundensis, or Lunds Universitets Års-skrift. Lund, 1364+

Am. Chemist.—The American Chemist. New York, 1870–77. 7 vols.

Am. Ch. J.—The American Chemical Journal, edited by Remsen. Baltimore, 1879–1913. 50 vols.

Am. J. Sci.—American Journal of Science and Arts, edited by Silliman, Dana, and others. New Haven. 1st series, 1818–45, 50 vols.; 2nd series, 1846–70, 50 vols.; 3rd series, 1871–95, 50 vols.; 4th series, 1896–1915+, 40 vols. Also numbered consecutively, 190 vols.

Analyst.—The Analyst. London, 1876–1915+. 45 vols.

Ann. chim. farm.—Annali di chimica e di farmacologia. Milan, 1886–90. 5 vols.

Ann. des Mines.—*See* Ann. Min.

Ann. Min.—Annales des Mines. Paris.

Ann. Phil.—Annals of Philosophy. London. 1st series, 1813–20, 16 vols.; new series, 1821–26, 12 vols.

Ann. Phys.—*See* Pogg. *and* W. Ann.

Apoth. Z.—Apotheker-Zeitung. Berlin.

Arb. Kais. Gesundheitsamt.—Arbeiten aus dem Kaiserlichen Gesundheitsamte.

Arch. Néer. Sc.—Archives Néerlandaises des Sciences exactes et naturelles.

Arch. Pharm.—Archiv der Pharmacie, continued from Archiv des Apothekervereins in Norddeutschland, which forms the 1st series 1st series, 1822–34, 50 vols.; 2nd series, 1835–72, 150 vols.; 3rd series, 1873–94+, 32 vols. Also numbered consecutively, which system is exclusively used after 3rd series, vol. 253 (1915).

Arch. sc. Phys. nat.—Archives des sciences physiques et naturelles de la Bibliothèque universelle de Génève.

A. Suppl.—Annalen der Chemie und Pharmacie. Supplement-Bande. Vol. i. 1861; vol. ii, 1862–63; vol. iii. 1864–65; vol. iv. 1865–66; vol. v. 1867; vol. vi. 1868; vol. vii. 1870; vol. viii. 1872.

B.—Berichte der deutschen chemischen Gesellschaft. Berlin, 1868–1915+. 48 vols.

Att. Acc. Linc.—Atti della reale accademia dei Lincei, rendconditi, etc.

B. A. B.—Sitzungsberichte der königlichen preussischen Akademie der Wissenschaften zu Berlin.

Belg. Acad. Bull.—Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique.

Berz. J. B.—Jahresbericht über die Fortschritte der physischen Wissenschaften, edited by Berzelius. 1822–47. 30 vols.

Br. Arch.—Archiv des Apothekervereins im nördlichen Teutschland, etc., edited by Brandes. 1st series, 1822–31, 39 vols., corresponds to 1st series of Arch. Pharm.

Bull. Acad. Crac.—Bulletin international de l'Académie des Sciences de Cracovie.

Bull. Ac. St. Pétersb.—Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg.

Bull. Soc.—Bulletin des Séances de la Société chimique de Paris. 2nd series, 1864–88, 50 vols.; 3rd series, 1889–1906, 36 vols.; 4th series, 1907–15+, 18 vols.

Bull. Soc. chim. Belg.—Bulletin de la Société chimique Belgique.

Bull. Soc. ind. Mulhouse.—Bulletin de la Société industrielle de Mulhouse. 1828–49. 22 vols.

Bull. Soc. Min.—Bulletin de la société française de Minéralogie. 1878–1915+. 37 vols.

C. A.—Chemical Abstracts. American Chemical Society. New York.

C. C.—Chemisches Centralblatt, continued from Pharmaceutisches Centralblatt.

C. B. Miner.—Centralblatt für mineralogie, Geologie und Palæontologie. Berlin.

Chem. Ind.—Die Chemische Industrie, edited by Jacobsen. Berlin.

Chem. Soc.—Journal of the Chemical Society of London. 1st series, 1849–62, 15 vols.; 2nd series, 1863–78, 17 vols.; new series, 1878–1915+. The vols. are numbered consecutively from 1849. 1878 = vol. 32. Total, 108 vols.

Chem.-tech. Centr-Anz.—Chemisch-technischer Central-Anzeiger.
Chem. Weekbl.—Chemiker Weekblad.
Chem. Z.—*See* Ch. Z.
Chem. Zeitschr.—Chemische Zeitschrift.
Ch. Gaz.—The Chemical Gazette. London, 1843–59. 17 vols.
Ch. Kal.—Chemiker Kalender, edited by Biedermann.
Ch. Z.—Chemiker Zeitung.
Ch. Z. Repert.—Chemisches Repertorium Beiblatt zur Chemiker-Zeitung. Göthen.
Cim.—Il Cimento. Turin, 1852–54. 6 vols.
C. N.—The Chemical News. London, 1860–1915+. 112 vols.
Comm.—Commentar zur Pharmacopœa germanica by Hager. Berlin, 1883.
Compt. chim.—Comptes-rendus mensuels des Travaux chimiques, edited by Laurent and Gerhardt. 1845–51. 7 vols.
C. R.—Comptes-rendus hebdomadaires des Séances de l'Académie des Sciences. Paris, 1835–1915+. 161 vols.
Crell. Ann.—Chemische Annalen für die Freunde der Naturlehre, etc., edited by Crell. 1784–1803. 40 vols.
Dansk. Vid. For.—Oversigt over det kgl. danske Videnskabernes Selskabs Forhandlinger. Copenhagen.
Dingl.—Dingler's Polytechnisches Journal, edited by Dingler and others. 1820–1915+. 330 vols.
Edinb. Trans.—Transactions of the Royal Society of Edinburgh. 1788–1915+. 51 vols.
Ed. J. Sci.—The Edinburgh Journal of Science. 1st series, 1824–29, 10 vols.; 2nd series, 1829–32, 6 vols. Continued as Phil. Mag.
Electrochem. Ind.—Electrochemical Industry (Oct., 1902, to Dec., 1904) later Electrochemical and Metallurgical Industry. New York.
Elektrochem Z.—Elektrochemische Zeitschrift. Berlin.
Eng. Min. J.—The Engineering and Mining Journal. New York.
Gazz. ch. it.—Gazzeta chimica italiana. Palermo, 1871–1915+. 45 vols.
Gilb. Ann.—Annalen der Physik, edited by Gilbert. 1st series, 1799–1808, 30 vols.; 2nd series, 1809–18, 30 vols.; 3rd series, 1819–24, 26 vols. Also numbered consecutively. 76 vols. Continued as Pogg.
Gm.-K.—Gmelin-Kraut's Handbuch der anorganischen Chemie, 6te Auflage. 1877–1905. 7te Auflage, 1907–1915+.
Gr.-Ot.—Graham-Otto's ausführliches Lehrbuch der anorganischen Chemie, 5te Auflage, by Michaelis. 1878–89.
Jahrb. Miner.—Jahrbuch für Mineralogie, Geologie und Palæontologie. Heidelberg. 1830–1832. Then. Neues Jahrbuch für Minerologie. Stuttgart.
Jahrb. d. Pharm.—Jahresbericht der Pharmacie.
J. Am. Chem. Soc.—Journal of the American Chemical Society. New York, 1876–1915+. 37 vols.
J. Anal. Appl. Ch.—The Journal of Analytical and Applied Chemistry, edited by Hart. 1887–93. 7 vols.
J. B.—Jahresbericht über die Fortschritte der Chemie, u. s. w.
J. Chim. méd.—Journal de Chimie médicale, de Pharmacie, et de Toxicologie. 1st series, 1825–34, 10 vols.; 2nd series, 1835–44, 10 vols.; 3rd series, 1845–54, 10 vols.; 4th series, 1855–64, 10 vols.; 5th series, 1865–76. 12 vols.
Jena. Zeit.—Jenaische Zeitschrift für Medicin und Naturwissenschaften.
J. Pharm.—Journal de Pharmacie et de Chimie. Paris. 2nd series, 1815–41, 27 vols.; 3rd series, 1842–64, 46 vols.; 4th series, 1865–79, 30 vols.; 5th series, 1879–94; 6th series, 1895–1909, 30 vols.; 7th series, 1910–15+, 10 vols.
J. Phys.—Journal der Physik, edited by Gren. 1790–98. 12 vols. Continued as Gilb. Ann.
J. Phys. Ch.—The Journal of Physical Chemistry. Ithaca, N. Y.
J. pr.—Journal für praktische Chemie, edited by Erdmann, Kolbe, and v. Meyer. Leipzig. 1st series, 1834–69, 108 vols.; 2nd series, 1870–1915+. 92 vols.
J. russ. phys. Chem. Soc.—Journal de la Société physico-chemique russe. St. Pétersbourg.
J. Russ. Soc.—Journal of the Russian Chemical Society. St. Petersburg, 1869–1915+. 47 vols.
J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry. London, 1882–1915+. 34 vols.
J. S. C. I.—*See* above.
J. Tok. Chem. Soc.—Journal of the Tokyo Chemical Society.
Kastn. Arch.—Archiv für die gesammte Naturlehre, edited by Kastner. Nuremberg, 1824–35. 25 vols.
Listy Chemické.—Listy Chemické, edited by Preis and others. Prague.
Lond. R. Soc. Proc.—*See* Roy. Soc. Proc.
Lund. Univ. Arsk.—Lunds Universitets Års-skrift. Lund.

M.—Monatshefte für Chemie und verwandter Theile der anderer Wissenschaften. Vienna, 1880–1915+. 36 vols.
M. A. B.—Sitzungsberichte der mathematisch-physikalischen Classe der kgl. bayerischen Akademie der Wissenschaften zu München.
Mag. Pharm.—Magazin der Pharmacie. 1823–31. 36 vols.
Mém. Acad. St. Pétersb.—Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg.
M. Ch.—*See* M.
Mem. Coll. Sci. Kyoto.—Memoirs of the College of Science, Kyoto.
Metall.—Metallurgie. Halle.
Miner. Jahrb.—Neues Jahrbuch für Mineralogie, etc. 1833–73. 40 vols.
Miner. Mag.—Mineralogical Magazine. London.
Miner. Mitt.—Mineralogische und petrographische Mitteilungen. Wien.
Monit. Scient.—Le Moniteur Scientifique, edited by Quesnesville. Paris.
N. Arch. Sc. ph. nat.—Nouvelles Archives des Sciences physiques et naturelles. Geneva.
N. Cim.—Il nuovo Cimento. Pisa, 1855–61. 14 vols.
N. Edinb. Phil. J.—New Edinburgh Philosophical Journal. 1819–64. 90 vols.
N. Jahrb. Miner.—Neues Jahrbuch für Mineralogie. Stuttgart.
N. Jahrb. Pharm.—Neues Jahrbuch der Pharmacie. 1796–1840. 42 vols.
N. J. Pharm.—Neues Journal der Pharmacie für Aerzte, etc., edited by Trommsdorff. 1817–34. 27 vols.
N. Rep. Pharm.—Neues Repertorium für Pharmacie. 1852–76. 25 vols.
Pharm. Centralbl.—Pharmaceutisches Centralblatt. 1830–49. 20 vols. Continued as C. C.
Pharm. Era.—Pharmaceutical Era.
Pharm. J. Trans.—Pharmaceutical Journal and Transactions.
Pharm. Post.—Pharmaceutische Post. Wien.
Pharm. Vierteljb.—Pharmaceutische Vierteljahresberichte.
Pharm. Weekbl.—Pharmaceutisches Weekblad.
Pharm. Ztg.—Pharmaceutische Zeitung.
Phil. Mag.—The Philosophical Magazine. London. 1st series, 1814–26, 26 vols.; 2nd series, 1827–32, 11 vols.; 3rd series, 1832–50, 37 vols.; 4th series, 1851–75, 50 vols.; 5th series, 1876–1900, 50 vols.; 6th series, 1901–1915+, 30 vols.
Phil. Mag. Ann.—The Philosophical Magazine and Annals of Chemistry, etc. Corresponds to Phil. Mag. 2nd series.
Phil. Trans.—The Philosophical Transactions of the Royal Society of London. 1665–1915+.
Phys. Rev.—The Physical Review.
Pogg.—Annalen der Physik und Chemie, edited by Poggendorf. 1st series, 1824–43, 60 vols.; 2nd series, 1844–53, 30 vols.; 3rd series, 1854–63, 30 vols.; 4th series, 1864–73, 30 vols.; 5th series, 1874–77, 10 vols. Continued as W. Ann.
Polyt. Centralbl.—Polytechnisches Centralblatt. 1st series, 1835–46, 12 vols.; 2nd series, 1847–73, 30 vols.
Proc. Am. A. A. S.—Proceedings of the American Association for the Advancement of Science.
Proc. Am. Acad.—Proceedings of the American Academy of Arts and Sciences. Boston, 1846–1915+. 50 vols.
Proc. Am. Phil. Soc.—Proceedings of the American Philosophical Society. Philadelphia.
Proc. Chem. Soc.—Proceedings of the Chemical Society of London.
Proc. K. Akad. Wet.—See Ver. K. Akad. Wet.
Proc. Soc. Manchester.—Proceedings of the Literary and Philosophical Society of Manchester.
Proc. Roy. Soc.—*See* Roy. Soc. Proc.
Q. J. Sci.—Quarterly Journal of Science. London, 1816–26. 22 vols.
Rass. Min.—Rassegna mineraria, metallurgica e chimica.
Real. Ac. Linc.—Atti di Reale Accademia dei Lincei. Rome.
Rend. Ac. Linc. *See* Att. Ac. Linc.
Rep. anal. Ch.—Repertorium der analytischen Chemie. 1881–87. 7 vols.
Rep. Brit. Assn. Adv. Sci.—Reports of the Meetings of the British Association for the Advancement of Science.
Repert.—*See* Rep. Pharm.
Répert. chim. appl.—Répertoire de Chimie pure et appliquée. Paris, 1858–63. 9 vols.
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Zeit. Pharm.—*See* Russ. Zeit. Pharm.
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Z. physiol. Chem.—Zeitschrift für physiologische Chemie. Strassburg.
Z. Ver. Zuckerind.—Zeitschrift des Verein der deutschen Zuckerindustrie.

A DICTIONARY OF CHEMICAL SOLUBILITIES

INORGANIC

DICTIONARY

OF

CHEMICAL SOLUBILITIES

INORGANIC

Actinium emanation.

Solubility coefficient of actinium emanation in H_2O at room temp. is 2.

If the solubility of actinium emanation in H_2O is made = 1, the relative solubility of the emanation in sat. KCl+Aq = 0.9; in conc. H_2SO_4 = 0.95; in ethyl alcohol = 1.1; in amyl alcohol = 1.6; in benzaldehyde = 1.7; in benzene = 1.8; in toluene = 1.8; in petroleum = 1.9; in CS_2 = 2.1 at 18°.

(Hevesy, Phys. Zeit. 1911, **12.** 1221.)

Air, Atmospheric.

See also **Nitrogen** and **Oxygen.**

100 vols. H_2O at 15° and 760 mm. absorb about 5 vols. atmospheric air. (Saussure.)

1 vol. H_2O at t° and 760 mm. pressure absorbs V vols. atmospheric air reduced to 760 mm. and 0°.

t°	V	t°	V	t°	V
0	0.02471	7	0.02080	14	0.01822
1	0.02406	8	0.02034	15	0.01795
2	0.02345	9	0.01192	16	0.01771
3	0.02287	10	0.01953	17	0.01750
4	0.02237	11	0.01916	18	0.01732
5	0.02179	12	0.01882	19	0.01717
6	0.02128	13	0.01851	20	0.01701

(Bunsen's Gasometry.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm. pressure.

t°	cc. N	cc. O	cc. N+O
0	16.09	8.62	24.71
5	14.18	7.60	21.78
10	12.70	6.79	19.49
15	11.67	6.25	17.92
20	11.08	5.93	17.01

(Bunsen, Gasometr. Methoden, 2te Aufl. 209, 220.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm. pressure (dry).

t°	cc. N	cc. O	N+O	%O
10	15.47	7.87	23.34	33.74
15	13.83	7.09	20.92	33.86
20	12.76	6.44	19.20	33.55
25	11.78	5.91	17.69	33.40

(Roscoe and Lunt, Chem. Soc **55.** 568.)

1 l. H_2O absorbs cc. N and O from air at t° and 760 mm.

t°	cc. N	cc. O	%O
0	19.53	10.01	33.88
6.0	16.34	8.28	33.60
6.32	16.60	8.39	33.35
9.18	15.58	7.90	33.60
13.70	14.16	7.14	33.51
14.10	14.16	7.05	33.24

(Pettersson and Sondén, B. **22.** 1439.)

1 l. H_2O absorbs cc. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	cc. N	t°	cc. N	t°	cc. N
0	19.14	10	15.14	20	12.63
2	18.20	12	14.53	22	12.27
4	17.34	14	13.98	24	11.95
6	16.54	16	13.48	25	11.81
8	15.81	18	13.03	..	..

(Hamberg, J. pr. (2) **33.** 447.)

1 l. H_2O absorbs cc. N from air at t° and 760 mm. pressure.

t°	cc. N	t°	cc. N	t°	cc. N
0	19.29	10	15.36	20	12.80
5	17.09	15	13.95	25	11.81

(Dittmar, Challenger Expedition, vol. **1.** pt. **1.**)

1 l. H_2O sat. with air at t° and 760 mm. contains cc. O (red. to 0° and 760 mm.).

t°	cc. O	t°	cc. O	t°	cc. O
0	10.187	11	7.692	22	6.114
1	9.910	12	7.518	23	5.999
2	9.643	13	7.352	24	5.886
3	9.387	14	7.192	25	5.776
4	9.142	15	7.038	26	5.669
5	8.907	16	6.891	27	5.564
6	8.682	17	6.730	28	5.460
7	8.467	18	6.614	29	5.357
8	8.260	19	6.482	30	5.255
9	8.063	20	6.356	..	...
10	7.873	21	6.233	..	...

(Winkler, B. **22.** 1773.)

1 vol. H_2O absorbs 0.01748 vol. air at 24.05° and 760 mm. pressure. (Winkler, B. **21.** 2851.)

Composition of the absorbed air between 0° and 24° is 34.91% O and 65.09% N (Bunsen); between 15° and 16°, 32.17% O and 67.83% N (König and Kranch, Z. anal. **19.** 259); 32% O and 68% N (Regnault); at 0°, 35.1% O; 10°, 34.8% O; 20°, 34.3% O; 25°, 33.7% O (Winkler, B. **21.** 2483). See also Roscoe and Lunt, and Pettersson and Sondén, page 1.

Solubility of atmos. oxygen and nitrogen in 1000 cc. H_2O at 760 mm. pressure (calc.).

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc.	cc.		cc.	cc.
0°	10.19	18.45	29°	5.33	10.30
1	9.91	17.99	30	5.24	10.15
2	9.64	17.55	31	5.15	9.99
3	9.39	17.12	32	5.07	9.83
4	9.14	16.71	33	4.99	9.67
5	8.91	16.30	34	4.91	9.52
6	8.68	15.91	35	4.83	9.37
7	8.47	15.54	36	4.76	9.22
8	8.26	15.18	37	4.69	9.08
9	8.06	14.83	38	4.62	8.94
10	7.87	14.50	39	4.55	8.81
11	7.69	14.19	40	4.48	8.67
12	7.52	13.89	41	4.42	8.55
13	7.35	13.61	42	4.35	8.43
14	7.19	13.33	43	4.28	8.31
15	7.04	13.07	44	4.22	8.20
16	6.89	12.83	45	4.15	8.09
17	6.75	12.57	46	4.09	7.97
18	6.61	12.34	47	4.03	7.87
19	6.48	12.12	48	3.97	7.76
20	6.35	11.91	49	3.91	7.65
21	6.23	11.71	50	3.85	7.55
22	6.10	11.52	51	3.79	7.45
23	5.98	11.33	52	3.74	7.34
24	5.86	11.14	53	3.68	7.24
25	5.75	10.96	54	3.62	7.13
26	5.64	10.79	55	3.56	7.03
27	5.54	10.62	56	3.51	6.92
28	5.43	10.46	57	3.45	6.81

Solubility of atmos. etc.—*Continued*

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc.	cc.		cc.	cc.
58°	3.39	6.71	80°	1.97	4.03
59	3.34	6.60	81	1.89	3.88
60	3.28	6.50	82	1.81	3.73
61	3.22	6.39	83	1.73	3.57
62	3.16	6.27	84	1.65	3.41
63	3.10	6.16	85	1.57	3.24
64	3.04	6.05	86	1.48	3.07
65	2.98	5.94	87	1.39	2.89
66	2.92	5.82	88	1.30	2.71
67	2.85	5.70	89	1.21	2.52
68	2.79	5.59	90	1.11	2.32
69	2.73	5.47	91	1.02	2.12
70	2.66	5.35	92	0.92	1.91
71	2.60	5.23	93	0.81	1.70
72	2.53	5.10	94	0.71	1.48
73	2.47	4.98	95	0.60	1.25
74	2.40	4.85	96	0.48	1.01
75	2.33	4.72	97	0.37	0.77
76	2.26	4.59	98	0.27	0.52
77	2.19	4.45	99	0.13	0.27
78	2.12	4.32	100	0.00	0.00
79	2.04	4.18			

(Winkler, B. 1901, **34.** 1440.)

Absorption of atmospheric air by H_2O at t° and 760 mm. pressure. β = coefficient of absorption. β_1 = "Solubility." (*See* under oxygen.)

t°	β	β_1	t°	β	β_1
0	0.02881	0.02864	55	0.01253	0.01059
5	2543	2521	60	1216	0978
10	2264	2237	65	1182	0892
15	2045	2011	70	1156	0801
20	1869	1826	75	1137	0705
25	1724	1671	80	1126	0600
30	1606	1539	85	1119	0481
35	1503	1420	90	1113	0343
40	1418	1315	95	1109	0185
45	1351	1224	100	1105	0000
50	1297	1140			

(Winkler, B. 1901, **34.** 1409.)

Sea-water absorbs less O and N from air than pure H_2O, but the ratio between O and N remains constant. In sea-water sat. with air at 6.22° the oxygen was 33.50% of the total gas absorbed. (Pettersson and Sondén.)

1 l. sea-water absorbs cc. N and O from air at t° and 760 mm. pressure.

t°	cc. N	cc. O	N+O	% O
0	14.41	7.77	22.18	35.03
5	13.22	6.93	20.15	34.39
10	12.08	6.29	18.37	34.24
15	11.01	5.70	16.71	34.11

(Tornoë, Norwegian North Atlantic Exped. Chem. 18.)

1 l. sea water absorbs cc. N from air at t° and 760 mm.

t°	cc. N	t°	cc. N	t°	cc. N
0	15.60	10	12.47	20	10.41
5	13.86	15	11.34	25	9.62

(Dittmar.)

1 l. sea-water absorbs cc. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry).

t°	cc. N	t°	cc. N	t°	cc. N
0	14.85	10	12.06	20	10.25
2	14.20	12	11.62	22	9.98
4	13.60	14	11.23	24	9.73
6	13.04	16	10.87	25	9.62
8	12.53	18	10.54	..	...

(Hamberg.)

Absorption of air which is free from carbonic acid by H_2SO_4 at 18° and 760 mm. α = coefficient of solubility.

H_2SO_4	α	H_2SO_4	α
98%	0.0173	70%	0.0055
90%	0.0107	60%	0.0059
80%	0.0069	50%	0.0076

(Tower, Z. anorg. 1906, **50**, 388.)

Absolute alcohol absorbs 0.11 vol. gas from air, 1/3 of which is O and 2/3, N. On mixing with an equal vol. H_2O, 2/3 of the dissolved gas is given off. (Döbereiner.)

100 vols. alcohol (95.1 %) absorb 14.1 vols. air. (Robinet, C. R. **58.** 608.)

100 vols. petroleum absorb 6.8 vols. air.
" " oil of lavender " 6.89 " "
" " benzene " 14.0 " "
" " oil of turpentine" 24.18 " "
(Robinet, *l.c.*)

1 vol. ether at 760 mm. pressure absorbs 0.290 vols. air at 0°; 0.287 vols. at 10°; 0.286 vols. at 15°. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Alcohol. C_2H_5OH.

Sp. gr. of pure ethyl alcohol+Aq. at 25°.

% alcohol	Sp. gr.	% alcohol	Sp. gr.
0	0.997077	55	0.898502
2	0.993359	60	0.886990
5	0.988166	65	0.875269
6	0.986563	70	0.863399
10	0.980434	75	0.851336
15	0.973345	80	0.839114
20	0.966392	85	0.826596
25	0.958946	90	0.813622
30	0.950672	95	0.799912
35	0.941459	98	0.791170
40	0.931483	99	0.788135
45	0.920850	100	0.785058
50	0.909852	—	—

(Osborne, McKelvy and Bearce, Bureau of Standards, Sci. Paper No. 197.)

Alum, Ammonia.

See **Sulphate, aluminum ammonium.**

Alum, Chrome.

See **Sulphate, aluminum chromium.**

Alum, Iron.

See **Sulphate, aluminum ferric.**

Alum, Potash.

See **Sulphate, aluminum potassium.**

Alumina.

See **Aluminum oxide.**

Aluminic acid, $H_2Al_2O_4 = Al_2O_3, H_2O$.

Aluminum hydroxide possesses acid properties, and salts corresponding to an acid of the above formula exist.

See **Aluminum hydroxide.**

Aluminates.

All aluminates are insol. in H_2O except those of K and Na (Fremy) and Ba (Beckmann, J. pr. (2) **26.** 385).

Barium aluminate, $BaAl_2O_4+4H_2O$.

Sol. in 10 pts. H_2O; can be recryst. from alcohol. (Deville, J. pr. **87.** 299.)

$+5H_2O$. Sl. sol. in H_2O with decomp. (Allen, Am. Ch. J. 1900, **24.** 313.)

$+7H_2O$. Sl. sol. in cold, not completely sol. in hot H_2O. Sol. in cold dil. HCl+Aq. (Beckmann, J. pr. (2) **26.** 385.)

$Ba_2Al_2O_5+5H_2O$. Sol. in 20 pts. H_2O by boiling. (Beckmann, B. **14.** 2151.)

Insol. in alcohol.

Sl. sol. in H_2O with decomp.; insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 311.)

$Ba_3Al_2O_6+7-11H_2O$. Sol. in 15 pts. H_2O with decomp. into $Ba_2Al_2O_5+5H_2O$; insol. in alcohol. (Beckmann.)

Barium aluminate bromide, $BaAl_2O_4, BaBr_2 + 11H_2O$.

Sol. in H_2O. (Beckmann, J. pr. (2) **26.** 385, 474.)

Barium aluminate chloride, $BaAl_2O_4, 3BaCl_2 + 6H_2O$.

Sol. in H_2O. (Beckmann, l.c.)

$BaAl_2O_4, BaCl_2+11H_2O$. Sol. in H_2O. (Beckmann, l.c.)

Barium aluminate iodide, $BaAl_2O_4, BaI_2$.

Sol. in H_2O. (Beckmann, l.c.)

Calcium aluminate, CaO, Al_2O_3.

Decomp. by H_2O but does not "set." Sol. in HCl; insol. in HNO_3, H_2SO_4, and HF. (Dufau, C. R. 1900, **131.** 543.)

$Ca_2Al_2O_5+7H_2O$. Slowly decomp. by H_2O; sl. sol. in H_2O. (Allen, Am. Ch. J. 1900, **24.** 316.)

$Ca_3Al_2O_6$. Insol. in H_2O; not decomp. by KOH+Aq; sol. in acids. (Tissier, C. R. **48.** 627.)

$+6H_2O$. Ppt; sl. sol. in H_2O; insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 316.)

$3Al_2O_3.4CaO+3H_2O$. Ppt. (Friedel, Bull. Soc. Min. 1903, **26.** 121; C. C. **1904,** I. 430.)

Cobalt aluminate.

"*Thenard's* or *Leithner's* blue." Insol. in H_2O.

$CoAl_2O_4$. Insol. in H_2O and acids. (Ebelmen.)

Cobalt magnesium aluminate, $[MgCo]Al_2O_4$.

"*Spinel Blue.*" Insol. in H_2O or $HCl+Aq$. (Ebelmen.)

Glucinum aluminate, $GlAl_2O_4$.

Min. *Chrysoberyll.* Not attacked by acids, but decomp. by $KOH+Aq$.

Iron (ferrous) aluminate, $FeAl_2O_4$.

Min. *Hercynite.* Not attacked by acids.

Lithium aluminate, $LiAlO_2$.

Sol. in H_2O. (Weyberg, C. C. **1906,** II. 1659.)

Lithium hydrogen aluminate, $LiHAl_2O_4+5H_2O$.

Sl. sol. in H_2O; decomp. on boiling. (Allen, Am. Ch. J. 1900, **24.** 310.)

Magnesium aluminate, $MgAl_2O_4$.

Min. *Spinel.* Insol. in H_2O.

Insol. in HNO_3+Aq; very sl. sol. in $HCl+Aq$; partly sol. in H_2SO_4 at boiling temp. (Abich, Pogg. **23.** 316.)

Sol. by standing 2 hours at 210° with a mixture of 3 pts. H_2SO_4 and 1 pt. H_2O, or by boiling with this mixture together with HF. (Mitscherlich, J. pr. **81.** 108.)

Sl. sol. in HCl, HF, and H_2SO_4; insol. in HNO_3. (Dufau, Bull. Soc. 1901, (3) **25.** 669.)

Manganous aluminate.

Insol. in H_2O and acids. (Ebelmen, A. ch. (3) **22.** 225.)

$MnAl_2O_4$. Insol. in $HCl+Aq$; readily attacked by HF, HNO_3 and H_2SO_4.

Decomp. by fusion with alkali chlorate, nitrate, oxide or carbonate. (Dufau, C. R. 1902, **135.** 963.)

Nickel aluminate.

Insol. in H_2O.

Potasssium aluminate, $K_2Al_2O_4+3H_2O$.

Decomp. by dissolving in pure H_2O with separation of Al_2O_3. (Fremy, A. ch. (3). **12.** 362.) Can be recrystallised from water containing a little alkali, without decomposition. (Fremy.)

Insol. in alcohol.

Sodium aluminate, $Na_2Al_2O_4$.

Easily and completely sol. in cold H_2O. (Schaffgotsch, Pogg. **43.** 117.)

$+4H_2O$. Insol. in alcohol. (Allen, Am. Ch. J. 1900, **24.** 308.)

$Na_6Al_2O_6$. Miscible with hot H_2O, and as sol. as NaOH in cold H_2O. Insol. in alcohol but decomp. thereby. (Tissier, C. R. **43.** 102.)

Strontium aluminate, $Sr_3Al_2O_6+6H_2O$.

Sl. sol. in H_2O (with slow decomp. in Aq. solution). (Allen, Am. Ch. J. 1900, **24.** 314.)

Thallium aluminate, $Tl_4Al_2O_5+7H_2O$.

Not completely sol. in, but slowly hydrolysed by H_2O.

Readily sol. in dil. acids and in the fixed alkalies.

Insol. in abs. alcohol. (Hawley, J. Am. Chem. Soc. 1907, **29.** 303.)

Zinc aluminate, $ZnAl_2O_4$.

Insol. in acids or alkalies.

Min. *Gahnite* (*Automolite*).

$+xH_2O$. Sol. in KOH, and NH_4OH+Aq. (Berzelius.)

Aluminicoantimoniotungstic acid.

Ammonium aluminicoantimoniotungstate, $6(NH_4)_2O$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+17H_2O$.

A shellac-like gum. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1856.)

Barium aluminicoantimoniotungstate, $5BaO$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+6H_2O$.

Somewhat insol. in dil. HCl. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1857.)

Silver aluminicoantimoniotungstate, $6Ag_2O$, $2Al_2O_3$, $3Sb_2O_5$, $18WO_3+12H_2O$.

Ppt.

Sol. in NH_4OH+Aq but requires HNO_3 (1:10) to dissolve it. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1857.)

Aluminicoarseniotungstic acid.

Ammonium aluminicoarseniotungstate, $6(NH_4)_2O$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+14H_2O$.

Sparingly sol. in H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1854.)

Barium aluminicoarseniotungstate, $4BaO$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+12H_2O$.

Very sl. sol. in H_2O.

Sol. in very dil. HCl or HNO_3. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1855.)

Cadmium aluminicoarseniotungstate, $4CdO$, $2Al_2O_3$, $3As_2O_5$, $18WO_3+17H_2O$.

Sol. in dil. mineral acids and in strong NH_4OH+Aq. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1855.)

Aluminicomolybdic acid.

Ammonium aluminicomolybdate, $3(NH_4)_2O$, Al_2O_3, $12MoO_3+19H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 696.)

$+20H_2O$. More sol. in H_2O than potassium

aluminicomolybdate. (Struve, Bull. Acad. St. Petersb. **12.** 147.)
$+22H_2O$. (Marckwald, Dissert. **1895.**)

Barium aluminicomolybdate, $4BaO, Al_2O_3, 12MoO_3+14H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Lead aluminicomolybdate, $4PbO, Al_2O_3, 12MoO_3+21H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Potassium aluminicomolybdate, $3K_2O, Al_2O_3, 12MoO_3+20H_2O$.

1 pt. of the salt is sol. in 40.67 pts. H_2O at 17°. Very difficultly sol. in acids. (Struve.)
$H_3Al(MoO_4)_3, 2KHMoO_4$. Sol. in H_2O. (Parmentier, C. R. **94.** 1713.)

Silver aluminicomolybdate, $4Ag_2O, Al_2O_3, 12MoO_3+16H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 712.)

Sodium aluminicomolybdate, $3Na_2O, Al_2O_3, 12MoO_3+22H_2O$.

Efflorescent. Easily sol. in H_2O. (Gentele J. pr. **81.** 413.)

Aluminicophosphotungstic acid.

Ammonium aluminicophosphotungstate, $9(NH_4)_2O, 2Al_2O_3, 4P_2O_5, 9WO_3+13H_2O$.

Sl. sol. in cold and in hot H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30,** 1851.)

Barium aluminicophosphotungstate, $4BaO, 2Al_2O_3, 4P_2O_5, 9WO_3+13H_2O$.

Sl. sol. in H_2O. Sol. in very dil. HCl or HNO_3. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1853.)

Silver aluminicophosphotungstate, $4Ag_2O, 2Al_2O_5, 4P_2O_5, 9WO_3+6H_2O$.

Nearly insol. in H_2O. Sol. in NH_4OH and in dil. HNO_3. Insol. in acetic acid. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1852.)

Zinc aluminicophosphotungstate, $5ZnO, 2Al_2O_3, 4P_2O_5, 9WO_3+11H_2O$.

Sol. in dil. acids and in a large quantity of conc. ammonia when NH_4Cl is present. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1853.)

Aluminicotungstic acid.

Ammonium aluminicotungstate, $3(NH_4)_2O, Al_2O_3, 9WO_3+4H_2O$.

Sol. in conc. HNO_3 and in conc. HCl. When the solution in conc. HCl was boiled, a yellow colored ppt. separated. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1230.)

Ammonium silver alumininicotungstate, $11Ag_2O, 21(NH_4)_2O, 4Al_2O_3, 36WO_3$.

The dry salt is insol. in pure H_2O, but readily sol. in H_2O containing NH_3 or HNO_3. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1231.)

Barium aluminicotungstate, $8BaO, Al_2O_3, 9WO_3+7H_2O$.

Not sol. in acids when dry. Somewhat decomp. by boiling with conc. HCl, HNO_3 or aqua regia. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1848.)

Copper aluminicotungstate, $2CuO, Al_2O_3, 9WO_3+16\frac{1}{2}H_2O$.

Sol. in large quantities of H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1847.)

Mercurous aluminicotungstate, $5Hg_2O, Al_2O_3, 9WO_3$.

Sl. sol. in H_2O. Sol. in HNO_3(1:5). (Daniels, J. Am. Chem. Soc. 1908, **30.** 1849.)

Zinc aluminicotungstate, $1\frac{1}{2}ZnO, Al_2O_3, 9WO_3+8H_2O$.

Insol. in H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1850.)
$ZnO, Al_2O_3, 9WO_3+20H_2O$. Sol. in H_2O. (Daniels.)

Aluminum, Al.

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H_2O, wine, beer, coffee, milk, oil, butter, fats, etc. Vinegar dissolves 0.349 g. from a sq. decimetre in 4 months, and 5 % NaCl+Aq, only 0.045 g. in the same time. (Ballaud, C. R. **114.** 1536.)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight. Hard or soft water, whether cold or hot, showed no action in 8 days; 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids. 4 % and 10 % acetic acid dissolved only 0.4 mg. of Al, while 10 % acetic acid dissolved 2.1 mg. from a roughened piece of Al foil in 8 days. 1 % soda solution dissolved 15 mg. in 8 days. (Rupp, Dingl. **283.** 119.)

Similar results were obtained by Arche. (Dingl. **284.** 255.)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree. The following losses in weight in mg. by the action of the given liquids on 100 sq. centimetres sheet aluminum for 6 days were obtained:

Liquids	Loss in mg.
Claret	2.84
Hock	3.27
Brandy	1.08
5 % alcohol	0.61
5 % tartaric acid+Aq	1.69
1 % " "	2.58
5 % acetic acid+Aq	3.58
1 % " "	4.38

Liquids	Loss in mg.
5 % citric acid+Aq	2.15
1 % " "	1.90
5 % lactic acid+Aq	4.77
5 % butyric acid+Aq	1.31
Coffee	0.50
Tea	0
Beer	0
4 % boric acid+Aq	1.77
5 % carbolic acid+Aq	0.23
1 % " "	0.49
¼ % salicylic acid+Aq	6.35

(Lunge, C.N. **65.** 110.)

The apparent solubility of this metal in H_2O is due to the presence of minute quantities of Na. Absolutely pure Al does not lose any weight to H_2O and the H_2O remains perfectly clear. Also dil. acids remain perfectly clear. (Moissan, C. R. 1895, **121.** 794–98; C. C. **1896,** I. 193.)

Sl. attacked by H_2O at 80°. (W. Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Easily sol. in dil. or conc. HCl+Aq, whether hot or cold; also in HBr, HI, or HF+Aq. Insol. in dil. H_2SO_4+Aq (de la Rive); sl. attacked by cold, easily by hot conc. H_2SO_4. Not attacked by HNO_3+Aq even when conc. and boiling (Wöhler); easily sol. in dil. H_2SO_4, or HNO_3+Aq in vacuo (Weeren, B. **24.** 1798); slowly sol. in 27 % HNO_3+Aq, 100 ccm. HNO_3+Aq requiring 2 months to dissolve 2 g. Al (Montemartini, Gazz. ch. it. **22.** 397); very sl. sol. in most organic acids, but solubility is increased by presence of NaCl.

Not attacked by dil. or conc. HNO_3 at ord. temp. but attacked by hot HNO_3. Attacked by H_3PO_4. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Completely sol. at 100° in two hours in HNO_3, sp. gr. 1.15–1.46. (Stillman, J. Am. Chem. Soc. 1897, **19.** 714.)

Very easily sol. in HNO_3 (contrary to the usual statement in text-books). (Woy, C. C. **190** , II. 94.)

Slowly attacked by HNO_3+Aq (20–25 %) at 25–30°. (Deventer, Chem. Weekbl. 1907, **4.** 69.)

Dil. HNO_3 or H_2SO_4 does not attack Al on account of formation of layer of gas. Action is increased by vacuum. Solutions of metallic chlorides, the metal of which is insol. and attaches itself to the Al (Pt, Au, Cu, Hg) increase the solubility, but when metal is soluble in the acid (Fe, Zn, etc.), there is no increase of solubility. (Ditte, C. R. 1890, **110.** 573.)

Violently attacked by dil. or conc. H_3PO_4+Aq. (Winteler.)

Not attacked by solution of HCl in liquid HCN. (Kahlenberg, J. phys. Chem. 1902, **6.** 662.)

Very easily sol. in conc. or dil. KOH, or NaOH+Aq. Slowly attacked by NH_4OH+Aq (Wohler); sol. in BaO_2H_2+Aq (Beckmann, J. pr. (2) **26.** 385); slowly sol. in CaO_2H_2+Aq.

Sol. in excess of 10 % KOH+Aq and in NaOH and LiOH+Aq; sol. in hot conc. $Ba(OH)_2$, $Sr(OH)_2$ and $Ca(OH)_2$+Aq. (Allen, Am. Ch. J. 1900, **24.** 304–331.)

Attacked by hot conc. NH_4OH+Aq. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Sl. attacked by sulphates, or nitrates+Aq, but all chlorides, bromides, and iodides, except those of the alkalies and alkaline earths, even $AlCl_3$+Aq, dissolve the metal. Insol. in alum, or in NaCl+Aq, but sol. in alum+NaCl+Aq. (Tissier, C. R. **41.** 362); sol. in NaCl+Aq (Deville, A. ch. (3) **43.** 14); sol. in neutral $FeCl_3$+Aq in vacuo. (Weeren, B. **24.** 1798.) Violently attacked by $CuCl_2$+Aq. (Tommasi, Bull. Soc. (2) **37.** 443.)

Rapidly sol. in $K_2S_2O_8$+Aq, more slowly sol. in $(NH_4)_2S_2O_8$+Aq. (Levi, Gazz. ch. it. 1908, **38.** (1) 583.)

Attacked by $(NH_4)_3PO_4$+Aq. Sl. attacked by $NaNO_3$+Aq or KNO_3+Aq at 100°. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Not affected by NH_4NO_3+Aq. (Hodgkinson, C. N. 1904, **90.** 142.)

Attacked by $POCl_3$ at 100°. (Renitzer, B. **13.** 845.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Attacked by NOCl. (Sudborough, Chem. Soc. 1891, **59.** 659.

92 % alcohol attacks Al less than H_2O. Pure Al is attacked less than commercial. (Hugounenq, J. Pharm. 1895, (6) **1.** 537.)

Sol. in organic acids containing chlorides. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Acetic, tartaric and citric acids attack Al only at first. Metal is covered by layer of hydroxide but on addition of haloid salts, gradual solution ensues. (Ditte, C. R. 1898, **127.** 919.)

Not attacked by sugar+Aq. (Klein, C. R. **102.** 1170.)

Aluminum arsenide.

Decomp. by H_2O with evolution of AsH_3. (Wöhler, Pogg. **11.** 160.)

Decomp. by H_2O. (Fonzes-Diacon, C. R. 1900, **130.** 1315.)

Aluminum boride, Al_2B_4.

Very slowly sol. in hot conc. HCl+Aq, and hot NaOH+Aq, but easily in moderately strong warm HNO_3+Aq. (Hampe, A. **183.** 75.)

Al_2B_{24}. Not attacked by HCl, or KOH+Aq. Scarcely attacked by boiling H_2SO_4. Hot conc. HNO_3+Aq dissolves gradually but completely. (Hampe, l. c.)

Aluminum borocarbide, $Al_3C_2B_{48}$.

Insol. in H_2O, HCl+Aq, H_2SO_4+Aq, or

KOH+Aq; slowly sol. in hot conc. HNO_3+Aq. (Hampe, l. c.)

Aluminum bromide, $AlBr_3$.

Anhydrous. Dissolved by H_2O with great violence and evolution of much heat. Very sol. in alcohol. More sol. in CS_2 than AlI_3. (Weber, Pogg. **103.** 264.)

Sol. in $SOCl_2$. (Besson, C. R. 1896, **123.** 884.)

Sol. in C_2H_5Br. (Plotnikoff, C. C. **1902,** II. 617.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328); (Eidmann, C. C. **1899**, II 1014.)

Solubility of $AlBr_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43.2	50°	66.0
	45	8.5	140	48.4	38	67.2
	42	13.8	142	50	50	70.7
	38	18.3	140	52.1	60	74.2
	50	21	130	54.5	70	78.3
	60	23.4	120	56.7	80	83.3
	70	25.7	110	58.6	85	86.7
	80	28.1	100	60.3	90	90.7
	90	30.6	90	61.7	93	94.8
	100	33.4	80	62.9	96	100
	110	36.3	70	64.1		
	120	39.6	60	65.1		
Ethylene bromide	10°	0	20°	33.9	70°	72.7
	6	8.4	30	40.1	80	82.3
	2	16.0	40	47.2	90	92.2
	—2	22.9	50	55.1	96	100
	10	28.4	60	63.6		
Benzoyl chloride	—0.5°	0	85°	47	40°	72.6
	—2.5	6.5	90	50.8	60	79.4
	—5	13.0	80	52.8	70	83.9
	10	17.4	60	56	80	89.2
	30	24.6	40	59.5	90	95.8
	50	31.8	20	63.1	96	100
	70	40	7	65.5		
	80	44.3	20	67.9		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr., **13.** 1.)

$+6H_2O$. Very sol. in H_2O.
$+15H_2O$. (Panfiloff, J. B. **1895.** 785.)

Aluminum antimony bromide, $2AlBr_3$, $5SbBr_5$ $+24H_2O$.

Hygroscopic. Decomp. by H_2O. (Weinland, B. 1903, **36.** 258.)

Aluminum potassium bromide, $AlBr_3$, KBr.

Sol. in H_2O. (Weber, Pogg. **103.** 267.)

Aluminum bromide ammonia, $AlBr_3$, xNH_3.

Decomp. by H_2O. (Weber, Pogg. **103.** 267.)

Aluminum *per*bromide carbon bisulphide, $AlBr_3$, Br_4, CS_2.

Sol. in ether, ethyl bromide, ethylene bromide and benzene; decomp. by H_2O. (Plotnikoff, J. Russ. phys. Chem. Soc. 1901, **33.** 91; C. C. **1901,** I. 1193.)

$2AlBr_3$, Br_4, CS_2. Sol. in ether and benzene; insol. in petroleum ether. (Plotnikoff, *l. c.*)

Aluminum bromochloride, $AlCl_2Br$.

Deliquescent. Somewhat less violently dissolved by H_2O than is $AlBr_3$. (v. Bartal, Z. anorg. 1907, **55.** 154.)

$+6H_2O$. Deliquescent. Sol. in H_2O without evolution of heat. (v. Bartal, Z. anorg. 1907, **55.** 155.)

Aluminum carbide, Al_4C_3.

Decomp. by fused KOH at 100°; insol. in fuming HNO_3 in the cold; decomp. by H_2O, and dil. acids. (Moissan, Bull. Soc. 1894, (3) **11.** 1012; C. R. 1894, **119.** 16–20.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Aluminum chloride, basic, $Al_6O_{14}H_{10}$, HCl.

Easily sol. in H_2O. (Schlumberger, Bull. Soc. 1895, (3) **13.** 56.)

Aluminum chloride, $AlCl_3$.

Anhydrous. Very deliquescent. Sol. in H_2O with a hissing noise and evolution of heat. Solution of $AlCl_3$ in H_2O loses HCl on evaporation, and $AlCl_3$ is finally wholly converted into Al_2O_3.

Sol. in 1.432 pts. H_2O at 15°. (Gerlach.)

$AlCl_3$+Aq containing 19.15 % $AlCl_3$ boils at 103.4°; $AlCl_3$+Aq containing 38.3 % $AlCl_3$ boils at 112.8°. (Gerlach.)

Sp. gr. of $AlCl_3$+Aq at 15°.

% $AlCl_3$	Sp. gr.	% $AlCl_3$	Sp. gr.
1	1.0072	22	1.1709
2	1.0144	23	1.1795
3	1.0216	24	1.1881
4	1.0289	25	1.1968
5	1.0361	26	1.2058
6	1.0435	27	1.2149
7	1.0510	28	1.2241
8	1.0585	29	1.2331
9	1.0659	30	1.2422
10	1.0734	31	1.2518
11	1.0812	32	1.2615
12	1.0890	33	1.2711
13	1.0968	34	1.2808
14	1.1047	35	1.2905
15	1.1125	36	1.3007
16	1.1207	37	1.3109
17	1.1290	38	1.3211
18	1.1372	39	1.3313
19	1.1455	40	1.3415
20	1.1537	41	1.3522
21	1.1632		

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. at 20° of $AlCl_3$+Aq containing mg. mols. $AlCl_3$ per liter.

M.	Sp. gr.
0.01	1.00104
0.025	1.00282
0.05	1.00588
0.075	1.00870
0.10	1.01158
0.25	1.02911
0.55	1.05706
1.0	1.11054
1.5	1.16308
2.0	1.21378

(Jones & Pearce, Am. Ch. J. 1907, **38.** 726.)

Sol. in 1 pt. strong alcohol at 12.5° (Wenzel); easily sol. in ether; sl. sol. in CS_2; insol. in ligroine or benzene.

Difficultly sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Insol. in CS_2 at ord. temp. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in methylal. (Eidmann, C. C. **1899, II.** 1014.)

Solubility of $AlCl_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43.2	130°	66 0
	44	8.5	125	48.4	140	67.2
	39.5	13.8	120	50	150	70 7
	50	18.3	110	52.1	160	74.2
	60	21.	100	54.5	170	78.3
	70	23.4	90	56.7	180	83.3
	80	25.7	80	58.6	185	86.7
	90	28.1	70	60.3	190	90.7
	100	30.6	60	61.7	192	94.8
	110	33.4	80	62.9	194	100
	120	36.3	100	64.1		
	125	39.6	120	65.1		
Benzoyl chloride	−0.5°	0	60°	33.0	80°	52.9
	−4	7.9	70	37.5	70	55.1
	−7.5	12.7	80	42.2	60	57.2
	0	14.1	90	47.1	40	61.0
	20	18.8	93	48.7		
	40	25.0	90	50.6		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr., **13.** 1.)

+$6H_2O$. Very deliquescent; very sol. in H_2O. Sol. in 0.25 pt. H_2O. (Thomson.)

Sol. in 2 pts. abs. alcohol at ordinary temp., and 1.5 pts. at b.-pt. (Thomson.)

Completely insol. in a solution of ether in H_2O sat. with HCl. (Havens, Am. J. Sci. 1898, (4) **6.** 46.

Aluminum ammonium chloride, $AlCl_3$, NH_4Cl.

(Baud, A. ch. 1904, (8) **1.** 46.)

Aluminum antimony chloride.

See **Chlorantimonate, aluminum.**

Aluminum barium chloride, $2AlCl_3$, $BaCl_2$.

(Baud, C. R. 1901, **133.** 869.)

Aluminum calcium chloride, basic.

$3CaO$, $CaCl_2$, Al_2O_3+$10H_2O$. (Steinmetz, Z. phys. Ch. 1905, **52.** 466.)

$10CaO$, $CaCl_2$, $6Al_2O_3$. Slowly decomp. by boiling H_2O. (Gorgeu, Bull. Soc. 1887, (2) **48.** 51.)

Aluminum calcium chloride, $4AlCl_3$, $3CaCl_2$

(Baud, A. ch. 1904, (8) **1.** 51.)

Aluminum nitrosyl chloride, $AlCl_3$, NOCl.

Deliquescent, and decomp. by H_2O. (Weber Pogg, **118.** 471.)

Aluminum palladium chloride, $AlCl_3$, $PdCl_2$+$10H_2O$.

See **Chloropalladite, aluminum.**

Aluminum phosphorus ***penta*****chloride,** $AlCl_3$, PCl_5.

Decomp. violently by H_2O. (Baudrimont.)

Aluminum phosphoryl chloride, $AlCl_3$, $POCl_3$.

Deliquescent. Sol. in H_2O with decomp. Sol. in warm $POCl_3$, from which it separates on cooling. (Casselmann, A. **98.** 220.)

Aluminum platinum chloride, $AlCl_3$, $PtCl_2$+$15H_2O$.

See **Chloroplatinite, aluminum.**

Aluminum potassium chloride, $AlCl_3$, KCl.

Slowly deliquescent. Sol. in H_2O with evolution of heat and decomp. (Degen, A. **18.** 332.)

Aluminum selenium chloride, $2AlCl_3$, $SeCl_4$.

Sol. in H_2O with evolution of heat and separation of traces of selenium. (Weber, Pogg. **104.** 427.)

Aluminum sodium chloride, $AlCl_3$, NaCl.

Much less deliquescent than $AlCl_3$. Sol. in H_2O with evolution of heat. Upon evaporating, NaCl crystallises out. (Wöhler.)

Aluminum strontium chloride, $4AlCl_3$, $3SrCl_2$.

(Baud, A. ch. 1909, (8) **1.** 52.)

Aluminum sulphur chloride, $2AlCl_3$, SCl_4.

Decomp. by H_2O with evolution of much

heat and separation of some sulphur. (Weber, Pogg, **104**. 421.)

$AlCl_3,SCl_4$. Decomp. by H_2O. (Ruff, B. 1901, **34**. 1757.)

Aluminum tellurium chloride, $2AlCl_3$, $TeCl_4$.

Very sol. in dil. H_2SO_4+Aq. (Weber, J. pr. **76**. 313.)

Aluminum chloride ammonia, $AlCl_3$, NH_3.

Sol. in H_2O. (Rose, Pogg, **24**. 248.)

Completely sol. in H_2O. (Baud, C. R. 1901, **132**. 135.)

$AlCl_3$, $2NH_3$. Very hygroscopic. (Stillman, Am. Ch. J. 1895, **17**. 750.)

$AlCl_3$, $3NH_3$. Decomp. by H_2O.

$AlCl_3$, $5NH_3$. M. pt. 380°. (Baud, C. R. 1901, **132**. 135.)

$AlCl_3$, $6NH_3$. Decomp. by H_2O. (Stillman, Am. Ch J. 1895, **17**. 752.) Somewhat hygroscopic. (Baud, C. R. 1901, **132**. 135.)

Aluminum chloride nitric oxide, $2AlCl_3$, NO.

Very hygroscopic. Decomp. rapidly in the air. Sol. in KOH+Aq. (Thomas, C. R. 1895, **121**. 130.)

Aluminum chloride phosphine, $3AlCl_3$, PH_3.

Decomp. by H_2O or NH_4OH+Aq. (Rose Pogg, **24**. 295.)

Aluminum chloride hydrogen sulphide.

Deliquescent. Decomp. by H_2O or NH_4OH +Aq. (Wöhler.)

Aluminum chloride sulphur *di*oxide, $AlCl_3$, SO_2.

Decomp. by H_2O, alcohol, or benzene. (Adrianowski, B. **12**. 688.)

$2AlCl_3$, SO_2. (Baud, A. ch. 1904, (8) **1**. 32.)

Aluminum cobalt, Co_3Al_3.

Sol. in strong acids. (Brunck, B. 1901, **34**. 2734.)

Aluminum copper, Cu_4Al_9.

Sol. in aqua regia; decomp. by HCl. (Brunck, B. 1901, **34**. 2733.)

Aluminum fluoride, AlF_3.

Anhydrous. Not attacked by H_2O or acids, and only very slightly by boiling conc. H_2SO_4. Insol. in boiling KOH+Aq. (Deville, C. R. **42**. 49.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)

Insol. in acetone. (Naumann, B. 1904, **37**. 4328.)

+½H_2O. Insol. in H_2O. Sl. sol. in HF. (Baud, C. R. 1902, **135**. 1104.)

+H_2O. Completely but only sparingly sol. in H_2O. (Mazzuchelli, Real. Ac. Linc. 1907, (5) **16**, I. 775; Chem. Soc. 1907, **92**, (2). 549.)

+3½H_2O. Two modifications: (1) Easily sol. in H_2O. Sol. in HF. (2) Insol. in H_2O. Sl. sol. in HF. (Baud, C. R. 1902, **135**. 1104.)

+7H_2O. Sol. in H_2O. (Deville, A. ch. (3) **61**. 329.)

Min. *Fluellite*.

+8½H_2O. Very efflorescent. Sat. solution contains 3.85 g. AlF_3 per 100 g. at 11° and 1 2 g. at −0.2°. (Mazzucchelli, Real. Ac. Linc. 1907, (5) **16**, I. 775; Chem. Soc. 1907, (2), **92**. 549.)

Aluminum hydrogen fluoride, $3AlF_3$, 2HF+ $5H_2O$.

Sol. in H_2O; precipitated by alcohol. (Deville.)

$2AlF_3$, HF+$5H_2O$. (Deville, A. ch. (6) **61**. 329.)

Aluminum ammonium fluoride, AlF_3, NH_4F.

Somewhat sol. in H_2O; insol. in H_2O containing NH_4OH or NH_4F. (Berzelius, Pogg. **1**. 45.)

AlF_3, $2NH_4F$+1.5H_2O. Sol. in 100 pts. H_2O at 16°. (Baud, C. R. 1902, **135**. 1338.)

AlF_3, $3NH_4F$. Nearly insol. in H_2O; easily sol. in dil. acids. (Petersen, J. pr. (2) **40**. 35.)

Quite easily sol. in H_2O, but insol. in NH_4F+Aq. (Helmholt, Z. anorg. **3**. 129.)

Aluminum barium fluoride.

Apparently not obtained in pure state. (Röder.)

Aluminum calcium fluoride, AlF_3, CaF_2+H_2O.

Min. *Evigtokite*.

Aluminum calcium sodium fluoride, AlF_3, CaF_2, NaF+H_2O.

Min. *Pachnolite*.

Aluminum cobaltous fluoride, AlF_3, CoF_2+ $7H_2O$.

Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22**. 272.)

Aluminum cupric fluoride, $2AlF_3$, CuF_2.

Very slowly but completely sol. in H_2O. (Berzelius.)

AlF_3, $2CuF_2$+11H_2O. Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22**. 272–76.)

$2AlF_3$, $3CuF_2$+18H_2O. Sol. in dil. HF+ Aq. (Weinland.)

Aluminum cupric hydrogen fluoride, AlF_3, CuF_2, HF+8H_2O.

Efflorescent in the air. Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22**. 272.)

Aluminum iron (ferrous) fluoride, AlF_3, FeF_2+7H_2O.

Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22**. 270.)

Aluminum lithium fluoride.

Insol. in H_2O. (Berzelius.)

Aluminum magnesium fluoride.

$2AlF_3$, MgF_2 (?). (Röder.)

Aluminum nickel fluoride, AlF_3, NiF_2+7H_2O.
Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 271.)

Aluminum potassium fluoride, $AlF_3, 3KF$.
Very sl. sol. in acid solutions, and still less in H_2O. (Gay-Lussac and Thénard.)
$AlF_3, 2KF$. As above.

Aluminum silicon fluoride.
See **Fluosilicate, aluminum.**

Aluminum sodium fluoride.
$2AlF_3, 3NaF$. Min. *Chiolite.*
$AlF_3, 2NaF$. Min. *Chodneffite.*
$AlF_3, 3NaF$. Min. *Cryolite.* Sl. sol. in H_2O. Insol. in HCl+Aq. Decomp. by H_2SO_4, or by boiling with NaOH+Aq.

Aluminum strontium fluoride.
As the Ba salt. (Röder.)

Aluminum thallous fluoride, $2AlF_3, 3TlF$.
Ppt. Sl. sol. in H_2O. (Ephraim, Z. anorg. 1909, **61.** 243.)

Aluminum zinc fluoride, AlF_3, ZnF_2+7H_2O.
Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 272.)
$2AlF_3, ZnF_2$. Slowly but completely sol. in H_2O. (Berzelius.)

Aluminum hydroxide, $Al_2O_3, H_2O = Al_2O_2(OH)_2$.
Dehydrated by conc. acids, without dissolving. (Becquerel, C. R., **67.** 108.)
Min. *Diaspore.* Insol. in HCl+Aq, and not attacked by boiling conc. H_2SO_4, unless it has been ignited.
$Al_2O_3, 2H_2O = Al_2O(OH)_4$. Pptd. Al hydroxide, when boiled twenty hours with H_2O is insol. in acids and alkalies, and has the above composition. (St. Gilles, A. ch. (3) **46.** 57.)
Min. *Bauxite.*
Soluble modifications—(a) *Meta-aluminum hydroxide From basic Al acetate.* Sol. in H_2O and more readily in $HC_2H_3O_2$. The aqueous solution is coagulated by traces of alkalies, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt. H_2SO_4 in 1000 pts. H_2O, added to 7000 pts. of above solution containing 20 pts. Al_2O_3, converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, comenic, and hemipinic acids act in the same way. HCl and HNO_3 have far less action, 600 mols. being necessary to produce the same effect as 1 mol. H_2SO_4, while acetic, formic, boric, arsenious, pyromeconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt. KOH in 1000 pts. H_2O coagulates 9000 pts. of the solution. NaOH, NH_4OH, and $Ca(OH)_2$ have the same effect.
The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt. is redissolved when treated with H_2O. Nitrates and chlorides coagulate with difficulty; Na_2SO_4, $MgSO_4$, and $CaSO_4$+Aq, however, have as strong an action as a liquid containing the same amount of H_2SO_4. A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt. formed by acids is not sol. in an ecessx of the acid, but by the long continued action of conc. H_2SO_4, especially if hot, the ppt. is dissolved; boiling conc. HCl+Aq also dissolves it, but less readily than H_2SO_4. The ppt. is sol. in boiling conc. KOH+Aq. The residue, when the solution is evaporated at 100°, has composition Al_2O_3, $2H_2O$, and is insol. in acids. (Crum, Chem. Soc. **6.** 225.)
(b) *By Dialysis.* Sol. in H_2O, from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially K_2SO_4), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0.5% Al_2O_3 or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to ½ its vol., and even very dil. solutions gelatinise spontaneously in a few days. The solution is not coagulated by alcohol or sugar. (Graham, A. **121.** 41.)
$Al_2O_3, 3H_2O = Al(OH)_3$. *Crystallised.* Difficultly sol. in acids and alkalies. (Cossa, N. Cim. (2) **3.** 228.) Insol. in boiling HCl+Aq. (Wöhler, A. **113.** 249.) Sl. sol. in KOH+Aq; nearly insol. in cold H_2SO_4, HCl, HNO_3+Aq; very slowly sol. in hot HCl+Aq, more readily in hot H_2SO_4. (v. Bonsdorff, Pogg. **27.** 275.)
α-modification. Unstable. Changes into β-modification. Sol. in N-H_2SO_4 at ord. temp. Sol. in N-NaOH and in hot NaOH of concentration $5Na_2O$, $100H_2O$. (Russ, Z. anorg. 1904, **41.** 226.)
β-modification. Insol. in N-H_2SO_4 at ord. temp. Difficulty sol. in warm N-NaOH, but easily sol. in hot NaOH of concentration $5Na_2O$, $100H_2O$. Its solubility in NaOH increases with increase in concentration of the hydroxyl ions. (Russ.)
δ-modification. Easily sol. in conc. H_2SO_4; only sl. sol. in HCl, HNO_3 or acetic acids, or in alkali+Aq. (Tommasi, C. C. **1905,** II. 605.)
Min. *Gibbsite.* Sol. in HCl+Aq, and dil. H_2SO_4+Aq. Readily sol. in conc. KOH, and NaOH+Aq.
Precipitated. Completely insol. in H_2O or H_2CO_3+Aq. Easily sol. in acids when freshly pptd., but solubility diminishes on standing.
Easily sol. in KOH or NaOH+Aq. (Sonnenschein.)

Herz (Z. anorg. **25.** 155) found that aluminum hydroxide which has been dried in a vacuum dessicator requires for solution in $NaOH$+Aq. 3 atoms Na to 1 atom Al. Slade (Z. Elektrochem. 1911, **17.** 261) was unable to obtain this result. Herz says Slade's error is due to insufficient shaking of the solution. (Herz, Z. Elektrochem. 1911, **17.** 403.)

New solubility determinations verify the statement of Herz (Z. anorg. 25, 155) that the solubility of $Al(OH)_3$ in $NaOH$+Aq is proportional to the concentration of $NaOH$. They do not, however, verify his statement that the ratio Na : Al in the solutions is always 3 : 1, for the author finds that the ratio Na : Al varies from 2 : 1 to 10 : 1 depending on the conditions of precipitation and the method and duration of drying of the $Al(OH)_3$. (Slade, Z. Elektrochem, 1912, **18.** 1.)

Sl. sol. in NH_4OH+Aq when freshly pptd., but presence of NH_4 salts diminish its solubility, and it separates out completely after long standing. (Fresenius.)

Somewhat sol. in NH_4OH+Aq, the more readily the larger the vol. of H_2O. Somewhat sol. in $(NH_4)_2CO_3$+Aq, but less than in NH_4OH+Aq. Sl. sol. in dil. NH_4Cl+Aq, unless that salt be in large excess. It is finally wholly pptd. if allowed to stand several days

18752 pts. NH_4OH+Aq (4 % NH_4OH) dissolve an amt. of $Al(OH)_3$ corresponding to one pt. Al_2O_3; NH_4Cl prevents this solubility almost completely. (Hanamann, Pharm. Viertelj. **12.** 527.)

$Al(OH)_3$, prepared by ppt. of a solution of $Al(NO_3)_3$ with NH_4OH, filtered and washed, is insol. in NH_4OH+Aq.

$Al(OH)_3$ prepared by pptn. of a solution of potassium aluminate with NH_4Cl, is sol. in a large excess of NH_4OH if this is added to the ppt. at once. This modification which is sol. in NH_4OH is unstable and easily goes over into the modification which is insol. in NH_4OH. (Renz, B. 1903, **36.** 2751.)

Conc. $(NH_4)_2CO_3$+Aq does not dissolve $Al(OH)_3$, and not a trace is dissolved by boiling conc. NH_4Cl+Aq. (Weeren, Pogg. **92.** 97.)

With NH_4F+Aq, it forms a double salt, $AlF_3, 3NH_4F$, which is sol. in H_2O, but not in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 127.)

Insol. in $(NH_4)_2S$+Aq. (Malaguti and Durocher, A. ch. (3) **17.** 421.) Fuchs found, on the contrary, that it is not wholly insol. in $(NH_4)_2S$+Aq. (Fresenius, Quant.)

Insol. in $FeCl_3$+Aq. (Béchamp.)

Determinations of the solubility of aluminum hydroxide in $AlCl_3$+Aq show that part goes into solution to form a compound, while the greater part is in the colloidal form. (Fischer, Z. anorg. 1904, **40.** 46.)

Only sl. sol. in conc. $Al_2(SO_4)_3$+Aq, but solubility increases with decrease in concentration of $Al_2(SO_4)_3$ until it reaches a maximum at a concentration of 32 % $Al_2(SO_4)_3$ at 20°, 28 % at 40°, and 38 % at 60°. With further decrease in concentration of $Al_2(SO_4)_3$ the solubility of $Al(OH)_3$ in $Al_2(SO_4)_3$ diminishes. (Kremann, C. A. **1909.** 2422.)

Sol. in $Ba(OH)_2$+Aq. (Rose.)

Sol. in boiling $Fe(NO_3)_3$, $Cr(NO_3)_3$, $Bi(NO_3)_3$, $Hg(NO_3)_2$, $HgNO_3$, $SnCl_2$, and $SbCl_3$ +Aq. (Persoz.)

Insol. in HCN or cold KCN+Aq; but sl. sol. in hot KCN+Aq. (Rose.)

Insol. in $KC_2H_3O_2$+Aq. (Osann, 1821.)

When moist, sol. in H_2SO_3+Aq, from which it is repptd. on boiling. (Berthier, A. ch. (3) **7.** 76.)

Somewhat sol. in $NaC_2H_3O_2$+Aq. (Mercer.)

Not pptd. by NH_4OH+Aq in presence of Na citrate. (Spiller.)

Sol. in ethyl amine, amyl amine, sinkaline, ethyl picoline hydroxide, stibethylium hydroxide, triethyltoluenyl ammonium hydroxide+Aq. (Friedländer.)

Sol. in alkyl amines. (Renz, B. 1903, **36.** 2751.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. to a considerable extent in $K_2C_4H_4O_6$+Aq.

Very sl. sol. in cane sugar+Aq. (Ramsey.)

Solubility in glycerine+Aq containing about 60 % by vol. of glycerine. 100 cc. of the solution contain 0.25 g. Al_2O_3. (Müller, Z. anorg. 1905, **43.** 322.)

$Al_2O_3, 5H_2O$. Insol. in H_2O, NH_4OH+Aq and alcohol. Sol. in HCl and HNO_3+Aq. (Zunino, Gazz. ch. it. 1900, **30** (1). 194.)

$Al_6O_{14}H_{10}$, "Trialuminum hydroxide."

Not sol. in conc. acids in the cold; not sol. in KOH (cold) and only sl. sol. in hot KOH. Characterized by its solubility in exactly one mol. dil. HCl. Dil. solutions do not gelatinize even on long standing. Conc. solution of NH_4Cl and other salts cause ppt. which redissolves on addition of H_2O.

Alkalies and alkali carbonates decomp. the salt with HCl and ppt. trialuminium hydroxide. H_2SO_4 and sol. sulphates give insol. compds. with the hydrate. HNO_3 like HCl gives soluble compds. with the hydrate. (Structural formula given.) (Schlumberger, Bull. Soc. 1895, (5) **13.** 41–65; C. C. **1895**, I. 421.)

Aluminum iodide, AlI_3.

Anhydrous. Fumes on air and deliquesces. Sol. in H_2O with evolution of much heat. Sol. in CS_2 and crystallizes from the hot sat. solution on cooling. (Weber.) Sol. in alcohol (Weber); ether and tetrachlormethane. (Gustavson.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

$+6H_2O$. Very sol. in H_2O.

Aluminum mercuric iodide, AlI_3, HgI_2+8H_2O.

Very deliquescent; sol. in H_2O without decomp. (Duboin, C. R. 1908, **146.** 1028.)

amidophosphate and in NH_4OH+Aq. Insol. in $HC_2H_3O_2$+Aq.
Acid. As the neutral salt.

Hydroxylamine amidophosphate, $(NH_3O)HPO_3(NH_2)$.
Sl. sol. in H_2O. (Stokes.)

Lithium amidophosphate, $LiHPO_3(NH_2)$.
Sl. sol. in H_2O. (Stokes.)

Magnesium amidophosphate, $MgPO_3(NH_2)+7H_2O$.
Very sl. sol. in H_2O; quite easily sol. in dil. NH_4Cl+Aq. Sol. in $HC_2H_3O_2$+Aq. (Stokes.)
$MgH_2(PO_3NH_2)_2+3\frac{1}{4}H_2O$. Insol. in NH_4Cl+Aq. (Stokes.)

Manganese amidophosphate.
Neutral. Ppt.
Acid. Sl. sol. in H_2O.

Nickel amidophosphate.
Neutral. Ppt. Sol. in $HC_2H_3O_2$ or NH_4OH+Aq.
Acid. Sl. sol. in H_2O.

Potassium amidophosphate, $K_2PO_3(NH_2)$.
Very sol. in H_2O and not decomp. by boiling. (Stokes.)
$KHPO_3(NH_2)$. Easily sol. in cold H_2O; insol. in alcohol. (Stokes.)

Silver amidophosphate, $Ag_2PO_3(NH_2)$.
Almost insol. in H_2O. Sol. in HNO_3 or NH_4OH+Aq.
$AgHPO_3(NH_2)$. Sl. sol. in H_2O; easily sol. in dil. HNO_3 or $HC_2H_3O_2$+Aq, also in NH_4OH+Aq.

Sodium amidophosphate, $Na_2PO_3(NH_2)$.
Not deliquescent; very sol. in H_2O; pptd. from aqueous solution by alcohol. (Stokes.)
$NaHPO_3(NH_2)+\frac{1}{4}(?)H_2O$. Nearly insol. in cold, and decomp. by hot H_2O. Insol. in alcohol.

Zinc amidophosphate.
Neutral. Perceptibly sol. in H_2O.
Acid. Sl. sol. in H_2O; sol. in NH_4OH or $HC_2H_3O_2$+Aq.

*Di*amidophosphoric acid, $PO(NH_2)_2OH$.
Sol. in cold H_2O; almost insol. in alcohol; stable in the air but decomp. when heated and by boiling in aq. solution. (Stokes, Am. Ch. J. 1894, **16.** 130.)

Barium *di*amidophosphate, $[PO(NH_2)_2O]_2Ba$.
Very sol. in H_2O; insol. in alcohol; aq. solution decomp. slowly. (Stokes, Am. Ch. J. 1894, **16.** 134.)

Magnesium *di*amidophosphate, $[PO(NH_2)_2O]_2Mg$.
Sol. in H_2O; insol. in alcohol. (Stokes.)

Potassium *di*amidophosphate, $PO(NH_2)_2OK$.
Sol. in H_2O; not deliquescent; insol. in alcohol. (Stokes.)

Silver *di*amidophosphate, $PO(NH_2)_2OAg$.
Very stable; insol. in H_2O. Very sol. in NH_4OH+Aq. (Stokes.)

Sodium *di*amidophosphate, $PO(NH_2)_2ONa$.
Sol. in H_2O; not deliquescent; insol. in alcohol. (Stokes.)

*Di*amido*tri*hydroxylphosphoric acid.

Silver *di*amido*tri*hydroxylphosphate, $(AgO)_3P(NHAg)_2$.
(Stokes, Am. Ch. J. 1894, **16.** 147.)
$(AgO)_3P(NH_2)(NHAg)$. Insol. in cold H_2O. (Stokes.)
$(AgO)_3P(NH_2)_2$. Decomp. by cold H_2O. (Stokes.)
$+2H_2O$. Decomp. by boiling H_2O. (Stokes.)

Amidoimidophosphoric acid.

Amido*hex*imido*hepta*phosphoric acid, $OH.PO.(NH_2)[NH.PO(OH)]_5.NH.PO(OH)_2=P_7N_7O_{15}H_{16}$.
Known only in solution in H_2O. (Stokes, Am. Ch. J. 1898, **20.** 758.)

Silver *di*amido*pyr*imidophosphate, $NH(PO.NH_2.OAg)_2$.
Almost insol. in H_2O; sol. in NH_4OH+Aq. (Stokes, Am. Ch. J. 1894, **16.** 136.)

Silver amido*tetr*imido *penta*phosphate, $P_5N_5O_{11}H_3Ag_9$.
Ppt. (Stokes, Am. Ch. J. 1898, **20.** 752.)

Silver amido*hex*imido*hepta*phosphate, $P_7N_7O_{15}H_9Ag_7$.
Ppt.; decomp. by acetic acid. (Stokes, Am. Ch. J. 1898, **20.** 759.)

Sodium amido*di*imido*tri*phosphate, $PO.ONa<{NH.PO(ONa)_2 \atop NHPO(ONa)NH_2}$.
$=P_3N_3O_7H_4Na_4+H_2O$.
Unstable; sol. in H_2O; insol. in alcohol. (Stokes, Am. Ch. J. 1896, **18.** 643.)

Sodium amido*hex*imido*hepta*phosphate, $P_7N_7O_{15}H_9Na_7$.
Sol. in H_2O; pptd. by alcohol. (Stokes, Am. Ch. J. 1898, **20.** 758.)

Amidophosphimic acid.

Silver amidophosphimate, $P(NH)NH_2(OAg)_2$.

Decomp. by heat; decomp. in contact with H_2O. (Stokes, Am. Ch. J. 1894, **16.** 139.)

$(AgO)_2P(NAg)(NHAg)$.(?) Sl. sol. in NH_4OH+Aq. (Stokes, Am. Ch. J. 1894, **16.** 149.)

Amidosulphonic acid, $HOSO_2NH_2$.

Easily sol. in H_2O, less easily in alcohol. (Berglund, B. **9.** 252 and 1896.)

Very stable; less easily sol. in H_2O than its K salt. (Raschig, A. **241.** 177.)

Stable in air. Non-deliquescent when cold. Sol. in 5 pts. H_2O at 0° and in 2½ pts. H_2O at 70°. Solution in H_2O can be boiled several minutes without decomp. Solubility is decreased by addition of H_2SO_4, so that if 1/5–1/4 pt. H_2SO_4 is added to H_2O, 100 pts. of the liquid dissolve only 3 pts. $HOSO_2NH_2$ in the cold. Pptd. from solution by HNO_3 or glacial acetic acid, but not by HCl. Solubility is decreased by presence of $NaHSO_4$. (Divers and Haga, Chem. Soc. 1896, **69.** 1641.)

Amidosulphonates.

Easily sol. in H_2O; sl. sol. in alcohol.

Aluminum amidosulphonate.

Very sol. in H_2O. (Berglund, Bull. Soc. (2) **29.** 422.)

Ammonium amidosulphonate, $(NH_4)NH_2SO_3$.

Deliquescent. Sol. in H_2O; insol. in alcohol.

Ammonium silver amidosulphonate, $NH_4SO_3(NH_2)$, $AgSO_3(NH_2)$.

(Ephraim & Gurewitsch, B. 1910, **43.** 148.)

Barium amidosulphonate, $Ba(NH_2SO_3)_2$.

Sol. in 3 pts. H_2O. (Berglund, l.c.)

Cadmium amidosulphonate, $Cd(NH_2SO_3)_2 + 5H_2O$.

Very sol. in H_2O. (B.)

Calcium amidosulphonate, $Ca(NH_2SO_3)_2 + 4H_2O$.

Very sol. in H_2O. (B.)

Cobalt amidosulphonate, $Co(NH_2SO_3)_2 + 3H_2O$.

Sol. in H_2O. (B.)

Copper amidosulphonate, $Cu(NH_2SO_3)_2 + 2H_2O$.

Sol. in H_2O. (B.)

Gold (auric) potassium amidosulphonate, $K_3Au_3(NSO_3)_3$.

Very sl. sol. in cold, more easily sol. in hot H_2O. Sol. in dil. HCl+Aq. (Hofmann, B. 1912, **45.** 1735.)

Lead amidosulphonate, $Pb(NH_2SO_3)_2 + H_2O$.

The most sol. of all amidosulphonates. (B.)

Lithium amidosulphonate. $LiNH_2SO_3$.

Deliquescent. (B.)

Magnesium amidosulphonate.

Very sol. in H_2O.

Manganese amidosulphonate, $Mn(NH_2SO_3)_2 + 3H_2O$.

Very sol. in H_2O. (B.)

Mercuric amidosulphonate, basic, $Hg(HgOSO_3NH_2)_2$.

Insol. in 3.5 % HNO_3+Aq. Very sol. in 3 % HCl+Aq. (Hofmann, B. 1912, **45.** 1733.)

$+2H_2O$. Insol. in hot H_2O. Sol. in KOH+Aq. (Divers and Haga, Chem. Soc. 1896, **69.** 1649.)

Mercuric potassium amidosulphonate, $KHgNSO_3$.

Very sl. sol. in cold H_2O and cold dil. KOH +Aq. Sol. in 3 % HCl+Aq. (Hofmann, B. 1912, **45.** 1732.)

Mercuric sodium amidosulphonate, $NaHgNSO_3$.

Nearly completely sol. in hot H_2O. (Hoffmann, B. 1912, **45.** 1734.)

Nickel amidosulphonate, $Ni(NH_2SO_3)_2 + 3H_2O$.

Sol. in H_2O. (B.)

Potassium amidosulphonate, KNH_2SO_3.

Sol. in H_2O. (Berglund.)

Potassium silver amidosulphonate, $NHAgSO_3K + H_2O$.

Decomp. by H_2O; sol. in NH_4OH+Aq. (Hoffmann, B. 1912, **45.** 1734.)

Silver amidosulphonate, $AgNH_2SO_3$.

Sol. in 15 pts. H_2O at 19° (B.)

Sodium amidosulphonate, $NaNH_2SO_3$.

Sol. in H_2O.

Strontium amidosulphonate, $Sr(NH_2SO_3)_2 + 4H_2O$.

Sol. in H_2O.

Thallium amidosulphonate, $TlNH_2SO_3$.

Sol. in H_2O.

Uranyl amidosulphonate.

Sol. in H_2O.

Zinc amidosulphonate, $Zn(NH_2SO_3)_2 + 4H_2O$.

Sol. in H_2O.

Amidosulphurous acid.

Ammonium amidosulphite, $NH_2.SO_2.NH_4$.

Very deliquescent. Decomp. in the air with loss of NH_3. Sol. in H_2O with decomp. Sol. in anhydrous alcohol. Sl. sol. in dry. ether. (Divers, Chem. Soc. 1900, **77**. 330.)

Ammonia, NH_3.

Very sol. in H_2O, with evolution of much heat.

1 vol. H_2O absorbs 670 vols. (½ pt. by weight) NH_3 at +10° and 29.8 in. pressure; sp. gr. of solution =0.875. (Davy.)

At low temperatures H_2O absorbs more than ½ its weight of NH_3, and sp. gr. of solution =0.850. (Dalton.)

100 pts. H_2O absorb 8.41 pts. NH_3 at 24°; 5.96 pts. at 55°. (Osann.)

1 vol. H_2O absorbs 780 vols. NH_3, 6 vols. H_2O increasing to 10 vols. sat. NH_4OH+Aq; 1 vol. sat. NH_4OH+Aq contains 468 vols. NH_3. (Thomson.)

1 vol. H_2O absorbs 450 vols. NH_3 at 15°. (Dumas.)

1 vol. H_2O absorbs 700 vols. NH_3 at ordinary temperature. (Otto.)

100 pts. H_2O absorb in NH_3 gas 47.7 pts. NH_3 by weight. (Berzelius.)

1 vol. H_2O absorbs 505 vols. NH_3 and vol. is increased to 1.5 vol., and sp. gr. becomes 0.900. (Ure.)

1 vol. H_2O at 0° and 760 mm. absorbs 1177.3 vols. NH_3. (Sims.)

1 vol. H_2O at 0° and 760 mm. absorbs 1146 vols. NH_3. (Roscoe and Dittmar.)

1 vol. H_2O at 0° and 760 mm. absorbs 1049.6 vols. NH_3. (Carius.)

1 vol. H_2O at 0° and 760 mm. absorbs 1270 vols. NH_3. (Berthelot.)

1 vol. H_2O at 0° and 760 mm. absorbs 1050 vols. NH_3. (Bunsen.)

100 cc. H_2O absorb 64.50 g. NH_3. (Raoult.)

Solubility of NH_3 in H_2O at 760 mm. and t°: 1 g. H_2O absorbs g. NH_3, according to Roscoe and Dittmar (A. **122**. 347) (RD); and according to Sims (A. **118**. 345) (S).

t°	g. NH_3 RD	g. NH_3 S	t°	g. NH_3 RD	g. NH_3 S
0	0.875	0.899	36	0.343	0.363
2	0.833	0.853	38	0.324	0.350
4	0.792	0.809	40	0.307	0.338
6	0.751	0.765	42	0.290	0.326
8	0.713	0.724	44	0.275	0.315
10	0.679	0.684	46	0.259	0.304
12	0.645	0.646	48	0.244	0.294
14	0.612	0.611	50	0.229	0.284
16	0.582	0.578	52	0.214	0.274
18	0.554	0.546	54	0.200	0.265
20	0.526	0.518	56	0.186	0.256
22	0.499	0.490	58	.....	0.247
24	0.474	0.467	60	.....	0.238
26	0.449	0.446	70	.....	0.194
28	0.426	0.426	80	.....	0.154
30	0.403	0.408	90	.....	0.114
32	0.382	0.393	98	.....	0.082
34	0.362	0.378	100	.....	0.074

Solubility of NH_3 by vol. in H_2O at 760 mm. and t°: 1 vol. H_2O at 760 mm. and t° dissolves V vols. NH_3 gas, vols. reduced to 0° and 760 mm.

t°	V	t°	V
0	1049.60	13	759.55
1	1020.78	14	743.11
2	993.26	15	727.22
3	966.98	16	711.82
4	941.88	17	696.85
5	917.90	18	682.26
6	894.99	19	667.99
7	873.09	20	653.99
8	852.14	21	640.19
9	831.98	22	626.54
10	812.76	23	612.98
11	794.32	24	599.46
12	776.60	25	585.94

(Carius, A. **99**. 144.)

Solubility of NH_3 in H_2O at P mm. pressure and 0°: 1 pt. H_2O absorbs pts. NH_3 at P mm. pressure and 0°.

P	Pts. NH_3	P	Pts. NH_3
10	0.044	900	0.968
20	0.084	950	1.101
30	0.120	1000	1.037
40	0.149	1050	1.075
50	0.175	1100	1.117
75	0.228	1150	1.161
100	0.275	1200	1.208
125	0.315	1250	1.258
150	0.351	1300	1.310
175	0.382	1350	1.361
200	0.411	1400	1.415
250	0.465	1450	1.469
300	0.515	1500	1.526
350	0.561	1550	1.584
400	0.607	1600	1.645
450	0.646	1650	1.707
500	0.690	1700	1.770
550	0.731	1750	1.835
600	0.768	1800	1.906
650	0.804	1850	1.976
700	0.840	1900	2.046
750	0.872	1950	2.120
800	0.906	2000	2.195
850	0.937	....	.....

(Roscoe and Dittmar, A. **112**. 349.)

In proportion as the temperature is higher, so much the more nearly does the solubility of NH_3 in H_2O conform to the law of Henry and Dalton, but only obeys it completely when the temperature is 100°, as is seen in the following table.

Solubility of NH_3 in H_2O at various pressures and temperatures: P = partial pressure, i. e. total pressure minus the tension of aqueous vapour at the given temperature; G = grams NH_3 dissolved in 1 g. H_2O at the given pressure; G at 760 = grams NH_3 that would be contained in 1 g. H_2O if the solubility was proportional to the pressure.

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0.082	3.113	.....	.....	.....	.....	.....	.....
30	0.117	2.960	.....	.....	.....	.....	.....	.....
40	0.148	2.820	.....	.....	.....	.....	.....	.....
60	0.169	2.522	0.119	1.513	.....	.....	.....	.....
80	0.240	2.280	0.141	1.337	0.052	0.497	.....	.....
100	0.280	2.127	0.158	1.200	0.064	0.490	.....	.....
120	0.316	2.000	0.173	1.095	0.076	0.483	.....	.....
140	0.346	1.880	0.187	1.017	0.088	0.476	.....	.....
160	0.375	1.780	0.202	0.962	0.099	0.470	.....	.....
180	0.398	1.684	0.207	0.918	0.109	0.462	.....	.....
200	0.421	1.598	0.232	0.881	0.120	0.454	.....	.....
250	0.472	1.434	0.266	0.810	0.145	0.440	.....	.....
300	0.519	1.315	0.296	0.750	0.168	0.426	.....	.....
350	0.563	1.223	0.325	0.705	0.191	0.414	.....	.....
400	0.606	1.152	0.353	0.670	0.211	0.402	.....	.....
450	0.650	1.100	0.378	0.638	0.232	0.399	.....	.....
500	0.692	1.052	0.403	0.612	0.251	0.382	.....	.....
550	0.732	1.012	0.425	0.587	0.269	0.372	.....	.....
600	0.770	0.975	0.447	0.566	0.287	0.363	.....	.....
650	0.809	0.946	0.470	0.550	0.304	0.355	.....	.....
700	0.850	0.923	0.492	0.53[illegible]	0.320	0.347	0.068	0.074
750	0.891	0.903	0.514	0.521	0.335	0.339	0.073	0.074
760	0.899	0.899	0.518	0.518	0.338	0.338	0.074	0.074
800	0.937	0.888	0.535	0.504	0.349	0.332	0.078	0.074
850	0.980	0.876	0.556	0.497	0.363	0.325	0.083	0.074
900	1.029	0.869	0.574	0.485	0.378	0.319	0.088	0.074
950	1.077	0.862	0.594	0.475	0.391	0.313	0.092	0.073
1000	1.126	0.855	0.613	0.466	0.404	0.307	0.096	0.073
1050	1.177	0.852	0.632	0.457	0.414	0.300	0.101	0.073
1100	1.230	0.850	0.651	0.450	0.425	0.294	0.106	0.073
1150	1.283	0.848	0.669	0.442	0.434	0.287	0.110	0.073
1200	1.336	0.846	0.685	0.433	0.445	0.282	0.115	0.073
1250	1.338	0.844	0.704	0.428	0.454	0.276	0.120	0.073
1300	1.442	0.843	0.722	0.422	0.463	0.271	0.125	0.073
1350	1.496	0.842	0.741	0.417	0.472	0.266	0.130	0.073
1400	1.549	0.841	0.761	0.413	0.479	0.260	0.135	0.073
1450	1.603	0.840	0.780	0.409	0.486	0.255	.....	.....
1500	1.656	0.839	0.801	0.406	0.493	0.250	.....	.....
1600	1.758	0.835	0.842	0.400	0.511	0.242	.....	.....
1700	1.861	0.832	0.881	0.394	0.530	0.237	.....	.....
1800	1.966	0.830	0.919	0.388	0.547	0.231	.....	.....
1900	2.070	0.828	0.955	0.382	0.565	0.226	.....	.....
2000	.....	.....	0.992	0.377	0.579	0.220	.....	.....
2100	.....	.....	.....	.....	0.594	0.215	.....	.....

(Sims, A. **118.** 346.)

Solubility of NH_3 in H_2O at temps. below 0°. One gram H_2O dissolves

grams NH_3	Temp.
0.947	—3.9°
1.115	—10°
1.768	—20°
2.781	—30°
2.946	—40°

(Mallet, Am. Ch. J. 1897, **19.** 807.

The solubility of NH_3 in H_2O does not follow Dalton's law at ord. temp., but does at temp. near 100°. (Konowaloff, J. Russ. Phys. Chem. Soc. 1894, **26.** 48; Chem. Soc. 1896, **70** (2). 351.

Sp. gr. of NH_4OH+Aq.

$\%NH_3$	Sp. gr.	$\%NH_3$	Sp. gr.
32.3*	0.8750	14.53	0.9435
29.25	0.8857	13.46	0.9476
26	0.9000	12.40	0.9513
25.37*	0.9054	11.56	0.9545
22.07	0.9166	10.82	0.9573
19.54	0.9255	10.17	0.9597
17.52	0 9326	9.6	0.9616
15.88	0.9385	9.5*	0.9632

(H. Davy, Elements, **1.** 241.)

* By direct experiment. The other numbers were obtained by calculation, making no allowance for compensation.

Sp. gr. of NH_4OH+Aq at 16°, according to Otto in his Lehrbuch.

$\%\ NH_3$	Sp. gr.	$\%\ NH_3$	Sp. gr.
12.000	0.9517	8.500	0.9650
11.875	0.9521	8.375	0.9654
11.750	0.9526	8.250	0.9659
11.625	0.9531	8.125	0.9664
11.500	0.9536	8.000	0.9669
11.375	0.9540	7.875	0.9673
11.250	0.9545	7.750	0.9678
11.125	0.9550	7.625	0.9683
11.000	0.9555	7.500	0.9688
10.950	0.9556	7.375	0.9692
10.875	0.9559	7.250	0.9697
10.750	0.9564	7.125	0.9702
10.625	0.9569	7.000	0.9707
10.500	0.9574	6.875	0.9711
10.375	0.9578	6.750	0.9716
10.250	0.9583	6.625	0.9721
10.125	0.9588	6.500	0.9726
10.000	0.9593	6.375	0.9730
9.875	0.9597	6.250	0.9735
9.750	0.9602	6 125	0.9740
9.625	0.9607	6.000	0.9745
9.500	0.9612	5.875	0.9749
9.375	0.9616	5.750	0.9754
9.250	0.9621	5.625	0.9759
9.125	0.9626	5.500	0.9764
9.000	0.9631	5.375	0.9768
8.875	0.9636	5.250	0.9773
8.750	0.9641	5.125	0.9778
8.625	0.9645	5.000	0.9783

Sp. gr. of NH_4OH+Aq, according to Ure in Dict. of Arts.

$\%\ NH_3$	Sp. gr.	$\%NH_3$	Sp. gr.
27.940	0.8914	15.900	0.9363
27.633	0.8937	14.575	0.9410
27.038	0.8967	13.250	0.9455
26.751	0.8983	11.925	0.9510
26.500	0.9000	10.600	0.9564
25.175	0.9045	9.275	0.9614
23.850	0.9090	7.950	0.9662
22.525	0.9133	6.625	0.9716
21.200	0.9177	5.300	0.9768
19.875	0.9227	3.975	0.9828
18.550	0.9275	2.650	0.9887
17.225	0.9320	1.325	0.9945

Sp. gr., b.-pt., and vols. gas in NH_4OH+Aq.

$\%\ NH_3$	Sp. gr.	B.-pt.	Vols. gas in 1 vol. liquid
35.3	0.85	—3.3°	494
32.6	0.86	+3.3°	456
29.9	0.87	10°	419
27.3	0.88	16.6°	382
24.7	0.89	23.3°	346
22.2	0.90	30°	311
19.8	0.91	36.6°	277
17.4	0.92	43.3°	244
15.1	0 93	50°	211
12.8	0.94	56.6°	180
10.5	0 95	63 3°	147
8.3	0 96	70°	116
6 2	0.97	78.3°	87
4.1	0.98	86.1°	57
2.0	0.99	91.1°	28

(Dalton, in New System, **2.** 422.)

Sp. gr. of NH_4OH+Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	0.8535	9	0.8746	18	0.8903
1	0.8561	10	0.8766	19	0.8916
2	0.8587	11	0.8785	20	0.8928
3	0.8611	12	0.8804	21	0.8940
4	0 8635	13	0.8823	22	0.8952
5	0.8658	14	0.8841	23	0.8963
6	0.8681	15	0.8858	24	0.8974
7	0.8703	16	0.8874	25	0.8984
8	0.8725	17	0.8889	..	.....

(Carius, A. **99.** 141.)

Sp. gr. of NH_4OH+Aq at 14°, according to Carius (A. **99.** 148).

$\%\ NH_3$	Sp. gr.	$\%\ NH_3$	Sp. gr.
36.0	0.8844	35.2	0.8860
35.8	0.8848	35.0	0.8864
35.6	0.8852	34.8	0.8868
35 4	0.8856	34.6	0.8872

Sp. gr. of NH_4OH+Aq at 14°, etc.—*Cont.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
34.4	0.8877	22.2	0.9185
34.2	0.8881	22.0	0.9191
34.0	0.8885	21.8	0.9197
33.8	0.8889	21.6	0.9203
33.6	0.8894	21.4	0.9209
33.4	0.8898	21.2	0.9215
33.2	0.8903	21.0	0.9221
33.0	0.8907	20.8	0.9227
32.8	0.8911	20.6	0.9233
32.6	0.8916	20.4	0.9239
32.4	0.8920	20.2	0.9245
32.2	0.8925	20.0	0.9251
32.0	0.8929	19.8	0.9257
31.8	0.8934	19.6	0.9264
31.6	0.8938	19.4	0.9271
31.4	0.8944	19.2	0.9277
31.2	0.8948	19.0	0.9283
31.0	0.8953	18.8	0.9289
30.8	0.8957	18.6	0.9296
30.6	0.8962	18.4	0.9302
30.4	0.8967	18.2	0.9308
30.2	0.8971	18.0	0.9314
30.0	0.8976	17.8	0.9321
29.8	0.8981	17.6	0.9327
29.6	0.8986	17.4	0.9333
29.4	0.8991	17.2	0.9340
29.2	0.8996	17.0	0.9347
29.0	0.9001	16.8	0.9353
28.8	0.9006	16.6	0.9360
28.6	0.9011	16.4	0.9366
28.4	0.9016	16.2	0.9373
28.2	0.9021	16.0	0.9380
28.0	0.9026	15.8	0.9386
27.8	0.9031	15.6	0.9393
27.6	0.9036	15.4	0.9400
27.4	0.9041	15.2	0.9407
27.2	0.9047	15.0	0.9414
27.0	0.9051	14.8	0.9420
26.8	0.9057	14.6	0.9427
26.6	0.9063	14.4	0.9434
26.4	0.9068	14.2	0.9441
26.2	0.9073	14.0	0.9449
26.0	0.9078	13.8	0.9456
25.8	0.9083	13.6	0.9463
25.6	0.9089	13.4	0.9470
25.4	0.9094	13.2	0.9477
25.2	0.9100	13.0	0.9484
25.0	0.9106	12.8	0.9491
24.8	0.9111	12.6	0.9498
24.6	0.9116	12.4	0.9505
24.4	0.9122	12.2	0.9512
24.2	0.9127	12.0	0.9520
24.0	0.9133	11.8	0.9527
23.8	0.9139	11.6	0.9534
23.6	0.9145	11.4	0.9542
23.4	0.9150	11.2	0.9549
23.2	0.9156	11.0	0.9556
23.0	0.9162	10.8	0.9563
22.8	0.9168	10.6	0.9571
22.6	0.9174	10.4	0.9578
22.4	0.9180	10.2	0.9586

Sp. gr. of NH_4OH+Aq at 14°, etc.—*Cont.*

% NH_3	Sp. gr.	% NH_3	Sp. gr.
10.0	0.9593	5.0	0.9790
9.8	0.9601	4.8	0.9799
9.6	0.9608	4.6	0.9807
9.4	0.9616	4.4	0.9815
9.2	0.9623	4.2	0.9823
9.0	0.9631	4.0	0.9831
8.8	0.9639	3.8	0.9839
8.6	0.9647	3.6	0.9847
8.4	0.9654	3.4	0.9855
8.2	0.9662	3.2	0.9863
8.0	0.9670	3.0	0.9873
7.8	0.9677	2.8	0.9882
7.6	0.9685	2.6	0.9890
7.4	0.9693	2.4	0.9899
7.2	0.9701	2.2	0.9907
7.0	0.9709	2.0	0.9915
6.8	0.9717	1.8	0.9924
6.6	0.9725	1.6	0.9932
6.4	0.9733	1.4	0.9941
6.2	0.9741	1.2	0.9950
6.0	0.9749	1.0	0.9959
5.8	0.9757	0.8	0.9967
5.6	0.9765	0.6	0.9975
5.4	0.9773	0.4	0.9983
5.2	0.9781	0.2	0.9991

Hager also gives a table in his Commentar zur Pharmacopoea, which is practically identical with those here given.

Strength of NH_4OH+Aq of certain sp. gr. at 12°.

Sp. gr.	1 kg. solution contains g. NH_3	1 l. solution contains g. NH_3	1 litre consists of	
			H_2O in cc.	liquid NH_3 in cc.
0.870	384.4	334.5	535.5	464.5
0.880	347.2	305.5	574.5	425.5
0.890	311.6	277.3	612.7	387.3
0.900	277.3	249.5	650.5	349.5
0.910	244.9	222.8	687.2	312.8
0.920	213.4	196.3	723.7	276.3
0.930	182.9	170.1	759.9	240.1
0.940	152.9	143.7	796.3	203.7
0.950	124.2	118.0	832.0	168.0
0.960	97.0	93.1	866.9	133.1
0.970	70.2	68.0	902.0	98.0
0.980	45.3	44.3	935.7	64.3
0.990	21.0	20.7	969.3	30.7

(Wachsmuth, Arch. Pharm. (3) **8.** 510.)

Sp. gr. of NH_4OH+Aq at 15°.
(Most careful experiments.)

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0.990	2.15	0.926	19.50
0.974	6.10	0.916	22.50
0.950	12.54	0.910	24.40

Sp. gr. of NH_4OH+Aq at 15°—*Continued*

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0 900	27.70	0.882	34.8
0.890	31.40	0.880	35.5
0 885	33.5	.....	.....

(Grüneberg, Chem. Ind. **12.** 97.)

The following table is calculated from the above by interpolation:—

Sp. gr.	% NH_3	Sp. gr.	% NH_3
0.995	1 05	0.935	16.90
0.990	2.15	0.930	18.35
0.985	3.30	0.925	19.80
0.980	4.50	0.920	21.30
0.975	5.75	0 915	22 85
0.970	7.05	0.910	24.40
0.965	8.40	0.905	26.00
0.960	9.80	0.900	27.70
0.955	11 20	0.895	29.50
0.950	12.60	0.890	31.40
0.945	14.00	0.885	33.40
0.940	15.45	0.880	35.50

(Grüneberg.)

Sp. gr. of NH_4OH+Aq at 14°.

% HN_3	Sp. gr.	% NH_3	Sp. gr.
31	0.8933	15.6	0 9400
23.8	0.9116	11.7	0.9536
20 4	0 9246	5.1	0.9780

(Lunge and Smith, B. **17.** 777.)

Sp. gr. of NH_4OH+Aq at 15°, according to Lunge and Wiernik (Zeit. f. angew. Ch. **1889.** 183).
(Most carefully worked out and calculated.)

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
1.000	0.00	0.0	0.00018
0.998	0.45	4.5	0.00018
0.996	0.91	9.1	0.00019
0.994	1.37	13.6	0.00019
0.992	1.84	18.2	0.00020
0.990	2.31	22.9	0.00020
0.988	2.80	27.7	0.00021
0.986	3.30	32.5	0.00021
0.984	3.80	37.4	0.00022
0.982	4.30	42.2	0.00022
0.980	4.80	47.0	0 00023
0.978	5.30	51.8	0.00023
0.976	5.80	56.6	0.00024
0.974	6.30	61.4	0.00024
0.972	6.80	66.1	0.00025
0.970	7.31	70.9	0.00025
0.968	7.82	75.7	0.00026

Sp. gr. of NH_4OH+Aq at 15°, etc.—*Continued*

Sp. gr.	% NH_3	1 l. contains g. NH_3	Correction for ± 1°
0.966	8.33	80.5	0.00026
0.964	8.84	85.2	0.00027
0.962	9.35	89.9	0.00028
0 960	9.91	95.1	0.00029
0.958	10.47	100.3	0.00030
0.956	11.03	105.4	0.00031
0.954	11.60	110.7	0.00032
0.952	12.17	115.9	0.00033
0.950	12.74	121.0	0.00034
0.948	13.31	126.2	0.00035
0.946	13.88	131.3	0.00036
0.944	14.46	136.5	0.00037
0.942	15.04	141.7	0.00038
0.940	15.63	146.9	0.00039
0.938	16.22	152.1	0.00040
0.936	16.82	157.4	0.00041
0.934	17.42	162.7	0.00041
0.932	18.03	168.1	0.00042
0.930	18.64	173.4	0.00042
0.928	19.25	178.6	0.00043
0.926	19.87	184.2	0.00044
0.924	20.49	189.3	0.00045
0.922	21.12	194.7	0.00046
0.920	21.75	200.1	0.00047
0.918	22.39	205 6	0.00048
0.916	23.03	210.9	0.00049
0.914	23.68	216.3	0.00050
0.912	24.33	221.9	0.00051
0 910	24.99	227.4	0.00052
0.908	25.65	232.9	0.00053
0 906	26.31	238.3	0.00054
0.904	26.98	243.9	0.00055
0.902	27.65	249.4	0.00056
0 900	28.33	255.0	0.00057
0.898	29.01	260.5	0.00058
0.896	29.69	266.0	0.00059
0.894	30.37	271.5	0.00060
0.892	31.05	277.0	0.00060
0 890	31.75	282.6	0.00061
0.888	32.50	288.6	0.00062
0.886	33.25	294.6	0.00063
0.884	34.10	301.4	0.00064
0.882	34.95	308.3	0.00065

NH_3 is much less sol. in KOH, or NaOH+Aq than in H_2O.

Solubility of NH_3 in H_2O, and KOH+Aq of various strengths: 100 pts. solvent absorbs g. NH_3 at t°.

t°	H_2O	KOH+Aq 11.25% K_2O	KOH+Aq 25.25% K_2O
0	90.00	72 00	49.50
8	72.75	57 00	37.50
16	59.75	46.00	28.50
24	49.50	37.25	21.75

(Raoult, A. ch. (5) **1.** 262.)

100 pts. sat. KOH+Aq dissolve only 1 pt. NH_3.

Solubility in NaOH+Aq is the same as in KOH+Aq of the same strength.

NH_4Cl+Aq absorbs slightly less NH_3 than the same vol. H_2O. $NaNO_3$, and NH_4NO_3+Aq absorb almost the same amount NH_3 as the same vol. H_2O. (Raoult, *l.c.*)

Solubility of NH_3 in 100 pts. $Ca(NO_3)_2$+Aq.

t°	H_2O	$Ca(NO_3)_2$+Aq 28.38% $Ca(NO_3)_2$	$Ca(NO_3)_2$+Aq 59.03% $Ca(NO_3)_2$
0	90.00	96.25	104.50
8	72.75	78.50	84.75
16	59.75	65.00	70.50

(Raoult, *l.c.*)

Solubility in salt solutions at 25°C.

Salt	Mols. NH_3 soluble in 1 liter of		
	.5-normal solution	1-normal solution	1.5-normal solution
KCl	0.930	0.866	0.809
KBr	0.950	0.904	0.857
KI	0.970	0.942	0.900
KOH	0.852	0.716	0.607
NaCl	0.938	0.889	0.843
NaBr	0.965	0.916	0.890
NaI	0.995	0.992	0.985
NaOH	0.876	0.789	0.716
LiCl	0.980	1.008	1.045
LiBr	1.001	1.040	1.090
LiI	1.030	1.094	1.190
LiOH	0.865	0.808	0.768
KF	0.839	0.722	0.626
KNO_3	0.923	0.862	0.804
KNO_2	0.920	0.855	0.798
KCN	0.926	0.858	0.802
KCNS	0.932	0.868	0.814
½K_2SO_4	0.875	0.772	0.678
½K_2SO_3	0.865	0.768	0.675
½K_2CO_3	0.788	0.650	0.554
½$K_2C_2O_4$	0.866	0.771	0.675
½K_2CrO_4	0.866	0.771	0.675
CH_3COOK	0.866	0.765	0.685
HCOOK	0.868	0.760	0.678
KBO_2	0.814	0.677	0.560
½K_2HPO_4	0.860	0.749	0.664
½Na_2S	0.887	0.795	0.726
$KClO_3$ 0.25-norm.	0.927	.....	.....
$KBrO_3$ 0.25-norm.	0.940	.....	.....
KIO_3 0.25-norm.	0.951	.....	.....

(Abegg & Riesenfeld, Z. phys. Ch. 1902, **40.** 100.)

Solubility in salts+Aq at 35° C.

Salt	Concentration of the aq. solution	Mols. NH_3 soluble in 1 liter of solution
KCl	0.5 normal	0.923
NaCl	"	0.966
CH_3COOK	"	0.902
½$(COOK)_2$	"	0.902
KOH	"	0.870
NaOH	"	0.896
½K_2CO_3	0.426 normal	0.914
½Na_2CO_3	"	0.932

(Riesenfeld, Z. phys. Ch. 1903, **45.** 462.)

The solubility of NH_3 in $NaNO_3$, NH_4NO_3 and in $AgNO_3,2NH_3$+Aq is nearly the same as in pure H_2O. (Konowaloff, C. C. **1898, II.** 659).

Distribution-coefficient of NH_3 between water and $CHCl_3$=26.3 at 20°; 24.9 at 25°; 23.2 at 30°.

The distribution-coefficient of NH_3 between $CHCl_3$ and a number of salt solutions has been determined for the purpose of studying the nature of metal-ammonia compounds in aqueous solution. (Dawson, Chem. Soc. 1900, **77.** 1242.)

Distribution of NH_3 between H_2O and $CHCl_3$ at 18°.

NH_3 concentration in aqueous solution. mols./litre	NH_3 concentration in $CHCl_3$ solution. mols./litre
0.9280	0.03506
1.921	0.07703
2.064	0.08350
2.274	0.09317
2.590	0.1083
3.700	0.1639
4.333	0.1996

(Dawson, Z. phys. Ch. 1909, **69.** 120.)

Distribution of NH_3 between hydroxides+Aq and $CHCl_3$ at 18°.

Aqueous solution	NH_3 concentration in the aqueous solution. mols./litre	NH_3 concentration in the $CHCl_3$ solution. mols./litre.
0.2-N. KOH	1.949	0.0841
0.5-N. KOH	1.978	0.0951
0.2-N. NaOH	2.016	0.0869
0.5-N. NaOH	1.944	0.0907
0.2-N. ½$Ba(OH)_2$	2.076	0.08905
0.5-N. ½$Ba(OH)_2$	3.397	0.1560

(Dawson, *l.c.*)

Distribution of NH_3 between $Cu(OH)_2+Aq$ and $CHCl_3$ at 18°.

Conc. of $Cu(OH)_2$ equivalents/litre	NH_3 concentration in aqueous solution. mols./litre	NH_3 concentration in $CHCl_3$ solution. mols./litre
0.041	2.014	0.07968
0.0705	2.653	0.1087
0.081	3.011	0.1247

Dawson, *l.c.*)

Sol. in alcohol and ether.

Sol. in 3 pts. alcohol of 38°. (Boullay.)

1 vol. alcohol of 0.829 sp. gr. absorbs about 50 vols. NH_3. (Davy.)

Much less sol. in ethyl, propyl, or amyl alcohol than in H_2O. (Pagliano and Emo, Gazz. ch. it. **13.** 278.)

Solubility of NH_3 in ethyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	19.7	24.5
6	17.1	20.6
11.7	14.1	16.4
14.7	13.2	15.2
17	12.6	14.7
22	10.9	12.2
28.4	9.2	10.1

(de Bruyn, R. t. c. **11.** 112.)

1 vol. abs. alcohol at 20° and 760 mm. pressure absorbs 340 vols. NH_3 gas. (Müller, W. Ann. 1891, **43.** 567.)

1 l. methyl alcohol sat. with NH_3 contains 218 g. NH_3 at 0°; sp. gr. of solution = 0.770; coefficient of solubility = 425.0. (Delépine).

Solubility of NH_3 in alcohol at t°: weight NH_3 = weight NH_3 contained in a litre of solution sat. at 760 mm. and t°; sp. gr. = sp. gr. of solution; C = coefficient of solubility.

Temp.	Degree of Alcohol	100°	90°	80°	70°	60°	50°
0°	Weight NH_3	130.5	146.0	206.5	.....	246.0	304.5
	Sp. gr.	0 782	0.783	0.808	.....	0.830	0.835
	C	209.5	245.0	390.0	.....	504.5	697.7
10°	Weight NH_3	108.5	120.0	167.0	.....	198.25	227.0
	Sp. gr.	0.787	0.803	0.800	....	0.831	0.850
	C	164.3	186.0	288.0	.....	373 0	438.6
20°	Weight NH_3	75.0	97.5	119.75	137.5	152.5	182.7
	Sp. gr.	0.791	0.788	0.821	0 829	0.842	0.869
	C	106.6	147.8	190.5	223.0	260.8	338.2
30°	Weight NH_3	51.5	74.0	81.75	100.3	129.5	152.0
	Sp. gr.	0.798	0.791	0.826	.....	0.846	0.883
	C	97.0	186.7	121.6	.....	211.6	252.0

(Delépine, J. Pharm. (5) **25.** 496.)

Solubility of NH_3 in methyl alcohol (absolute) at t°.

t°	% NH_3	Pts. NH_3 per 100 pts. alcohol
0	29.3	41.5
6	26.0	35.2
11.7	23.5	30.7
14.7	21.8	27.9
17	20.8	26.3
22	18.3	22.4
28.4	14.8	17.4

(de Bruyn, *l.c.*)

Readily sol. in ether.

Sol. in 0.4 vol. petroleum from Amiano. (Saussure.)

1 vol. oil of turpentine absorbs 7.5 vols. NH_3 at 16°.

1 vol. oil of lemon absorbs 8.5 vols. NH_3 at 16°.

1 vol. oil of rosemary absorbs 9.75 vols. NH_3 at 29°.

1 vol. oil of lavender absorbs 47 vols. NH_3 at 20°. (Saussure.)

1 vol. caoutchine absorbs 3 vols. NH_3. (Himly.)

Valerol absorbs much NH_3. (Gerhardt, A. ch. (3) **7.** 278.)

1 vol. ether at 760 mm. pressure absorbs 17.13 vols. NH_3 at 0°; 12.35 vols. at 10° and 10.27 vols. at 15°. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

$+H_2O$. Colorless crystals.

$+\frac{1}{2}H_2O$. Large transparent crystals. (Rupert, J. Am. Chem. Soc. 1909, **31.** 868.)

Ammonia, with metal salts.

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg, and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc., compounds, for

further reference. New data on Co and Cr ammonium compounds and those of the Pt metals, published since the first edition, has not been included in the present edition.

Ammonium amalgam, NH_4, *x*Hg.

Decomp. by H_2O, but more easily in presence of naphtha, alcohol, or ether.

Ammonium azoimide, $N_4H_4=NH_4N_3$.

Easily sol. in H_2O; sl. sol. in absolute alcohol, easily in 80% alcohol. Insol. in ether or benzene. (Curtius, B. **24.** 3344.)

Ammonium cobalt azoimide, NH_4N_3, CoN_6.

Rather sol. in H_2O. (Curtius and Rissom, J. pr. 1898, (2) **58.** 302.)

Ammonium bromide, NH_4Br.

Easily sol. in H_2O with absorption of much heat.

1 pt. NH_4Br dissolves in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
10	1.51	30	1.23	100	0.78
16	1.39	50	1.06	..	....

(Eder, W. A. B. **82.** (2) 1284.)

NH_4Br+Aq containing 41.09% NH_4Br is sat. at 15°. (Gerlach.)

Sp. gr. of NH_4Br+Aq at 15°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
5	1 0326	20	1.1285
10	1.0652	30	1.1921
15	1.0960	41 09	1.2920

(Eder.)

Sp. gr. of NH_4Br+Aq at 16°.

% NH_4Br	Sp. gr.	% NH_4Br	Sp. gr.
2	1.0119	22	1.1375
3	1.0181	23	1.1440
4	1.0242	24	1.1506
5	1.0303	25	1.1573
6	1.0364	26	1.1642
7	1.0425	27	1.1713
8	1.0486	28	1.1787
9	1.0547	29	1.1862
10	1.0609	30	1.1938
11	1.0672	31	1.2018
12	1.0735	32	1.2098
13	1.0798	33	1.2180
14	1.0862	34	1.2260
15	1.0926	35	1.2342
16	1.0988	36	1.2425
17	1.1051	37	1.2509
18	1.1115	38	1 2594
19	1.1181	39	1.2679
20	1.1246	40	1.2765
21	1.1310	41	1.2850

(Hager, Comm. **1883.**)

25 g. NH_4Br+50 g. H_2O lower the temp. from 15.1° to —1.1°. (Rüdorff.)

Sol. in liquid NH_3 at —50°. (Moissan C. R. 1901, **133.** 713.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J 1898, **20.** 826.)

Sl. sol. in alcohol.

1 pt. NH_4Br dissolves in 32.3 pts. alcohol (0 806 sp. gr.) at 15°; 9.5 pts. at 78°. (Eder, *l.c.*)

100 pts. absolute methyl alcohol dissolve 12.5 pts. at 19°; 100 pts. absolute ethyl alcohol dissolve 3.22 pts. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = sp. gr. of the sat. solution at 25°/4°.

P	G	S
0.00	0.255	0.8065
4.37	0.299	0.8083
10.40	0.321	0.8117
41.02	0.506	0.8252
80.69	0.813	0.8501
84.77	0.847	0.8508
91.25	0.934	0.8551
100.00	0.983	0.8605

(Herz, Z. anorg. 1908, **60.** 156.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.983	0.8605
11.11	0.851	0.8524
23.8	0.690	0.8426
65.2	0.308	0.8184
91.8	0.128	0.8097
93.75	0.125	0.8089
100.	0.095	0.8059

(Herz, *l.c.*)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Br in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.255	0.8065
8.1	0.251	0.8062
17.85	0.237	0.8052
56.6	0.163	0.8048
88.6	0.111	0.8042
91.2	0.105	0.8049
95.2	0.104	0.8059
100	0.095	0.8059

(Herz, *l.c.*)

Sol. in 809 pts. ether (0.729 sp. gr.). (Eder, *l.c.*)
Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014); (Naumann, B. 1904, **37.** 4328.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethylacetate. (Naumann, B. 1910, **43.** 314.)

Ammonium *tri*bromide, NH_4Br_3.

Gives off Br in air. Sol. in H_2O. (Roozeboom, B. **14.** 2398.)
Decomp. in the air. Very sol. in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 106.)

Ammonium antimony bromide, $3NH_4Br$, $2SbBr_3$.

Easily sol. in abs. alcohol. (Caven, C. C. **1905.** II, 293.)
$7NH_4Br$, $3SbBr_3$. Easily sol. in abs. alcohol. (Caven, C. C. **1905.** II, 293.)
See also **Bromantimonate, ammonium.**

Ammonium bismuth bromide, NH_4Br, $BiBr_3+H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in alcohol. (Nicklès, C. R. **51.** 1097.)

Ammonium cadmium bromide, NH_4Br, $CdBr_2+\frac{1}{2}H_2O$.

Sol. in 0.73 pt. H_2O, 5.3 pts. abs. alcohol, 280 pts. ether (sp. gr. 0.729), and 24 pts. alcohol ether (1 : 1). (Eder, Dingl. **221.** 89.)
Sol. in H_2O without decomp. between 1° and 110.1°.
100 pts. of the solution contain at:

1°	14.8°	52.2°	110.1°	
53.82	58.01	65.32	75.83	pts. of the salt.

(Rimbach, B. 1905, **38.** 1555.)

$4NH_4Br$, $CdBr_2$. Sol. in 0.96 pt. H_2O, from which it is pptd. by alcohol or ether. (Eder.)
Solubility in H_2O at t°.
Below 160° the salt is decomp. by H_2O; at 160° it is sol. in H_2O without decomp.

t°	100 pts. of the solution contain			Solid phase
	Pts. Cd	Pts. Br	Pts. NH_4	
0.8	14.72	50.46	6.67	Double salt+NH_4Br
13.0	14.94	51.48	6.85	"
44.5	15.01	53.85	7.35	"
76.4	14.60	55.28	7.80	"
123.5	15.50	59.50	8.45	"
160.0	14.70	62.67	9.43	Double salt

(Rimbach, B. 1905, **38.** 1558.)

Not sol. in HBr+Aq without decomp. (Rimbach.)
Not sol. without decomp. in LiBr+Aq, $CaBr_2$+Aq, $MgBr_2$+Aq, $NiBr_2$+Aq, or $CoBr_2$+Aq, even though very conc. solutions are used. Sol. without decomp. in $ZnBr_2$+Aq. (Rimbach, B. 1905, **38.** 1571.)

Ammonium chloromolybdenum bromide, $2NH_4Br$, $Cl_4Mo_3Br_2$.

Decomp. by pure H_2O. Can be crystallized from HBr+Aq. Apparently sol. without decomp. in alcohol. (Blomstrand.)

Ammonium cuprous bromide.

$4NH_4Br$, Cu_2Br_2. Fairly stable in air.
$2NH_4Br$, $Cu_2Br_2+H_2O$. Fairly stable in air. (Wells, Z. anorg. 1895, **10.** 159.)

Ammonium cuprous bromide ammonia, NH_4Br, Cu_2Br_2, $3NH_3$.

(Fleurent, C. R. 1891, **113.** 1047.)

Ammonium cupric bromide, $2NH_4Br$, $CuBr_2+2H_2O$.

Very sol. in H_2O. (de Koninck, B. **21.** 777 R.)

Ammonium iridium bromide.

See **Bromiridate, ammonium.**

Ammonium iron (ferric) bromide, $(NH_4)FeBr_4+2H_2O$.

Very deliquescent; sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)

Ammonium lead bromide, $12NH_4Br$, $7PbBr_2+7H_2O$.

Decomp. on air, or with cold H_2O. (André, C. R. **96.** 1502.)
$6NH_4Br$, $PbBr_2+H_2O$. Decomp. by cold H_2O. (A.)
$7NH_4Br$, $PbBr_2+1\frac{1}{2}H_2O$. Stable on air; decomp. by cold H_2O. (A.)
None of the above compounds exist. (Wells, Sill. Am. J. **146.** 25.)
$2NH_4Br$, $PbBr_2$. Decomp. by H_2O. Sol. in conc. KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 351.)
NH_4Br, $3PbBr_2$. (Wells.)

Ammonium magnesium bromide, NH_4Br, $MgBr_2+6H_2O$.

Deliquescent. Sol. in H_2O. (Lerch, J. pr. (2) **28.** 338.)

Ammonium mercuric bromide, $2HgBr_2$, NH_4Br.

Decomp. by H_2O into its constituent salts. (Rây, Chem. Soc. 1902, **81.** 648.)

Ammonium molybdenum bromide, $2NH_4Br$, $MoBr_3+H_2O$.

Easily sol. in H_2O. (Rosenheim, Z. anorg. 1905, **46.** 322.)

Ammonium molybdenum bromide chloride.

See **Ammonium chloromolybdenum bromide.**

Ammonium osmium bromide.
See **Bromosmate, ammonium.**

Ammonium osmyl bromide, $(NH_4)_2OsO_2Br_4$.
Sol. in H_2O. (Wintrebert, A. ch. 1903, (7) **28.** 95.)

Ammonium osmyl oxybromide, $(NH_4)_2OsO_3Br_2$.
(Wintrebert, A. ch. 1903 (7) **28.** 117.)

Ammonium palladium bromide.
See **Bromopalladate, ammonium,** *and* **Bromopalladite, ammonium.**

Ammonium platinum bromide.
See **Bromoplatinate, ammonium.**

Ammonium rhodium bromide.
See **Bromorhodite, ammonium.**

Ammonium selenium bromide.
See **Bromoselenate, ammonium.**

Ammonium tellurium bromide.
See **Bromotellurate, ammonium.**

Ammonium thallic bromide, $NH_4Br, TlBr_3+2H_2O$.
Sol. in H_2O. (Willm.)
$+4H_2O$. Efflorescent. Sol. in H_2O. (Nicklès.)
$+5H_2O$. Sol. in H_2O. (Nicklès.)

Ammonium stannous bromide (ammonium bromostannite), $NH_4Br, SnBr_2+H_2O$.
Sol. in H_2O. (Benas, C. C. **1884.** 958.)
$2NH_4Br, SnBr_2$. Sol. in H_2O. (Raymann and Preis, A. **223.** 323.)
$+H_2O$. Sol. in H_2O. (Benas, *l.c.*)
$+2H_2O$. (Richardson, Am. Ch. J. **14.** 96.)
$NH_4Br, 2SnBr_2$(?). (Benas.)

Ammonium stannic bromide, $2NH_4Br, SnBr_4$.
See **Bromostannate, ammonium.**

Ammonium uranyl bromide, $2NH_4Br, UO_2Br_2+2H_2O$.
Very deliquescent, and sol. in H_2O. (Sendtner.)

Ammonium zinc bromide, $2NH_4Br, ZnBr_2$.
Deliquescent, and sol. in H_2O. (Bödeker, J. B. **1860.** 17.)
$+H_2O$. Very deliquescent, and sol. in H_2O. (André, A. ch. (6) **3.** 104.)
$+xH_2O$. (Ephraim, Z. anorg. 1908, **59.** 66.)
$3NH_4Br, ZnBr_2$. Sol. in H_2O. Decomp. only by great dilution. (Jones & Knight, Am. Ch. J. 1899, **22.** 136.)
$+H_2O$. Not hygroscopic. (Ephraim, Z. anorg. 1908, **59.** 66.)

Ammonium bromide arsenic *tri*oxide.
See **Arsenite bromide, ammonium.**

Ammonium bromide mercuric chloride, $NH_4Br, 2HgCl_2$.
Ppt. (Rây, Chem. Soc. 1902, **81.** 649.)

Ammonium bromide mercuric iodide, $2NH_4Br, HgI_2$.
Decomp. by H_2O. Sol. in alcohol without decomp. (Grossmann, B. 1903, **36.** 1602.)
$3NH_4Br, 2HgI_2$. Decomp. by H_2O. Sol. in alcohol without decomp. (Grossmann, B. 1903, **36.** 1602.)

Ammonium lead bromochloride, $NH_4Pb_2Br_4Cl$.
Decomp. by H_2O. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 350.)
$NH_4Pb_2Cl_4Br$. Decomp. by H_2O. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 349.)

Ammonium bromochloroiodide, NH_4ClBrI.
Very stable; sol in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 108.)

Ammonium lead bromoiodide, $NH_4PbBrI_2+2H_2O$ and $NH_4Pb_2BrI_4$.
Decomp. by H_2O. Sol. in conc. KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 352.)

Ammonium bromiodobromide, NH_4BrIBr.
Decomp. in the air. Sol. in ether. (Jackson, Am. Ch. J. 1900, **24.** 28.)

Ammonium chloride, NH_4Cl.
(Sal-ammoniac.) Not deliquescent. Sol. in H_2O with reduction of temp.

Sol. in 2.24 pts. H_2O. (Wenzel.)
NH_4Cl+Aq sat. at 10° has sp. gr. =1.072. (T.)
Sol. in 2.72 pts. cold, and 1 pt. boiling H_2O. (M. R., and P.)
Sol. in 3 pts. H_2O at 18.75°. (Abl.)
Sol. in 6 pts. cold, and 1 pt. boiling H_2O. (Fourcroy.)
100 pts. H_2O at 18.75° dissolve 36.75 pts. NH_4Cl.
NH_4Cl+Aq sat. at its b.-pt. (114.2°) contains 88.9 pts. NH_4Cl in 100 pts. of the solution. (Berzelius.)
100 pts. H_2O at 15° dissolve 33–36 pts.; and at 100°, 100 pts. NH_4Cl. (Ure's Dict.)
NH_4Cl+Aq sat. at 15° has sp. gr. =1.075209, and contains at least 31.88 pts. NH_4Cl dissolved in every 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 478.)
NH_4Cl+Aq sat. at 10° contains 23.8% NH_4Cl. (Eller.)
NH_4Cl+Aq sat. in the cold contains 14.3% NH_4Cl. (Fourcroy.)
Sol. in 1 pt. H_2O at 113.5°, b.-pt. of sat. solution. (Griffiths.)
Sol. in 2.7 pts. H_2O at 18.75°, forming a liquid of 1.08 sp. gr. (Karsten, 1840.)
Sol. in 2.727 pts. H_2O at 10°. (Gren's Handbuch.)

100 pts. H_2O at 718 mm. pressure and t° dissolve pts. NH_4Cl.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	28.40	30	41.72	60	55.04	90	68.36
10	32.84	40	46.16	70	59.48	100	72.80
20	37.28	50	50.60	80	63.92	110	77.24

(Alluard, C. R. **59.** 500.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29.7	30	41.4	60	55.2	90	71.3
1	30.0	31	41.8	61	55.7	91	71.9
2	30.3	32	42.2	62	56.2	92	72.5
3	30.6	33	42.7	63	56.7	93	73.1
4	31.0	34	43.1	64	57.2	94	73.7
5	31.4	35	43.6	65	57.7	95	74.3
6	31.8	36	44.0	66	58.2	96	74.9
7	32.2	37	44.4	67	58.7	97	75.5
8	32.6	38	44.9	68	59.2	98	76.1
9	33.0	39	45.3	69	59.7	99	76.7
10	33.3	40	45.8	70	60.2	100	77.3
11	33.7	41	46.2	71	60.7	101	78.0
12	34.1	42	46.7	72	61.2	102	78.6
13	34.5	43	47.1	73	61.7	103	79.2
14	34.8	44	47.6	74	62.3	104	79.9
15	35.2	45	48.0	75	62.8	105	80.5
16	35.6	46	48.5	76	63.4	106	81.2
17	36.0	47	49.0	77	63.9	107	81.8
18	36.4	48	49.5	78	64.5	108	82.5
19	36.8	49	49.9	79	65.1	109	83.1
20	37.2	50	50.4	80	65.6	110	83.8
21	37.6	51	50.9	81	66.2	111	84.4
22	38.0	52	51.3	82	66.7	112	85.1
23	38.4	53	51.8	83	67.3	113	85.7
24	38.8	54	52.3	84	67.8	114	86.4
25	39.3	55	52.8	85	68.4	115	87.1
26	39.7	56	53.2	86	69.0	115.65	87.3
27	40.1	57	53.7	87	69.6	....	....
28	40.5	58	54.2	88	70.2	....	....
29	40.9	59	54.7	89	70.7	....	....

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864.** 57.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4Cl	t°	Pts. NH_4Cl	t°	Pts. NH_4Cl
0	29.7	10.8	33.9	64.9	57.9
6.2	32.2	31.6	42.2	90.6	67.2

(Lindström, Pogg. **136.** 315.)

NH_4Cl+Aq sat. at 13–16° contains 26.16% NH_4Cl. (v. Hauer, J. pr. **103.** 114.)

Sol. in 2.72 pts. H_2O at 19°. (Schiff, A. **109.** 326.)

Sol. in 2.803 pts. H_2O at 15°. (Gerlach.)

Sat. NH_4Cl+Aq at 75° contains 38.23% NH_4Cl. (Tschugaeff, Z. anorg. 1914, **86.** 161.)

NH_4Cl+Aq sat. at 30° contains 29.5% NH_4Cl. (Meerburg, C. C. **1904.** II, 1362.)

Solubility in H_2O at t°.

t°	1000 mols. H_2O dissolve mols. NH_4Cl	100 g. H_2O dissolve g. NH_4Cl
3.5	105.2	31.25
25 0	129.7	38.5
50.0	167.0	49.6

(Biltz and Marcus, Z. anorg. 1911, **71.** 169.)

Solubility of NH_4Cl in H_2O at t°.

t°	g. NH_4Cl in 100 g. of the solution	Solid phase
— 0.45	0.7^{8}	Ice
— 1.25	1.9^{8}	"
— 1.70	2.7^{5}	"
— 3.05	4.6	"
— 4.45	6.6^{7}	"
— 6.4	9.2^{3}	"
— 8.25	11.4	"
— 9.7	13.1	"
—11.9	15.3	"
—13.25	16.7	"
—14.70	18.1^{5}	"
—15.4	18.9	"
±—16.0	±19.5	Ice+NH_4Cl
—15.0	19.7	NH_4Cl
—12.2	20.0	"
—10.9	20.3	"
— 7.4	21.1	"
— 5.7	21.7	"
— 2.3	22.3	"
±— 1.1	22.6	"
0	22.7	"

(Meerburg, Z. anorg. 1903, **37.** 203.)

100 g. H_2O dissolve 29.5 g. NH_4Cl at 30.° (Schreinemakers, Arch. neer. Sc. (2) **15.** 17.)

Spec. gravity of NH_4Cl+Aq. G=according to Gerlach at 15° (Z. anal. **8.** 281); S=according to Schiff at 19° (A. **110.** 74).

% NH_4Cl	Sp. gr. G	Sp. gr. S	% NH_4Cl	Sp. gr. G	Sp. gr. S
1	1.00316	1.0029	17	1.05086	1.0495
2	1.00632	1.0058	18	1.05367	1.0523
3	1.00948	1.0087	19	1.05648	1.0551
4	1.01264	1.0116	20	1.05929	1.0579
5	1.01580	1.0145	21	1.06204	1.0606
6	1.01880	1.0174	22	1.06479	1.0633
7	1.02180	1.0203	23	1.06754	1.0660
8	1.02481	1.0233	24	1.07029	1.0687
9	1.02781	1.0263	25	1.07304	1.0714
10	1.03081	1.0293	26	1.07375	1.0741
11	1.03370	1.0322	26.297	1.07658	......
12	1.03658	1.0351	27	....	1.0768
13	1.03947	1.0380	28	....	1.0794
14	1.04325	1.0409	29	....	1.0802
15	1.04524	1.0438	30	....	1.0846
16	1.04805	1.0467	......	....	......

For older determinations, see Storer's Dict.

Sp. gr. of NH_4Cl+Aq at 18°.

% NH_4Cl	Sp. gr.	% NH_4Cl	Sp. gr.
5	1.0142	20	1.0571
10	1.0289	25	1.0710
15	1.0430	..	......

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. at 20°/4° of a normal solution of NH_4Cl=1.01454. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

NH_4Cl+Aq containing 6.52% NH_4Cl has sp. gr. 20°/20°=1.0195. (Le Blanc & Rohland, Z. phys. Ch. 1896, **19.** 272.)

Temp. of maximum density of NH_4Cl+Aq	g. mol. NH_4Cl in 1000 g. H_2O
2.640°	0.1899
0.055°	0.5407

(de Coppet, C. R. 1900, **131.** 178.)

Sp. gr. of dil. NH_4Cl+Aq at 20.004° and 731 mm. (corr.)
Conc.=g. equiv. NH_4Cl per l. at 20.004°.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,001,8
0.0002	1.000,003,7
0.0005	1.000,009,3
0.0010	1.000,018,5
0.0020	1.000,036,9
0.0050	1.000,091,3
0.0100	1.000,180,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1688.)

Sp. gr. of dil. NH_4Cl+Aq.

NH_4Cl g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.4431	1.000150
0.9061	1.000304
1.8085	1.000606
3.5947	1.001196
7.7845	1.002562
15.3425	1.004994
31.2364	1.010018

(Dijken, Z. phys. Ch. 1897, **24.** 107.)

B.-pt. of NH_4Cl+Aq, containing pts. NH_4Cl to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 439); L=according to Legrand (A. ch. (2) **59.** 436).

B.-pt.	G	L	B.-pt.	G	L
101°	6.5	7.8	109°	50.6	53.5
102	12.8	13.9	110	56.2	59.9
103	19.0	19.7	111	61.9	66.4
104	24.7	25.2	112	67.8	73.3
105	29.7	30.5	113	74.2	80.5
106	34.6	35.7	114	81.3	88.1
107	39.6	41.3	114.2	....	88.9
108	45.0	47.3	114.8	87.1	....

Sat. NH_4Cl+Aq boils at 115.8° at 718 mm. pressure. (Alluard, C. R. **59.** 500.)

NH_4Cl+Aq containing 74.2 pts. NH_4Cl to 100 pts. H_2O forms a crust at 113°; highest temperature observed, 114.8°. (Gerlach, Z. anal. **26.** 426.)

NH_4Cl+Aq containing 10% NH_4Cl boils at 101.7°; 20% NH_4Cl, at 104.4°. (Gerlach.)

NH_4Cl+Aq containing 10.6% NH_4Cl gives off NH_3 at 37°. (Leeds, Am. J. Sci. (3) **7.** 197.)

When NH_4Cl+Aq is boiled, or even evap. on water bath, a little NH_3 is expelled. (Fresenius.)

30 pts. NH_4Cl mixed with 100 pts. H_2O lower the temp. from 13.3° to −5.1°, that is 18.4°. (Rüdorff, B. **2.** 68.)

Freezing-point of sat. solution is −15.4°, the same temp. which is caused by mixing 25 pts. NH_4Cl with 100 pts. snow. (Rüdorff, Pogg. **122.** 337.)

Conc. HCl+Aq precipitates part of NH_4Cl from sat. NH_4Cl+Aq. (Vogel, J. pr. **2.** 199.)

Solubility of NH_4Cl in HCl+Aq at 0°. NH_4Cl =mols. NH_4Cl (in milligrammes) dissolved in 10 cc. of the liquid; HCl= mols. HCl (in milligrammes) dissolved in 10 cc. of the liquid.

NH_4Cl	HCl	Sum of mols.	Sp. gr.
46.125	0.0	46.125	1.076
43.6	2.9	46.5	1.0695
41.0	5.5	46.5	1.0705
39.15	7.85	47.0	1.0715
36.45	10.85	47.30	1.073
27.37	21.4	48.77	1.078
10.875	53.0	63.875	1.106
8.8	61.0	69.8	1.114

(Engel, Bull. Soc. (2) **45.** 655.)

Solubility of NH_4Cl in HCl+Aq.

t°	HCl concentration. g. mol. per 100 g. H_2O	Weight NH_4Cl dissolved in 1000 g. H_2O	Molecular solubility
0°	0	298.40	5.59
"	¼	286.43	5.36
"	½	271.23	5.08
"	1	245.35	4.60
25°	0	395.10	7.40
"	¼	380.85	7.13
"	½	366.00	6.85
"	1	339.05	6.35

(Armstrong & Eyre, Proc. R. Soc. (A.) **84.** 127.)

Solubility in NH_4OH+Aq. NH_4Cl=mols. NH_4Cl (in mgs.) in 10 cc. solution; NH_3=mols. NH_3 (in mgs.) in 10 cc. solution.

NH_4Cl	NH_3	Sp. gr.
46.125	0	1.076
45.8	5.37	1.067
45.5	12.025	1.054
45.125	23.4	1.044
44.5	38.0	1.031
44.0	47	1.025
43.625	54.5	1.017
43.125	80.0	0.993
44.0	90.0	0.992
44.375	95.5	0.983
49.75	130	0.953
60.0	169.75	0.931

(Engel, Bull. Soc. (3) **6.** 17.)

$NH_4Cl+BaCl_2$. 100 pts. H_2O dissolve 33.8 pts. NH_4Cl+11.6 pts. $BaCl_2$ at 20°. (Rüdorff, Pogg. **148.** 467.)

Solubility of NH_4Cl and $BaCl_2$ in H_2O.

t°	Wt. per 100 NH_4Cl	Wt. per 100 $BaCl_2$	Solid phase
—16.2°	16.10	8.07	$NH_4Cl+BaCl_2.2H_2O$
0	19.26	8.22	
30	24.89	8.19	
40	26.93	8.40	
50	29.53	8.55	

(Schreinemakers, Chem. Weekbl. 1910, **7.** 333.)
See also $BaCl_2+NH_4Cl$ under $BaCl_2$.

$NH_4Cl+CdCl_2$. Solubility of NH_4Cl and $CdCl_2$.
See **Ammonium cadmium chloride.**

$NH_4Cl+CuCl_2$. Solubility of NH_4Cl in H_2O at 30° in presence of varying amounts of $CuCl_2$.

% by wt. $CuCl_2$	% by wt. NH_4Cl	Solid phase
0	29.5	NH_4Cl
1.9	28.6	$NH_4Cl+CuCl_2, 2NH_4Cl. 2H_2O$
3.6	25.9	$CuCl_2, 2NH_4Cl. 2H_2O$
7.7	19.8	"
10.5	16.5	"
12.3	14.9	"
15.6	12.1	"
19.9	9.4	"
24.0	7.1	"
29.4	4.9	"
35.1	3.4	"
41.4	2.1	"
43.2	2.0	$CuCl_2, 2NH_4Cl. 2H_2O+CuCl_2. 2H_2O$
43.9	0.	$CuCl_2. 2H_2O$

(Meerburg, Z. anorg. 1905, **45.** 3)

$NH_4Cl+PbCl_2$. Solubility of NH_4Cl and $PbCl_2$ in H_2O at 22°.

g. equivalent in 1000 g. H_2O: NH_4Cl	g. equivalent in 1000 g. H_2O: $PbCl_2$	Solid phase
0.0	0.0749	$PbCl_2$
0.1	0.0325	"
0.2	0.0194	"
0.3	0.0153	"
0.4	0.0138	"
0.5	0.0130	"
0.52	0.0127	$PbCl_2+NH_4Cl,2PbCl_2$
0.55	0.0123	$NH_4Cl,2PbCl_2$
0.6	0.0113	"
0.65	0.0105	"
0.7	0.0099	"
0.8	0.0087	"
0.9	0.0083	"
1.0	0.0080	"
1.2	0.0075	"
1.5	0.0073	"
2.0	0.0077	"
2.5	0.0092	"
3.0	0.0112	"
4.0	0.0182	"
5.0	0.0296	"
6.0	0.0473	"
7.0	0.0774	"
7.29	0.0898	$NH_4Cl+NH_4Cl,2PbCl_2$
7.29	0.0000	NH_4Cl

(Brönstedt, Z. phys. Ch. 1911, **77.** 132.)

Solubility of NH_4Cl and $2PbCl_2,NH_4Cl$ in H_2O at 100°.

NH_4Cl g. equivalent in 1000 g. solution	NH_4Cl g. equivalent in 1000 g. H_2O	$PbCl_2$ g. equivalent in 1000 g. solution	$PbCl_2$ g. equivalent in 1000 g. H_2O	Solid phase
1.277	1.404	0.160	0.176	$NH_4Cl+2PbCl_2.H_2O$

(Brönstedt, *l. c.*)

$NH_4Cl+MgCl_2$. Solubility of NH_4Cl and $NH_4MgCl_3.6H_2O$.

t°	In 1000 g. H_2O: g. mols. NH_4Cl	In 1000 g. H_2O: g. mols. $MgCl_2$	Solid phase
3.5°	27.5	55.7	$NH_4Cl+NH_4MgCl_3.6H_2O$
25	42.1	56.4	"
50	62.9	59.1	"

(Biltz and Marcus, Z. anorg. 1911, **71.** 170.)

Solubility of $NH_4MgCl_3.6H_2O$ and $MgCl_2.6H_2O$.

$t°$	In 1000 g. mol. H_2O		Solid phase
	g. mol. NH_4Cl	g. mol. $MgCl_2$	
3.5°	0.5	99.5	$MgCl_2.6H_2O+$
25°	0.5	103.8	$NH_4MgCl_3.6H_2O$
50°	0.8	111.2	

(Biltz and Marcus, Z. anorg. 1911, **71.** 170.)

$NH_4Cl+NH_4NO_3$. 100 pts. H_2O dissolve 29.1 pts. NH_4Cl+173.8 pts. NH_4NO_3 at 19.5°. (Rüdorff, B. **6.** 482.)

$NH_4Cl+Ba(NO_3)_2$. 100 pts. H_2O dissolve at 18.5°—

	1	2	3	4	5
NH_4Cl	36.7	38.6	38.06	39.18	.
$Ba(NO_3)_2$	....	8.6	16.73	17.02	8.9

2, sat. $Ba(NO_3)_2$+Aq treated with NH_4Cl; 3, sat. NH_4Cl+Aq treated with $Ba(NO_3)_2$; 4, simultaneous treatment of both salts with H_2O. (Karsten.)

$NH_4Cl+KNO_3$. 100 pts. H_2O dissolve at 18.5°—

	1	2	3	4	5	6
KNO_3	29.9	30.56	37.68	38.62	....	34.2
NH_4Cl	....	44.33	37.98	39.84	36.7	38.8
		74.89	75.66	78.46		73.0

1 and 5, according to Mulder; 2, sat. KNO_3+Aq treated with NH_4Cl; 3, sat. NH_4Cl+Aq treated with KNO_3; 4, simultaneous treatment of NH_4Cl and KNO_3 (Karsten); 6, by warming solution with excess of both salts and cooling to 14.8°. The amount of excess of one or the other salt has no influence. (Rüdorff.)

$NH_4Cl+NaNO_3$. Slowly sol. in sat. $NaNO_3$+Aq, at first to a clear solution, but afterwards NaCl separates out. (Karsten.)

$NH_4Cl+KCl$. 100 pts. H_2O dissolve—

	(Rüdorff) 15°	(Karsten) 18.75°		
KCl	16.97	34.4	16.27	.....
NH_4Cl	28.90	....	29.83	37.02

	(Rüdorff) 22°	(Mulder) At b.-pt.		
KCl	19.1	58.5	21.9	....
NH_4Cl	30.4	....	67.7	87.3

100 pts. sat. solution of $NH_4Cl+KCl$ contain 30.61 pts. of the two salts at 13–16°. (v. Hauer, J. pr. **103.** 114.)

$NH_4Cl+NaCl$. 100 pts. H_2O dissolve—

	(Mulder) 10–20°	10°	10°	(v. Hauer) 13–16°
NH_4Cl	....	19.50	33.3	18.8–20.3
NaCl	35.8	30.00	....	24.6–26.1
		49.50		43.4–46.4

	(Karsten) 18.75°		(Rüdorff) 18.7°	(Mulder) At b.-pt.		
NH_4Cl	22.06	37.02	22.9	87.3	78.5	....
NaCl	26.38	....	23.9	...	22.3	40.4
	48.44		46.8		100.8	

Sp. gr. of sat. solution of $NH_4Cl+NaCl$ is 1.179. (Karsten.)

$NH_4Cl+(NH_4)_2SO_4$. 100 pts. H_2O dissolve 25.8 pts. NH_4Cl+46.5 pts. $(NH_4)_2SO_4$ at 21.5°. (Rüdorff, B. **6.** 484.)

Solubility in $(NH_4)_2SO_4$+Aq at 30°.

Composition of the solution		Solid phase
% by wt. NH_4Cl	% by wt. $(NH_4)_2SO_4$	
0	44	$(NH_4)_2SO_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(NH_4)_2SO_4+NH_4Cl$
17.93	25.81	"
19.07	23.22	NH_4Cl
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, **69.** 562.)

$NH_4Cl+CuSO_4$. Sol. in sat. $CuSO_4$+Aq, at first to a clear solution, but a double sulphate of NH_4 and Cu soon separates. (Karsten.)

$NH_4Cl+MgSO_4$. Slowly and difficultly sol. in sat. $MgSO_4$+Aq with subsequent separation of double sulphate. (Karsten.)

$NH_4Cl+K_2SO_4$. 100 pts. H_2O dissolve, at 18.75°—

		a	*b*	*c*	
K_2SO_4	10.8	11.1	13.26	13.28	....
NH_4Cl	....	38.2	37.94	37.92	36.7
		49.3	51.20	51.20	

In (*a*) NH_4Cl was added to sat. K_2SO_4+Aq.
In (*b*) K_2SO_4 was added to sat. NH_4Cl+Aq.
In (*c*) NH_4Cl and K_2SO_4 were treated together with H_2O. (Karsten.)

100 pts. H_2O at 14° dissolve 14.1 pts. K_2SO_4+36.8 pts. NH_4Cl=50.9 pts. K_2SO_4+NH_4Cl, under all conditions. (Rüdorff, Pogg. **148.** 565.)

100 pts. H_2O dissolve at b.-pt.—

K_2SO_4 . . .	26.75	33.3– 33.9	. . . .
NH_4Cl . . .	. . . .	90.4–111.8	87 3
		123.7–145.7	

(Mulder.)

NH_4Cl+Na_2SO_4. 100 pts. H_2O dissolve 28.9 pts. NH_4Cl+24.7 pts. Na_2SO_4, if NH_4Cl+Aq sat. at 10° is sat. with Na_2SO_4 at 11°.

100 pts. H_2O dissolve 31.8 pts. NH_4Cl+9.0 pts. Na_2SO_4, if Na_2SO_4+Aq sat. at 10° is sat. with NH_4Cl at 11°. (Mulder, J. B. **1866.** 68.)

Sol. in sat. Na_2SO_4+Aq. (Karsten.)

Sol. in sat. $ZnSO_4$+Aq. (Karsten.)

Sl. sol. in liquid NH_3 at —50°. (Moissan, C. R. 1901, **133.** 713.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Very sl. sol. in absolute alcohol.

100 pts. alcohol of 0.939 sp. gr. dissolve—

at 4°	8°	27°	38°	56°	
11.2	12.6	19.4	23.6	30.1	pts. NH_4Cl.

(Gerardin, A. ch. (4) **5.** 129.)

14 pts. boiling highest rectified spirit dissolve 1 pt. NH_4Cl. (Wenzel.)

100 pts. alcohol of—

0.900 sp. gr.	dissolve 6.5	pts. NH_4Cl.
0.872 " "	" 4.75	" "
0.834 " "	" 1.5	" "

(Kirwan.)

Though somewhat sol. in pure absolute alcohol, NH_4Cl is absolutely insol. in alcohol in presence of methyl amine chlorides. (Winkles, A. **93.** 324.)

100 pts. absolute methyl alcohol dissolve 3.35 pts. at 19°.

100 pts. absolute ethyl alcohol dissolve 0.62 pt. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility of NH_4Cl in methyl alcohol.

t°	Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0°	0	298.40	5.59
"	¼	297.35	5.57
"	½	296.55	5.55
"	1	292.65	5.47
"	3	283.15	5.30
25°	0	395.10	7.40
"	¼	394.75	7.39
"	½	393 85	7 37
"	1	392.90	7.36
"	3	386.20	7.23

(Armstrong and Eyre, Proc. R. Soc. Lond. (A) **84.** 127.)

Solubility of NH_4Cl in ethyl alcohol at 0°.

Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0	298.40	5.59
¼	295.50	5.53
½	291.95	5.47
1	286.40	5.37
3	266.25	4.99

(Armstrong and Eyre, *l.c.*)

See also **ammonium cupric chloride.**

Solubility of NH_4Cl in propyl alcohol.

t°	Alcohol concentration, mol. g. alcohol for 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0°	0	298.46	5.59
"	¼	295.40	5.53
"	½	291.30	5.45
"	1	284.00	5.32
25°	0	395.10	7.40
"	¼	393.50	7.37
"	½	390.80	7.32
"	1	384.80	7.21

(Armstrong and Eyre, *l.c.*)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = sp. gr. of the sat. solution at 25°/4°.

P	G	S
0.00	0.0533	0.7908
4.37	0.0583	0.7909
10.40	0.0658	0.7910
41.02	0.118	0.7957
80.69	0.217	0.8020
84.77	0.227	0.8026
91 25	0.247	0.8040
100.00	0.276	0.8062

(Herz, Z. anorg. 1908, **60.** 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.276	0.8062
11.11	0.231	0.8035
23.8	0.182	0.8008
65.2	0 071	0.8005
91.8	0.026	0.8002
93.75	0 023	0.8000
100.00	0.018	0.8009(?)

(Herz, Z. anorg. 1908, **60.** 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NH_4Cl in 10 cc. of the solution.
S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.0533	0.7908
8.1	0.0505	0.7910
17.85	0.0455	0.7916
56.6	0.0312	0.7962
88.6	0.0210	0.7996
91.2	0.0203	0.8001
95.2	0.0190	0.8003
100	0.0177	0.8009

(Herz, Z. anorg. 1908, **60.** 160.)

Insol. in ether and CS_2. (Fordos and Gélis, A. ch. (3) **32.** 393.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. anal. appl. Ch. **6.** 184.)

Solubility of NH_4Cl in acetone+Aq at 25°.
A = cc. acetone in 100 cc. acetone+Aq.
NH_4Cl = millimols. NH_4Cl in 100 cc. of the solution.

A		NH_4Cl	Sp. gr.
0		585.1	1.0793
10		534.1	1.0618
20		464.6	1.0451
30		396.7	1.0263
40		328.5	0.99984
46.5	lower	283.7	0.97998
to	2 phases		
85.7	upper	18.9	0.8390
90		9.4	0.8274

(Herz, Z. anorg. 1905, **45.** 263.)

Solubility of NH_4Cl in glycerine+Aq at 25°.
G = g. glycerine in 100 g. glycerine+Aq.
NH_4Cl = millimols. NH_4Cl in 100 cc. of the solution.

G	NH_4Cl	Sp. gr.
0	585.1	1.0793
13.28	544.6	1.0947
25.98	502.9	1.1127
45.36	434.4	1.1452
54.23	403.5	1.1606
83.84	291.4	1.2225
100	228.4	1.2617

(Herz, *l.c.*)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.); (Eidmann, C. C. **1899.** II, 1014.)

Insol. in anhydrous pyridine. Sol. in 97% pyridine+Aq, 95% pyridine+Aq and in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Very sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sol. in formic acid. (Zanninovich-Tessarin, Z. phys. Ch. 1896, **19.** 251.)

Ammonium antimony chloride, $SbCl_6(NH_4)_2$, $SbCl_6(NH_4)_3$.

Ppt. Decomp. by H_2O. (Weinland, B. 1905, **38.** 1085.)

$SbCl_6(NH_4)$, $SbCl_5$, NH_4OH. Very deliquescent; sl. sol. in H_2O with decomp. (Weinland, B 1901, **34.** 2635.)

Ammonium antimonous chloride, NH_4Cl, $SbCl_3$.

Deliquescent. (Dehérain, C. R. **52.** 734.)

$2NH_4Cl$, $SbCl_3+2H_2O$. Permanent in dry air; decomp. by much H_2O. (Poggiale.)

$3NH_4Cl$, $SbCl_3+3H_2O$. As above.

Ammonium antimonic chloride, $3NH_4Cl$, $SbCl_5$.

Decomp. by H_2O. (Dehérain, C. R. **52.** 734.)

$4NH_4Cl$, $SbCl_5$. Decomp. by H_2O. (D.)

See also **Chlorantimonate, ammonium.**

Ammonium antimony platinum chloride, $(Sb, Pt)Cl_6(NH_4)_2$.

Ppt. (Weinland, B. 1905, **38.** 1084.)

Ammonium antimony tin chloride, $(Sb,Sn)Cl_6(NH_4)_2$.

Ppt. (Weinland, B. 1905, **38.** 1085.)

Ammonium arsenyl chloride, $2NH_4Cl$, $AsOCl+\frac{1}{2}H_2O$.

(Wallace, Phil. Mag. (4) **16.** 358.)

Ammonium bismuth chloride, NH_4Cl, $2BiCl_3$.

Deliquescent. (Dehérain, C. R. **54.** 724.)

$2NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe.) Pogg. **64.** 237.)

$+2\frac{1}{2}H_2O$. (Rammelsberg.)

$3NH_4Cl$, $BiCl_3$. Decomp. by H_2O. (Arppe.)

$5NH_4Cl$, $2BiCl_3$. (Rammelsberg.)

Ammonium bismuth potassium chloride, $2NH_4Cl$, $BiCl_3$, KCl.

(Dehérain, C. R. **54.** 724.)

Ammonium cadmium chloride, NH_4Cl, $CdCl_2$.

Solubility of NH_4Cl, $CdCl_2$ in H_2O at t°.

t°	Pts. by weight in 100 pts. of solution			g. in 100 g. solution	Grams in 100 H_2O	Mols. H_2O free salt dissolved by 100 mols. H_2O
	Cl	Cd	NH_4			
2.4°	13.44	14.26	2.24	29.94	42.74	3.25
16.0	15.07	15.82	2.56	33.45	50.26	3.83
41.2	17.46	18.61	2.89	38.96	63.83	4.86
63.8	19.73	20.92	3.34	43.99	78.54	5.98
105.9	23.52	24.70	4.01	52.58	109.33	8.30

(Rimbach, B. 1897, **30.** 3076.)

$+\frac{1}{2}H_2O$. Sl. sol. in H_2O, alcohol, and wood spirit. (v. Hauer, W. A. B. **13.** 449.)

$4NH_4Cl, CdCl_2$. Sol. in H_2O. (v. Hauer.) Decomp. by H_2O to $NH_4Cl, CdCl_2$. Decomp. increases with decrease of temp. At 3.9° approximately wholly decomp. to $NH_4Cl, CdCl_2$. At 113.9° very nearly all is $4NH_4Cl, CdCl_2$. (Rimbach, B. 1897, **30.** 3077.)

Solubility of $4NH_4Cl, CdCl_2$ in H_2O at t°.

t°	Pts. dissolved in 100 pts. by weight of solution.		
	Cd	Cl	NH_4
3.9	5.75	18.17	7.37
16.1	6.93	20.26	7.97
40.2	9.91	23.84	8.92
58.5	12.50	26.53	9.35
112.9	16.66	31.79	10.78
113.9	16.51	32.71	11.30

(Rimbach, B. 1897, **30.** 3071.)

Sol. without decomp. in 37.3% HCl(d = 1.19) and 24.8% HCl(d = 1.125). (Rimbach, B. 1905, **38.** 1569.)

Solubility of $4NH_4Cl,CdCl_2+NH_4Cl$ in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH_4	Mol. % NH_4Cl	Mol. % Tetra-salt
1.0	2.82	17.11	7.82	59.0	41.0
13.2	2.76	18.84	8.71	74.0	26.0
40.1	3.16	22.56	10.49	71.0	29.0
58.2	3.51	25.21	11.72	69.0	31.0

(Rimbach, B. 1902, **35.** 1300.)

Solubility of $4NH_4Cl, CdCl_2+NH_4Cl, CdCl_2$ in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH_4	Mol. % Mono-salt	Mol. % Tetra-salt
1.1	5.34	17.62	7.27	49.6	50.4
14.0	7.12	19.86	7.84	47.0	53.0
40.7	10.24	23.82	8.85	77.0	23.0
58.5	12 50	26.53	9.35	....	....

(Rimbach, B. 1902, **35.** 1300.)

Sol. without decomp. in 50% LiCl+Aq, 33.3% $CaCl_2$+Aq and 50% $MgCl_2$+Aq. (Rimbach, B. 1905, **38.** 1569.)

Ammonium chloromolybdenum chloride, $2NH_4Cl, Cl_4Mo_3Cl_2+2H_2O$.

Decomp. by pure H_2O; can be crystallized from HCl+Aq. (Blomstrand.)

Ammonium chromium chloride, $2NH_4Cl, CrCl_3+H_2O$.

Sol. in H_2O with decomp. (Neumann, A. **244.** 229.)

$+6H_2O = 2NH_4Cl, [CrCl_2.4H_2O]Cl+2H_2O$. Hygroscopic. Decomp. by H_2O and by alcohol. (Weinland, B. 1907, **40.** 3770.)

Ammonium cobaltous chloride, $NH_4Cl, CoCl_2 +6H_2O$.

Deliquescent in moist air. Very easily sol. in H_2O. (Hautz, A. **66.** 284.)

Ammonium cobaltous chloride ammonia, $NH_4Cl, CoCl_2, NH_3$. (F. Rose.)

Ammonium cuprous chloride, $4NH_4Cl.Cu_2Cl_2$. Decomp. in the air.

$4NH_4Cl, 3Cu_2Cl_2$. Decomp. by H_2O, not by alcohol. (Ritthausen, J. pr. **59.** 369.)

Fairly stable in air. (Wells, Z. anorg. 1895, **10.** 158.)

Ammonium cupric chloride, $NH_4Cl, CuCl_2$.

Solubility of $NH_4Cl, CuCl_2$ in absolute alcohol at 25°.

% $CuCl_2$	Solid phase	% $CuCl_2$	Solid phase
4.65	$NH_4Cl+NH_4Cl, CuCl_2$	12.90	$NH_4Cl, CuCl_2$
4.74	$NH_4Cl+NH_4Cl, CuCl_2$	34.92	$NH_4Cl, CuCl_2+CuCl_2, C_2H_5OH$
6.45	$NH_4Cl, CuCl_2$	34.50	"

(Foote and Walden, J. Am. Ch. Soc. 1911, **33.** 1032.)

$+2H_2O$. Sol. in 2 pts. H_2O. (Hautz, A. **66.** 280.)

Does not exis t. (Meerburg, C. C. **1904. II.** 1362.

$2NH_4Cl, CuCl_2+2H_2O$. Easily sol. in H_2O, also in alcohol, even when absolute. (Cap and Henry, J. pr. **13.** 184.)

Solubility of $2NH_4Cl, CuCl_2$ in H_2O at t°.

g. $2NH_4Cl, CuCl_2$ in 100 g. of the solution	t°	Solid phase
3.87	—1.5°	ice
5.88	—2.48	"
8.78	—3.95	"
9.97	—4.60	"
13.12	—6.40	"
15.84	—8.04	"
17.64	—9.24	"
20.12	—10.80	"
±20.3	±—11.0	ice+$2NH_4Cl, CuCl_2.2H_2O$
20.46	—10	$2NH_4Cl, CuCl_2.2H_2O$
21.16	—5	"
22.02	0	"
24.26	+12	"
25.95	20	"
27.70	30	"
30.47	40	"
33.24	50	"
36.13	60	"
39.25	70	"
43.36	80	"

(Meerburg, Z. anorg. 1905, **45.** 8.)

Somewhat sol. in liquid NH_3. (Franklin and Kraus, Am. Ch. J. 1898, **20.** 827.)

Is the only hydrate of $2NH_4Cl$, $CuCl_2$ existing between —11° and +80°. (Meerburg, C. C. **1904.** II, 1362.)

$+3H_2O$. (Bourgeois, Bull. Soc. 1898, (3) **19.** 786.)

Ammonium cupric chloride ammonia, $2NH_4Cl$, $CuCl_2$, $2NH_3$.

Decomp. by H_2O, less easily by alcohol. Decomp. by acids. (Ritthausen.)

Ammonium indium chloride, $2NH_4Cl$, $InCl_3$ $+H_2O$.

Easily sol. in H_2O. (Meyer.)

Ammonium iodine chloride, NH_4Cl, ICl_3.

More sol. in H_2O than KCl, ICl_3. (Filhol, J. Pharm. **25.** 441; Berz. J. B. **20.** (2) 110.)

Ammonium iridium *tri*chloride.

See **Chloriridite, ammonium.**

Ammonium iridium *tetra*chloride.

See **Chloriridate, ammonium.**

Ammonium iron (ferrous) chloride, NH_4Cl, $FeCl_2$.

Easily sol. in H_2O; insol. in alcohol. (Winkler.)

Ammonium iron (ferric) chloride, $2NH_4Cl$, $FeCl_3+H_2O$.

Deliquescent. Sol. in H_2O without decomp. (Fritzsche); sol. in 3 pts. H_2O at 18.75°. (Abl.)

Sol. in H_2O. (Walden, Z. anorg. 1894, **1.** 332.)

Ammonium iron (ferric) potassium chloride, NH_4Cl, $FeCl_3$, $KCl+1\frac{1}{2}H_2O$.

Min. *Kremersite.* Deliquescent.

Ammonium lead chloride, NH_4Cl, $2PbCl_2+3H_2O$.

Sol. in H_2O without decomp. (?). (André, C. R. **96.** 1502.)

$6NH_4Cl$, $PbCl_2+H_2O$.

$9NH_4Cl$, $PbCl_2+1\frac{1}{2}H_2O$.

$9NH_4Cl$, $2PbCl_2+2\frac{1}{2}H_2O$.

$10NH_4Cl$, $PbCl_2+H_2O$.

$11NH_4Cl$, $2PbCl_2+3\frac{1}{2}H_2O$.

$18NH_4Cl$, $PbCl_2+4H_2O$.

All these salts are decomp. by H_2O. (André A. ch. (6) **3.** 104.)

Of the salts prepared by André, only one NH_4Cl, $2PbCl_2$ exists. (Wells, Sill. Am. J. **146.** 25.)

Solubility determinations show that NH_4Cl, $2PbCl_2$ is the only double salt formed at 25°. (Foote, Am. Ch. J. 1907, **37.** 121.)

NH_4Cl, $PbCl_2+\frac{1}{3}H_2O$. (Wells, *l.c.*)

Ammonium lead *tetra*chloride.

See **Chloroplumbate, ammonium.**

Ammonium magnesium chloride, NH_4MgCl_3 $+6H_2O = NH_4Cl$, $MgCl_2+6H_2O$.

Deliquescent. Very sol. in H_2O.

Sol. in 6 pts. cold H_2O. (Fourcroy.)

Solubility in NH_4Cl+Aq at t°.

t°	Per 1000 Mol. H_2O	
	Mol. NH_4Cl	Mol. $MgCl_2$
3.5°	27.5	55.7
25.0	[illegible]2.1	56.4
50.0	62.9	59.1

(Biltz, Z. anorg. 1911, **71.** 170.)

$4NH_4Cl,5MgCl_2+33H_2O$. Sol. in H_2O. (Berthelot and André, A. ch. (6) **11.** 294.)

Ammonium manganous chloride, NH_4Cl, $MnCl_2+\frac{1}{2}H_2O$.

Sol. in $1\frac{1}{2}$ pts. H_2O at ordinary temp. (Hautz, A. **66.** 280); does not exist. (Saunders, Am. Ch. J. **14.** 134.)

$2NH_4Cl$, $MnCl_2+H_2O$. Sol. in H_2O (Rammelsberg); does not exist. (Saunders.)

$+2H_2O$. Easily sol. in H_2O, but with decomp. into NH_4Cl and $MnCl_2$. (Saunders.)

Ammonium manganic chloride, $2NH_4Cl$, $MnCl_3$.

Sol. in H_2O; less sol. in NH_4Cl+Aq. Unstable. (Neuman, M. 1894, **15.** 490.)

$+H_2O$. Decomp. by H_2O. Sol. in HCl apparently without decomp. (Rice, Chem. Soc. 1898, **73.** 260.)

Ammonium mercuric chloride, $2NH_4Cl$, $HgCl_2+H_2O$ (sal alembroth).

Sol. in 0.66 pt. H_2O at 10°, and in nearly every proportion of hot H_2O.

NH_4Cl, $HgCl_2$. Easily sol. in H_2O.

$+\frac{1}{2}H_2O$. Easily sol. in H_2O. (Kane.)

$2NH_4Cl$, $3HgCl_2+4H_2O$. Easily sol. in H_2O. (Holmes, C. N. **5.** 351.)

NH_4Cl, $2HgCl_2$. Very sol. in H_2O. (Rây, Chem. Soc. 1902, **81.** 648.)

NH_4Cl, $5HgCl_2$. (Strömholm, J. pr. 1902, (2) **66.** 441.)

Ammonium mercuric sodium chloride, NH_4Cl, $HgCl_2$, 4NaCl (?).

Sol. in H_2O. (Kossmann, A. ch. (3) **27.** 243.)

Ammonium molybdenum chloride, $2NH_4Cl$, $MoCl_3+H_2O$.

Very sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903.** II, 652.)

See also **Ammonium chloromolybdenum chloride.**

Ammonium molybdenum chloride iodide.

See **Ammonium chloromolybdenum iodide.**

Ammonium molybdenyl chloride, $2NH_4Cl$, $MoO_2Cl_2+2H_2O$.

(Weinland, Z. anorg. 1905, **44.** 98.)

$2NH_4Cl$, $MoOCl_3$. Sol. in H_2O; insol. in H_2O sat. with HCl. (Klason, B. 1901, **34.** 149.

Ammonium nickel chloride, NH_4Cl, $NiCl_2+6H_2O$.

Deliquescent in moist air. Easily sol. in H_2O. (Hautz.)

$4NH_4Cl$, $NiCl_2+7H_2O$ (?).

Ammonium osmium *tetra***chloride.**

See **Chlorosmate, ammonium.**

Ammonium osmium *sesqui***chloride.**

See **Chlorosmite, ammonium.**

Ammonium osmyl chloride, $(NH_4)_2OsO_2Cl_4$.

Sol. in H_2O. Decomp. by HCl. (Wintrebert, A. ch. 1903, (7) **28.** 92.)

Ammonium osmyl oxychloride, $(NH_4)_2OsO_3Cl_2$.

Very sl. sol. in H_2O. Sol. in KOH+Aq with decomp. (Wintrebert, A. ch. 1903, (7) **28.** 116.)

Ammonium palladium chlorides.

See **Chloropalladate, ammonium** *and* **chloropalladite, ammonium.**

Ammonium rhodium *di***chloride,** $4NH_4Cl$, $RhCl_2+3\frac{1}{2}H_2O$.

Sol. in H_2O, but decomp. slowly. (Willm. B. **16.** 3033.)

Does not exist. (Leidié, A. ch. (6) **17.** 277.)

Ammonium rhodium *tri***chloride.**

See **Chlororhodite, ammonium.**

Ammonium rhodium chloride ammonium nitrate, Rh_2Cl_6, $6NH_4Cl$, $2NH_4NO_3$.

See **Chlororhodite nitrate, ammonium.**

Ammonium ruthenium *tri***chloride.**

See **Chlororuthenite, ammonium.**

Ammonium ruthenium *tetra***chloride.**

See **Chlororuthenate, ammonium.**

Ammonium tellurium chloride.

See **Chlorotellurate, ammonium.**

Ammonium thallic chloride, $3NH_4Cl$, $TlCl_3$.

Easily sol. in H_2O. (Willm.)

$+2H_2O$. Easily sol. in H_2O and alcohol. (Nicklès, J. Pharm. (4) **1.** 28.)

Ammonium thorium chloride, $8NH_4Cl$, $ThCl_4+8H_2O$.

Sol. in H_2O. (Chydenius.)

Ammonium tin (stannous) chloride (ammonium chlorostannite), NH_4Cl, $SnCl_2+H_2O$.

Decomp. by H_2O. Resembles K salt. (Richardson, Am. Ch. J. **14.** 93.)

$2NH_4Cl$, $SnCl_2+H_2O$. Sol. in H_2O, but decomp. by boiling. (Rammelsberg.)

Contains $2H_2O$. (Richardson.)

$4NH_4Cl$, $SnCl_2+3H_2O$. Decomp. by H_2O. (Poggiale, C. R. **20.** 1182.)

Does not exist. (Richardson.)

Ammonium tin (stannic) chloride.

See **Chlorostannate, ammonium.**

Ammonium titanium chloride, $2NH_4Cl$, $TiCl_4+2H_2O$.

Ppt.; decomp. in moist air; sol. in fuming HCl; insol. in ether. (Rosenheim, Z. anorg. 1901, **26.** 242.)

Ammonium titanium chloride, $3NH_4Cl$, $TiCl_4$. Sol. in H_2O.

$6NH_4Cl$, $TiCl_4$. Sol. in H_2O. (Rose.)

Ammonium tungsten chloride, $(NH_4)_3W_2Cl_9=3NH_4Cl$, $2WCl_3$.

Easily sol. in H_2O. Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 577.)

Ammonium uranyl chloride.

Very deliquescent, and sol. in H_2O. (Peligot.)

$2NH_4Cl,(UO_2)Cl_2+2H_2O$. Solution at 15° contains in 100 g. 3.51 g., NH_4, 40.67 g. UO_2 and 19.15 g. Cl, hence there is considerable decomp. (Rimbach, B. 1904, **37.** 466.)

Ammonium vanadium chloride, $2NH_4Cl$, VCl_3+H_2O.

Difficulty sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Ammonium zinc chloride, NH_4Cl, $ZnCl_2+2H_2O$.

Deliquescent. Very sol. in H_2O. (Hautz, A. **66.** 287.)

$2NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Rammelsberg, Pogg. **94.** 507.)

$+H_2O$. Deliquescent in moist air. Sol. in $^2/_3$ pt. cold H_2O with absorption of heat. Sol. in 0.28 pt. hot H_2O (Golfier-Bassayre, A. ch. **70.** 344); sol. in $\frac{1}{2}$ pt. cold H_2O. (Hautz, A. **66.** 287.)

$3NH_4Cl$, $ZnCl_2$. Sol. in H_2O. (Marignac.)

$+H_2O$. (Berthelot, A. ch. (6) **11.** 294.)

$4NH_4Cl$, $ZnCl_2$. (Dehérain.)

$6NH_4Cl$, $ZnCl_2+^2/_3H_2O$. (Berthelot, *l.c.*)

Ammonium chloride zinc oxychloride, $2ZnCl_2$, $8NH_4Cl$, ZnO.

Sol. in a little H_2O, but decomp. by excess. (André.)

$3ZnCl_2$, $10NH_4Cl$, ZnO. As above. (André, A. ch. (6) **3.** 88.)

Ammonium chloride antimony fluoride, NH_4Cl, SbF_3.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Ammonium chloride arsenic *tri***oxide.**

See **Arsenite chloride, ammonium.**

Ammonium chloride bismuth bromide, $3NH_4Cl, BiBr_3+H_2O$.

Deliquescent; decomp. by H_2O. (Muir, Chem. Soc. **31.** 148.)

$2NH_4Cl, BiBr_3+3H_2O$. Decomp. by H_2O. (Muir.)

$5NH_4Cl, 2BiBr_3+H_2O$. Decomp. by H_2O. (Muir.)

Ammonium chloride chromic oxychloride, $2NH_4Cl, CrOCl_3$.

Decomp. in the air. Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4045.)

Ammonium chloride cuprocupric thiosulphate, $2NH_4Cl, Cu_2O, CuO. 3S_2O_2$.

See **Thiosulphate ammonium chloride, cuprocupric.**

Ammonium chloride lead iodide, $3NH_4Cl, PbI_2$.

Decomp. with H_2O. (Behrens, Pogg. **62.** 252.)

$4NH_4Cl, PbI_2+2H_2O$. Decomp. with H_2O. (Poggiale, C. R. **20.** 1180.)

Ammonium chloride mercuric bromide, $NH_4Cl, HgBr_2$.

(Edhem-Bey, Dissert. **1885.**)

Ammonium chloride platinum sulphite.

See **Chloroplatosulphite, ammonium.**

Ammonium chloride tin (stannous) bromide, $2NH_4Cl, SnBr_2+H_2O$.

Sol. in H_2O. (Raymann and Preis, A. **223.** 323.)

Ammonium *di*chloroiodide, NH_4Cl_2I.

Slowly decomp. when exposed to dry air at ord. temp. Very sol. in H_2O. (Chattaway, Chem. Soc. 1915, **107.** 107.)

Ammonium *tetra*chloroiodide, NH_4Cl_4I.

Decomp. in the air. (Chattaway, Chem. Soc. 1915, **107.** 107.)

Ammonium lead chloroiodide, $NH_4PbClI_2+2H_2O$ and $(NH_4)_2PbCl_2I_2+2H_2O$.

Sol. in KOH+Aq and in strong acids; decomp. by H_2O. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 348.)

Ammonium fluoride, NH_4F.

Abundantly sol. in H_2O; sl. sol. in alcohol. (Marignac, Ann. Min. (5) **15.** 221.)

Insol. in liquid NH_3. (Ruff and Geisel, B. 1903, **36.** 820.)

Almost insol. in liquid NH_3 at 50°. (Moissan, C. R. 1901, **133.** 713.)

Sol. in methyl alcohol. (Carrara, Gazz. ch. it. 1896, **26.** 119.)

Ammonium hydrogen fluoride, NH_4F, HF.

Deliquescent in moist air. Sol. in H_2O.

Ammonium antimony fluoride, $2NH_4F, SbF_3$.

Deliquescent; sol. in 0.9 pt. cold H_2O. Insol. in alcohol or ether. (Flückinger, A. **84.** 248.)

$NH_4F, 4SbF_3$. 3 pts. sol. in 2 pts. H_2O. (Raad and Hauser, B. 1890, **23.** R. 125.)

NH_4F, SbF_5. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Ammonium bismuth fluoride, $2NH_4F, BiF_3$.

Insol. in H_2O. Rather difficultly sol. in acids. (Helmholt, Z. anorg. **3** 115.)

Ammonium cadmium fluoride, NH_4F, CdF_2.

Insol. in H_2O. Sol. in acids on boiling. (Helmholt, Z. anorg. **3.** 115.)

Ammonium chromium fluoride, $3NH_4F, CrF_3$.

Easily sol. in H_2O. Sl. sol. in NH_4F+Aq. (Petersen, J. pr. (2) **40.** 52.)

$2NH_4F,CrF_3+H_2O$. (Wagner, B. **19.** 896.)

Ammonium cobaltous fluoride, $2NH_4F, CoF_2+2H_2O$.

Sl. sol. in H_2O. (Wagner, B. **19.** 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3.** 132.)

Ammonium columbyl fluoride.

See **Fluoxycolumbate, ammonium.**

Ammonium columbium fluoride oxyfluoride, $3NH_4F, CbF_5, CbOF_3$.

See **Fluoxycolumbate columbium fluoride, ammonium.**

Ammonium copper fluoride, $2NH_4F, CuF_2+2H_2O$.

Insol. in H_2O. (Helmholt, Z. anorg. **3.** 115.)

Nearly insol. in H_2O but decomp. thereby. (Haas, Ch. Z. 1908, **32.** 8.)

Ammonium glucinum fluoride, $2NH_4F, GlF_2$.

Sol. in H_2O. (Marignac, A. ch. (4) **30.** 51.)

Very sol. in H_2O. (Helmholt, Z. anorg. **3.** 130.)

Ammonium iron (ferrous) fluoride, $2NH_4F, FeF_2$. (Wagner, B. **19.** 896.)

NH_4F, FeF_2+2H_2O. (W.)

Ammonium iron (ferric) fluoride, $2NH_4F, FeF_3$.

More sol. in H_2O than the corresponding K compound. Decomp. by boiling. (Nicklès, J. Pharm. (4) **7.** 15.)

$3NH_4F, FeF_3$. Sl. sol. in H_2O. (Marignac, A. ch. (3) **60.** 306.)

Easily sol. in acids. (Helmholt, Z. anorg. **3.** 124.)

Ammonium manganic fluoride, $2NH_4F, MnF_4$.

More sol. than the K salt. (Nicklès, C. R **65.** 107.)

True composition is $4NH_4F, Mn_2F_6$. (Christensen, J. pr. (2) **34.** 41.)

See also **Fluomanganate, ammonium.**

Ammonium manganyl fluoride.

See **Fluoxymanganate, ammonium.**

Ammonium molybdenum fluoride.

Insol. in H_2O. Sol. in HCl+Aq. (Berzelius.)

See also **Fluomolybdate, ammonium.**

Ammonium molybdenyl fluoride.

See **Fluoxymolybdate, ammonium.**

Ammonium nickel fluoride, $2NH_4F, NiF_2+2H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Easily sol. in H_2O. (Helmholt, Z. anorg. **3.** 143.)

Ammonium scandium fluoride, $(NH_4)_3ScF_6$.

Easily sol. in H_2O. Aqueous solution is not decomp. by boiling. Decomp. by acids. (R. I. Meyer, Z. anorg. 1914, **86.** 275.)

Ammonium silicon fluoride.

See **Fluosilicate, ammonium.**

Ammonium silver fluoride, $2NH_4F, AgF+H_2O$.

Not hydroscopic. Sol. in H_2O; sol. in conc. NH_4F+Aq. Sol. in alcohol. (Grützner, Arch. Pharm. 1900, **238.** 3.)

$15NH_4F, AgF+4H_2O$. More deliquescent than NH_4F. (Böhm, Dissert. **1906.**)

Ammonium tantalum fluoride.

See **Fluotantalate, ammonium.**

Ammonium tantalyl fluoride.

See **Fluoxytantalate, ammonium.**

Ammonium tellurium fluoride, NH_4F, TeF_4.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Ammonium tin (stannous) fluoride, $2NH_4F, SnF_2+2H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Ammonium tin (stannic) fluoride, $2NH_4F, SnF_4$.

See **Fluostannate, ammonium.**

Ammonium titanium *sesqui***fluoride.**

See **Fluotitanate, ammonium.**

Ammonium titanyl fluoride.

See **Fluoxypertitanate, ammonium.**

Ammonium tungstyl fluoride.

See **Fluoxytungstate, ammonium.**

Ammonium uranyl fluoride.

See **Fluoxyuranate, ammonium.**

Ammonium vanadium *sesqui***fluoride.**

See **Fluovanadate, ammonium.**

Ammonium vanadyl fluoride.

See **Fluoxyvanadate, ammonium.**

Ammonium zinc fluoride, $2NH_4F, ZnF_2$.

Sol. in H_2O. (R. Wagner.)

$+2H_2O$. Very sl. sol. in H_2O. Easily sol. in dil. acids. (Helmholt.)

Ammonium zirconium fluoride.

See **Fluozirconate, ammonium.**

Ammonium fluoride manganic oxyfluoride, $2NH_4F, MnOF_2$.

Precipitate. (Nicklès.)

See also **Fluoxymanganate, ammonium.**

Ammonium fluoride molybdenum *tri***oxide,** $2NH_4F, MoO_3$.

Decomp. by H_2O. (Mauro, Gazz. ch. it. **18.** 120.)

Ammonium fluoride tungsten oxyfluoride.

See **Fluoxytungstate, ammonium.**

Ammonium fluoride tungsten oxyfluoride ammonium tungstate, $4NH_4F, WO_2F_2, (NH_4)_2WO_4$.

See **Fluoxytungstate tungstate, ammonium.**

Ammonium fluoride vanadium oxyfluoride.

See **Fluoxyvanadate,** *and* **fluoxyhypovanadate, ammonium.**

Ammonium hydroselenide, NH_4HSe.

Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)

Ammonium hydrosulphide, NH_4SH.

Sol. in H_2O and alcohol. Solutions decomp. on air.

Ammonium hydroxide, NH_4OH.

See **Ammonia,**

Ammonium imidosulphamide, $(S_2O_4N_3H_4)NH_4$.

(Hantzsch, B. 1905, **38.** 1033.)

Ammonium iodide, NH_4I.

Very deliquescent. Sol. in 0.60 pt. H_2O. (Eder, Dingl. **221.** 89.)

Sp. gr. of aqueous solution of NH_4I at 18° containing—

10	20	30	40	50% NH_4I.
1.0652	1.1397	1.2260	1.3260	1.4415

(Kohlrausch, W. Ann. **1879.** 1.)

NH_4I+Aq containing 12.51% NH_4I has sp. gr. 20°/20° = 1.0846.

NH_4I+Aq containing 19.19% NH_4I has sp. gr. 20°/20° = 1.1359.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Very sol. in liquid NH_3 at —50°. (Moissan, C. R. 1901, **133.** 713.)

Sol. in $SOCl_2$. (Walden, Z. anorg. 1900, **25.** 216.)
Sol. in liquid SO_2. (Walden, Z. anorg. 1902, **30.** 160.)
Sol. in 4.0 pts. abs. alcohol. (Eder, *l.c.*)
" 210 " ether. (Eder, *l.c.*)
" 20 " alcohol-ether (1 : 1). (Eder, *l.c.*)
Sol. in acetone. (Eidmann, C.C. **1899**, II. 1014.); (Naumann, B. 1904, **37.** 4328.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Ammonium *di*iodide, NH_4I_2.

Sol. in alcohol, ether, CS_2, and KI+Aq; less sol. in chloroform. (Guthrie, Chem. Soc. (2) **1.** 239.)

Ammonium *tri*iodide, NH_4I_3.

Sl. deliquescent. Sol. in little H_2O, but decomp. by much H_2O. (Johnson, Chem. Soc. **33.** 397.)

Ammonium antimony iodide, NH_4I, SbI_3+2H_2O.

Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)
$3NH_4I, 4SbI_3+9H_2O$. Decomp. by H_2O, with separation of SbOI. Sol. in $HC_2H_3O_2$, HCl, and $H_2C_4H_4O_6$+Aq. Decomp. by CS_2. (Schäffer, Pogg. **109.** 611.)
$3NH_4I, SbI_3+3H_2O$. As above.
$4NH_4I, SbI_3+3H_2O$. As above.

Ammonium bismuth iodide, NH_4I, BiI_3+H_2O.

Deliquescent; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)
$4NH_4I, BiI_3+3H_2O$. As above. (Linau, Pogg. **111.** 240.)
$2NH_4I, BiI_3+2\frac{1}{2}H_2O$. Decomp. by H_2O, or MCl, MBr, or MI+Aq. (Nicklès, J. pr. (2) **39.** 116.)

Ammonium cadmium iodide, $2NH_4I, CdI_2+2H_2O$.

Deliquescent. (Croft.)
Sol. at 15° in 0.58 pt. H_2O, 0.70 pt. abs. alcohol., 8.9 pts. ether (sp. gr. 0.729), and 1.8 pts. alcohol-ether (1 : 1). (Eder, Dingl. **221.** 89.)

100 pts. of the solution in H_2O contain 85.97 pts. of the salt at 14.5°. (Rimbach, B. 1905, **38.** 1563.)
$NH_4I, CdI_2+\frac{1}{2}H_2O$. Sol. at 15° in 0.90 pt. H_2O, 0.88 pt. abs. alcohol, and 2.4 pts. ether (sp. gr. 0.729). (Eder, *l.c.*)
$+H_2O$. (Grossmann, Z. anorg. 1902, **33.** 154.)

Ammonium chloromolybdenum iodide, $2NH_4I, Cl_4Mo_3I_2+2H_2O$.

Decomp. by H_2O. Cryst. from HI+Aq. (Blomstrand.)

Ammonium cuprous iodide, $2NH_4I, Cu_2I_2+H_2O$.

Decomp. on the air, or by H_2O, or alcohol. (Saglier, C. R. **104.** 1440.)
$+\frac{1}{2}H_2O$. Decomp. by H_2O with separation of Cu_2I_2. (Gossner, Zeit. Kryst. 1903, **38.** 501.)

Ammonium cupric iodide ammonia, $2NH_4I, CuI_2, 2NH_3+2H_2O$.

Insol. in H_2O or alcohol; sl. sol. in NH_4OH+Aq.
$+6H_2O$. Unstable. (Saglier, C. R. **104.** 1440.)
$NH_4I, 2CuI_2, 3NH_3$. (Fleurent, C. R. 1891, **113.** 1047.)

Ammonium iridium *di*iodide, $2NH_4I, IrI_2$.

Insol. in cold or hot H_2O, and in alcohol. Sol. in warm dil. acids. (Oppler.)

Ammonium iridium *sesqui*iodide.

See **Iodiridite, ammonium.**

Ammonium iridium *tetra*iodide.

See **Iodiridate, ammonium.**

Ammonium lead iodide, NH_4I, PbI_2+2H_2O.

Decomp. by much H_2O. (Wells, Sill. Am. J. **146.** 25.)
$4NH_4I, 3PbI_2+6H_2O$. Sl. sol. in H_2O. (Mosnier, C. R. 1895, **120.** 444.)
Sol. in H_2O with decomp. Sol. in strong KOH+Aq and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) **17.** 347.)

Ammonium magnesium iodide, NH_4I, MgI_2+6H_2O.

Very deliquescent. (Lerch, J. pr. (2) **28.** 338.)

Ammonium mercuric iodide, NH_4I, HgI_2+H_2O.

Decomp. into its constituents by H_2O. (Boullay, A. ch. (2) **34.** 345.)
Sol. without decomp. in alcohol and ether.
$NH_4I, 2HgI_2$. Decomp. by H_2O. Sol. in KI+Aq. Very sol. in alcohol, ether and nitrobenzol. (Löw, Zeit. Kryst, **51.** 138.)

Ammonium silver iodide, $2NH_4I, AgI$.

Deliquescent. Decomp. by H_2O. (Poggiale.)

Ammonium thallic iodide, NH_4I, TlI_3.

Sol. in H_2O. (Nicklès, J. Pharm. (4) **1.** 32.)

Ammonium tin (stannous) iodide, NH_4I, SnI_2.

Decomp. by small amt. H_2O but completely sol. in a large amt. (Boullay, A. ch. (2) **34.** 376.)
$+1\frac{1}{2}H_2O$. (Personne.)

Ammonium zinc iodide, $2NH_4I, ZnI_2$.

Extremely deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. **43.** 665.)

$NH_4I, ZnI_2+4\frac{1}{2}H_2O$. Hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 384.)

Ammonium iodide arsenic *tri*oxide.

See **Arsenite iodide, ammonium.**

Ammonium cobalt nitride.

See **Ammonium cobalt azoimide.**

Ammonium ruthenium *di*hydronitrosobromide, $NO.Ru_2H_2(NH_3)_6Br_3.2HBr$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 363.)

Ammonium ruthenium nitrosochloride, $3NH_4Cl.2HCl.NORu_2H_2Cl_3$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 354.)

Ammonium ruthenium *di*hydronitrosochloride, $NO.Ru_2H_2(NH_3)_6Cl_3.2HCl$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 358.)

Ammonium peroxide, $(NH_4)_2O_2$.

M.-pt. —2°. Sl. sol. in ether without decomp. (D'Ans, B. 1913, **46.** 3076.)

Sol. in alcohol; insol. in ether; decomp. slowly in aq. solution. (Melikoff, B. 1897, **30.** 3145.)

Ammonium hydrogen peroxide, $(NH_4)_2O_2$, H_2O_2.

Decomp. at ordinary temp. (Melikoff, B. 1898, **31.** 447.)

$+H_2O$. Unstable; deliquesces at ordinary temp.; sol. in alcohol; insol. in light petroleum. (Melikoff, B. 1898, **31.** 152.)

Ammonium selenide, $(NH_4)_2Se$.

Sol. in H_2O with decomp. (Bineau, A. ch. (2) **67.** 229.)

Stable in the air. Sol. in H_2O; aq. solution decomp. slowly. (Lenher and Smith, J. Am. Chem. Soc. 1898, **20.** 277.)

Ammonium hydrogen selenide, NH_4HSe.

Sol. in H_2O. (Fabre, C. R. **103.** 269.)

Ammonium *mono*sulphide, $(NH_4)_2S$.

Decomp. on air. Sol. in H_2O, but solution decomposes rapidly.

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Ammonium *di*sulphide, $(NH_4)_2S_2$.

Sol. in H_2O with decomp.

Does not exist. (Bloxam, Chem. Soc. 1895, **67.** 293.)

Ammonium *tetra*sulphide, $(NH_4)_2S_4$.

Easily sol. in H_2O. Conc. solution is stable, dil. solution decomp. on air. Easily sol. in alcohol without decomp., but solution decomp. on the air more rapidly than the aqueous solution. (Fritzsche, J. pr. **32.** 313.)

$+\frac{1}{4}H_2O$. When dissolved in H_2O, it is at once dissociated with deposition of S. (Bloxam, Chem. Soc. 1895, **67.** 303.)

Ammonium *penta*sulphide, $(NH_4)_2S_5$.

Decomp. on air. Sol. in H_2O with separation of S. Sol. in alcohol without decomp., but solution decomposes quickly on standing. (Fritzsche, J. pr. **32.** 313.)

Rapidly decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 298.)

$+H_2O$. Decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 298.)

Ammonium *hepta*sulphide, $(NH_4)_2S_7$.

More stable on air, and less easily decomposed by H_2O than $(NH_4)_2S_5$.

$+1\frac{1}{3}H_2O$. Decomp. by H_2O with separation of S. Slowly attacked by dil. HCl+Aq. (Bloxam, Chem. Soc. 1895, **67.** 307.)

***Tetr*ammonium *hepta*sulphide,** $(NH_4)_4S_7+4H_2O$.

Sol. in H_2O. Solution can be kept for a long time without depositing S. (Bloxam, Chem. Soc. 1895, **67.** 298.)

***Di*ammonium *ennea*sulphide,** $(NH_4)_2S_9+\frac{1}{2}H_2O$.

Decomposed by H_2O with separation of S. Not attacked by boiling dil. HCl+Aq on account of formation of a hard crust of S on the crystals. (Bloxam, Chem. Soc. 1895, **67.** 306.)

***Tetr*ammonium *ennea*sulphide,** $(NH_4)_4S_9$.

Solution in H_2O deposits crystals of $(NH_4)_2S_5$ on standing. (Bloxam, Chem. Soc. 1895, **67.** 302.)

$+3\frac{1}{2}H_2O$. Decomp. by H_2O with separation of S. (Bloxam, Chem. Soc. 1895, **67.** 299.)

Ammonium *poly*sulphides.

Conc. NH_3+Aq dissolves H_2S to form $(NH_4)_2S,2NH_4SH$. On dilution more H_2S is absorbed to form $(NH_4)_2S,4NH_4SH$, then $(NH_4)_2S,8NH_4SH$, then $(NH_4)_2S,18NH_4SH$ and finally NH_4SH. (Bloxam, Chem. Soc. 1895, **67.** 284.)

Ammonium copper sulphide, $(NH_4)_2S$, $2CuS_3$ (?).

Sol. in warm H_2O, but decomp. on standing. Warm KOH+Aq acts similarly; sl. sol. in NH_4OH+Aq, Na_2CO_3+Aq, or absolute alcohol. Insol. in ether. Decomp. by dil. acids. (Priwoznik, B. **6.** 1291.)

Correct formula is NH_4CuS_4. Sl. sol. in H_2O. Decomp. by conc. and dil. acids. Easily sol. in NaOH. Sl. sol. in alcohol. (Biltz, B. 1907, **40.** 976.)

Ammonium gold *poly*sulphide, AuS_3NH_4.

Ppt. (Hofmann, B. 1903, **36.** 3092; B. 1904, **37.** 245.)

Ammonium iridium *pentadeca*sulphide, $IrS_{15}(NH_4)_3$.

Ppt. (Hofmann, B. 1904, **37.** 247.)

Ammonium palladium *undeca***sulphide,** $PdS_{11}(NH_4)_2+\frac{1}{2}H_2O$.

Ppt. (Hofmann, B. 1904, **37.** 248.)

Ammonium platinum *pentadeca***sulphide,** $PtS_{15}(NH_4)_2+2H_2O$.

Can be washed with CS_2 without decomp. Sol. in alcohol. Insol. in ether. (Hofmann, B. 1903, **36.** 3091.)

Ammonium stannic sulphide.

See **Sulphostannate, ammonium.**

Ammonium telluride, NH_4HTe.

Easily sol. in H_2O. (Bineau, A. ch. (2) **67.** 229.)

Ammonium sulphide ammonia, $(NH_4)_2S$, $2NH_3$.

Very unstable. (Bloxam, Chem. Soc. 1895, **67.** 294.)

Ammonium *aci***sulphomelid,** $(NSO.ONH_4)_3$ (?).

(Hantzsch and Stuer, B. 1905, **38.** 1039.)

Ammonplatin*di*amine comps.

See **Platin*tri*amine comps.**

Ammon*di*sulphonic acid, $NH_3(SO_3H)_2$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is identical with imidosulphonic acid $NH(SO_3H)_2$, which see. (Raschig, A. **241.** 161.)

Ammon*tri*sulphonic acid, $NH_2(SO_3H)_3$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Contains 2 at. H less, and is nitrilosulphonic acid $N(SO_3H)_3$, which see. (Raschig, A. **241.** 161.)

Ammon*tetra*sulphonic acid, $NH(SO_3H)_4$.

Known only in its salts. (Claus, A. **158.** 52 and 194.)

Does not exist, but was impure nitrilosulphonic acid, which see. (Raschig, A. **241.** 161.)

Anhydroarseniotungstic acid, $H_3AsW_8O_{28}$.

See under **Arseniotungstic acid.**

Anhydrooxycobaltamine chloride,

$$Co_2(NH_3)_{10}\begin{bmatrix}Cl\\O(OH)\end{bmatrix}Cl_4+H_2O.$$

Easily sol. in H_2O, but decomposes after a few minutes; can be recrystallized from dil. HCl+Aq. Precipitated from sat. H_2O solution by conc. HCl+Aq, or alcohol. (Vortmann, M. Ch. **6.** 404.)

$Co_2(NH_3)_{10}\left(\begin{matrix}Cl\\OH\end{matrix}\right)Cl_4$. Sol. in H_2O. (Vortmann.)

Anhydrooxycobaltamine chloride mercuric chloride, $Co_2(NH_3)_{10}(ClO_2H)Cl_4$, $3HgCl_2$.

Can be recryst. from very dil. hot HCl+Aq.

—— **chloroplatinate,** $Co_2(NH_3)_{10}(ClO_2H)Cl_4$, $2PtCl_4$.

Can be recrystallized from H_2O containing HCl.

—— **chloronitrate,** $Co_2(NH_3)_{10}Cl(O.OH)(NO_3)_4+H_2O$.

Can be recrystallized from dil. HCl+Aq.

$Co_2(NH_3)_{10}Cl(O.OH)Cl_2(NO_3)_2+H_2O$. More easily sol. in H_2O than the preceding comp.

—— **chlorosulphate,** $Co_2(NH_3)_{10}Cl(O.OH)(SO_4)_2$.

—— *di***chromate,** $[Co_2(NH_3)_{10}O.OH]_2(Cr_2O_7)_5+8H_2O$.

Sl. sol. in H_2O.

—— **nitrate,** $Co_2(NH_3)_{10}(NO_3)(O.OH)(NO_3)_4+H_2O$.

Sl. sol. in pure H_2O with immediate decomp. Can be recrystallized from H_2O containing HNO_3.

—— **sulphate,** $[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5$, $2H_2SO_4+2H_2O$.

Sl. sol. in cold H_2O. When crystallized from dil. H_2SO_4+Aq, is converted into—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5,H_2SO_4+3H_2O$, which by further recrystallization from very dil. H_2SO_4+Aq becomes—

$[Co_2(NH_3)_{10}O.OH]_2(SO_4)_5+8H_2O$. Sl. sol. in cold H_2O. (Vortmann.)

Anhydrophospholuteotungstic acid, $H_3PW_9O_{28}$.

See under **Phosphotungstic acid.**

Antimonic Acid.

*Meta***antimonic acid,** $HSbO_3$.

Very sl. sol. in H_2O; sol. in conc. HCl+Aq; sl. sol. in dil. HNO_3+Aq; easily sol. in tartaric acid+Aq; easily sol. in hot KOH, or NaOH+Aq; completely insol. in NH_4OH+Aq. (Fremy, A. ch. (3) **23.** 407.)

Sl. sol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Insol. in NH_4OH+Aq. Insol. in $HNO_3+H_2SO_4$. Slowly sol. in cold, quickly in hot HCl+Aq. Sl. sol. in tartaric and oxalic acid and in KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 48.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

*Pyro***antimonic acid,** $H_4Sb_2O_7$.

More sol. in H_2O and acids than H_3SbO_4. Sol. in cold NH_4OH, or KOH+Aq. (Fremy.)

Slowly sol. in cold H_2O.

5.88 g. Sb_2O_5 in 1 l. H_2O at 15°
8.55 " " " 1 l. " " 25°
21.30 " " " 1 l. " " 60°

(Delacroix, J. Pharm. 1897, **6.** 337–41.)

Sl. sol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Insol. in NH_4OH+Aq, and in $HNO_3+H_2SO_4$. Slowly sol. in cold, quickly in hot HCl+Aq. Sl. sol. in tartaric acid, oxalic acid and KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 48.)

*Ortho***antimonic acid,** H_3SbO_4.

Sl. sol. in H_2O. Insol. in NH_4OH+Aq. Easily sol. in KOH+Aq. (Fremy.)

Does not exist. (Raschig, B. **18.** 2745.)

Has, however, been prepared by Daubrawa (A. **186.** 110), Conrad (C. N. **40.** 198), and Beilstein and Blaese (Bull. Ac. St. Petersb. **33.** 97).

Very sol. in H_2O. (Delacroix, Bull Soc. 1899 (3) **21.** 1049.)

Very sl. sol. in H_2O, in KOH and K_2CO_3+ Aq. Slowly sol. in cold, quickly in hot HCl + Aq. Insol. in NH_4OH+Aq, and in $HNO_3+H_2SO_4$. Sl. sol. in tartaric acid, oxalic acid and KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 52.)

+½H_2O. (Beilstein and Blaese.)

According to Beilstein and Blaese only one antimonic acid, H_3SbO_4, exists.

*Tetr***antimonic acid,** $Sb_2O_5+4H_2O=H_8Sb_2O_9$.

Slowly sol. in cold H_2O.

Solution sat. at t° contains g. Sb_2O_5 per litre—

t°	15°	25°	60°	70°
g. Sb_2O_5	5.88	8.3–8.75	21.30	53.89

Decomp. in solution by heating to 100° or long standing in the cold to Sb_2O_5, $3H_2O$. (Delacroix, Bull. Soc. 1899, (3) **21.** 1049.)

Insol. in H_2O. Very sl. sol. in KOH and K_2CO_3+Aq. Slowly sol. in cold, quickly in hot HCl+Aq. Insol. in NH_4OH+Aq. Insol. in $HNO_3+H_2SO_4$. Sl. sol. in tartaric acid, oxalic acid and in KHC_2O_4+Aq. (Senderens, Bull. Soc. 1899, (3) **21.** 51.)

*Hex***antimonic acid,** $Sb_2O_5+6H_2O=H_{12}Sb_2O_{11}$.

Sol. in H_2O to the extent of 22 g. Sb_2O_5 per l. but on standing becomes turbid and a white powder is pptd. until finally only 3 g. Sb_2O_5 are dissolved per l. (Senderens, Bull. Soc. 1899, (3) **21.** 48–49.)

Antimonates.

α. Antimonates. From $HSbO_3$. Some of the K and NH_4 salts are sol. in H_2O, the others are slightly sol. or insol.

β. Pyroantimonates. From $H_4Sb_2O_7$. As a class, insol. in H_2O, but decomp. thereby except in presence of large excess of alkali. (Fremy, A. ch. (3) **12.** 499.)

Probably do not exist. (Beilstein and Blaese.)

Aluminum antimonate, Al_2O_3, $3Sb_2O_5$ (?).

Ppt. Somewhat sol. in excess of Al salts +Aq. Insol. in $K_4Sb_2O_7$+Aq.

$Al(SbO_3)_3+15H_2O=AlH_6(SbO_4)_3+12H_2O$. Ppt. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 101.)

$Al(SbO_3)_3+7H_2O=AlH_6(SbO_4)_3+4H_2O$. Ppt. (B. and B.)

Al_2O_3, $Sb_2O_5+9H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Ammonium antimonate, $NH_4SbO_3+2H_2O$, Insol. in H_2O.

+2½H_2O. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

+$6H_2O$. *See* $(NH_4)_2H_2Sb_2O_7+5H_2O$.

Ammonium *pyro***antimonate,** $(NH_4)_4Sb_2O_7$.

Known only in solution.

$(NH_4)_2H_2Sb_2O_7+5H_2O$.

Sol. in H_2O, but decomp. by standing or boiling into insol. salt. Insol. in alcohol. (Fremy, J. pr. **45.** 215). Composition is $NH_4SbO_3+6H_2O$, according to Raschig (B. **18.** 2743).

Barium antimonate, $Ba(SbO_3)_2$.

Ppt. Scarcely sol. in H_2O. Slowly sol. in $BaCl_2$+Aq.

+$2H_2O$. Somewhat sol. in H_2O. Easily sol. in HCl+Aq. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

+5, or $6H_2O$. Ppt.

$BaSb_4O_7+5H_2O$. Sol. in conc. HCl. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

BaO, $3Sb_2O_5+5H_2O$. Insol. in H_2O. Incompletely sol. in HCl. (Delacroix, *l.c.*)

BaO, $4Sb_2O_5+15H_2O$. (Delacroix, *l.c.*)

9BaO, $10Sb_2O_5+18H_2O$. Insol. in HCl+Aq. (Delacroix, *l.c.*)

Bismuth antimonate, $BiSbO_4+H_2O$.

Ppt. Insol. in H_2O; sol. in HCl+Aq. (Cavazzi, Gazz. ch. it. **15.** 37.)

$3Bi_2O_3$, $Sb_2O_5+H_2O$. Insol. in H_2O; sol. in HCl+Aq. (Cavazzi.)

$2Bi_2O_3$, Sb_2O_5. As above. (Cavazzi.)

Cadmium antimonate, $Cd(SbO_3)_2+2H_2O$.

Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

+3½H_2O. Very sol. in H_2O. Sol. in HCl +Aq. (Ebel, Dissert. **1890.**)

+$5H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

+$6H_2O$. Ppt. Insol. in H_2O. (Ebel, B. **22.** 3043.)

Calcium antimonate, $Ca(SbO_3)_2$.

Ppt.

+$5H_2O$. Ppt. (Heffter, Pogg. **86.** 418.)

+$6H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)

3CaO, $2Sb_2O_5+6H_2O$. Min. *Ullmanite.*

Chromic antimonate, $Cr(SbO_3)_3+14H_2O$.

Ppt. (Beilstein and Blaese.)

Cobaltous antimonate, $Co(SbO_3)_2+5H_2O$.

Insol. in H_2O. Loses $3H_2O$ in the presence of H_2SO_4 and passes into $Co(SbO_3)_2+2H_2O$,

also insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+6H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+7H_2O$. Sl. sol. in H_2O. Sl. sol. in boiling solutions of cobalt salts.
$+12H_2O$. Ppt. (Heffter, Pogg. **86.** 448.)

Cobaltous hydrogen antimonate, $CoH_4(SbO_4)_2+H_2O$.
(Gorgeul, Ann. Phys. Beibl. 1897, **21.** 198.)

Cupric antimonate, $3CuO, 2Sb_2O_5$.
Ppt. (Beilstein and Blaese.)
$Cu(SbO_3)_2$. Insol. in H_2O, acids, or alkalies. (Berzelius.)
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
Insol. in H_2O. (Senderens, *l.c.*)
$CuO, 2Sb_2O_5+9H_2O$. Insol. in H_2O. Sol in Sb_2O_5, $4H_2O$+Aq. (Delacroix, Bull. Soc 1899, (3) **21.** 1054.)
$2CuO, 3Sb_2O_5+10H_2O$. Insol. in H_2O. Sol. in NH_4OH and in *tri*antimonic acid+Aq. (Delacroix, *l. c.*
$CuO, 6Sb_2O_5+16H_2O$. (Delacroix, *l.c.*)

Cupric antimonate ammonia, $Cu(SbO_3)_2$, $4NH_3+4H_2O$.
Insol. in H_2O and NH_4OH+Aq. (Schiff, A. **123.** 39.)
$CuSb_2N_3H_{21}O_{12}=Cu(ONH_4)OH$, $2(NH_4SbO_3+2H_2O)$. (Raschig, B. **18.** 2743.)
$Cu(SbO_3)_2,3NH_3+9H_2O$. (Delacroix, Bull. Soc. 1901, (3) **25.** 289.)

Glucinum antimonate, $Gl(SbO_3)_2+6H_2O$.
Somewhat sol. in hot H_2O. Easily sol. in warm HCl. (Ebel, Dissert. **1890.**)

Iron (ferrous) antimonate.
Sl. sol. in H_2O. (Berzelius.)

Iron (ferric) antimonate.
Insol. in H_2O. (B.)
Fe_2O_3, $Sb_2O_5+7H_2O$. Ppt. (Ebel, B. **22.** 3043.)
Fe_2O_3, $2Sb_2O_5+11H_2O$. Ppt. (Beilstein and Blaese.)
$Fe(SbO_3)_3+6\frac{1}{2}H_2O$. Ppt. (B. and B.)

Lead antimonate, basic, $Pb_3(SbO_3)_2(OH)_4+2H_2O=Pb_3(SbO_4)_2+4H_2O$.
Min. *Bleinerite, Bindheimite.*
$2Pb(SbO_3)_2$, $PbO+11H_2O$. Ppt. (B. and B.)

Lead antimonate, $Pb(SbO_3)_2$.
Insol. in H_2O. Incompletely decomp. by acids. (Berzelius.)
Naples Yellow. Insol. in H_2O.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. **1899**, (3) **21.** 57.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+6H_2O$. Ppt. (Beilstein and Blaese.)
$+9H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

Lead antimonate chloride, $Pb(SbO_3)_2$, $PbCl_2$.
Min. *Nadorite.* Sol. in HCl, HNO_3, and tartaric acid+Aq.

Lithium antimonate, $LiSbO_3$.
Sl sol. in cold, sol. in hot H_2O, and crystallizes on cooling. Much more sol. than $NaSbO_3$
$+3H_2O$. Ppt. Sl. sol. in H_2O. (Beilstein and Blaese.)

Magnesium antimonate, $Mg(SbO_3)_2+12H_2O$.
Sol. in hot, less sol in cold H_2O. (Heffter.)
Sol. in $MgSO_4$+Aq; insol. in $KSbO_3$+Aq. (Berzelius.)

Manganous antimonate, $Mn(SbO_3)_2$.
Difficultly sol. in H_2O.
When heated, is sol. only in strong acids.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 56.)
$+5H_2O$. Ppt. (Ebel, B. **22.** 3043.)
$+6H_2O$. Insol. in H_2O. (Senderens, *l.c.*)
$+7H_2O$. Ppt. (Beilstein and Blaese.)

Mercurous antimonate.
Insol. in H_2O. (Berzelius.)

Mercuric antimonate, $Hg(SbO_3)_2$.
Insol. in H_2O, alkalies, and most acids.
Sl. attacked by boiling H_2SO_4, and HCl+Aq.
$+2H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 55.)
$+5H_2O$. Insol. in H_2O. (Senderens.)
$+6H_2O$. Ppt. (Beilstein and Blaese.)

Nickel antimonate, $Ni(SbO_3)_2+2H_2O$.
Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 54.)
$+5H_2O$. Insol. in H_2O. (Senderens.)
$+6H_2O$. Ppt. Insol. in H_2O. (Heffter, Pogg. **86.** 446.)
$+12H_2O$. Sl. sol. in H_2O. (Heffter.)

Potassium antimonate, $KSbO_3$.
Insol. in H_2O. Sol. in warm KOH+Aq, but separates nearly completely on cooling. By boiling with H_2O, or by standing for a long time with cold H_2O, it gradually dissolves as $2KSbO_3+5H_2O$, or $K_2H_2Sb_2O_7+4H_2O$, or $2KH_2SbO_4+3H_2O$.
Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)
$+H_2O$. Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)
$+1\frac{1}{2}H_2O$ ($=2KSbO_3+5H_2O$ of Fremy). Easily sol. in H_2O, especially if warm. Solution is pptd. by NH_4Cl+Aq. (Fremy, A. ch. (3) **12.** 499.)
$+2\frac{1}{2}H_2O$. 100 pts. H_2O at 20° dissolve 2.81 pts. anhydrous salt; sp. gr. of solution sat. at 18°=1.0263. Composition is given as $K_2H_2Sb_2O_7+4H_2O$. (Knorre and Olschewsky, B. **20.** 3043.)
$+3\frac{1}{2}H_2O$. Insol. in H_2O. (Senderens, *l.c.*)

$+4\frac{1}{2}H_2O$. Sol. in H_2O. (Delacroix, J. Pharm. 1897, (6) **6.** 533.)

$2K_2O, 3Sb_2O_5+10H_2O$. Sl. sol. in H_2O. (Delacroix, J. Pharm. 1897, **6.** 337.)

$+10H_2O$. (Delacroix, *l.c.*)

Potassium *pyro*antimonate, $K_4Sb_2O_7$.

Deliquescent; decomp. by boiling with H_2O into $KSbO_3+5H_2O$, by cold H_2O into $K_2H_2Sb_2O_7+6H_2O$. (Fremy.)

Does not exist. (Knorre and Olschewsky.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Potassium hydrogen *pyro*antimonate, $K_2H_2Sb_2O_7$.

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+2\frac{1}{2}H_2O$. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)

$+3\frac{1}{2}H_2O$. Very difficultly sol. in hot or cold H_2O. (Knorre and Olschewsky, B. **18.** 2358.)

$+6H_2O$. Quite difficultly sol. in cold H_2O. Not precipitated by NH_4Cl+Aq. Aqueous solution gradually decomposes. (Fremy.)

$+4H_2O$. *See* $2KSbO_3+5H_2O$.

Potassium antimonate sulphantimonate, $KSbO_3, K_3SbS_4+5H_2O$.

Decomp. on air, and with cold H_2O. Sol. in hot H_2O. (Rammelsberg.)

Silver antimonate.

Insol. in H_2O. (Berzelius.)

$AgSbO_3+3H_2O=AgH_2SbO_4+2H_2O$. Easily sol. in NH_4OH+Aq, when freshly pptd. (Beilstein and Blaese.)

$+1\frac{1}{2}H_2O$. Ppt. (Ebel, B. **22.** 3043.)

Silver antimonate ammonia, $AgH_2SbO_4, 2NH_3+H_2O$.

(Beilstein and Blaese.)

Sodium antimonate, $NaSbO_3$.

Sol. in much H_2O, but soon becomes decomposed into $Na_2H_2Sb_2O_7$.

$+3\frac{1}{2}H_2O$, composition of $Na_2H_2Sb_2O_7+6H_2O$, according to Beilstein and Blaese.

1000 pts. H_2O dissolve 0.31 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

1000 pts. alcohol of 15.8% dissolve 0.13 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

1000 pts. alcohol of 25.6% dissolve 0.07 pt. $NaSbO_3+3\frac{1}{2}H_2O$ at 12.3°.

Somewhat more sol. when freshly precipitated.

Absolutely insol. in glacial $HC_2H_3O_2$.

Presence of NaOH or Na salts diminish solubility, while NH_4OH or K salts increase it slightly. (Beilstein and Blaese, Bull. Ac. St. Petersb. **33.** 201.)

$+4\frac{1}{2}H_2O$. Sol. in H_2O. (Delacroix, Bull. Soc. 1899, (3) **21.** 1051.)

$2Na_2O, 3Sb_2O_5+10H_2O$. (Delacroix, *l. c.*)

$Na_2O, 3Sb_2O_5+11H_2O$. (Delacroix, *l. c.*)

Sodium *pyro*antimonate, $Na_2H_2Sb_2O_7+6H_2O$.

Boiling H_2O dissolves $\frac{1}{350}$ pt. of this salt. (Fremy.) 1000 pts. H_2O dissolve 2.5 pts. salt. (Ebel, B. **22.** 3044.) *See also* $NaSbO_3+3\frac{1}{2}H_2O$.

$+5H_2O$. (Knorre and Olschewsky.)

Strontium antimonate, $Sr(SbO_3)_2+6H_2O$.

Ppt. Less sol. in H_2O than $SrSO_4$. (Heffter, Pogg. **86.** 418.)

Thallous antimonate, $TlSbO_3+2H_2O=TlH_2SbO_4+H_2O$.

Somewhat sol. in H_2O, when freshly precipitated; insol. when dried. (Beilstein and Blaese.)

Tin (stannous) antimonate, $2SnO, Sb_2O_5$.

Ppt. (Lenssen, A. **114.** 113.)

$Sn(SbO_3)_2+2H_2O$. Attacked with difficulty by acids or alkalies, most easily by hot conc. H_2SO_4. (Schiff, A. **120.** 55.)

$2SnO, 3Sb_2O_5+4H_2O$.

$SnO, 2Sb_2O_5$.

Tin (stannic) antimonate.

Insol. in H_2O. (Levol, A. ch. (3) **1.** 504.)

Uranium antimonate, $5UO_2, 3Sb_2O_5+15H_2O$.

Ppt. Sol. in hot conc. $HCl+Aq$, and in UCl_3+Aq. (Rammelsberg.)

Zinc antimonate, $Zn(SbO_3)_2$.

Very slightly sol. in H_2O (Berzelius); sol. in solutions of Zn salts.

$+2H_2O$. (Ebel, Dissert. **1890.**)

Insol. in H_2O. (Senderens, Bull. Soc. 1899, (3) **21.** 57.)

$+5H_2O$. Not wholly insol. in cold, moderately sol. in hot H_2O. (Ebel, Dissert. **1890.**)

$+6H_2O$. Insol. in H_2O. (Senderens.)

Antimoniomolybdic acid.

Ammonium antimoniomolybdate, $5(NH_4)_2O, 4Sb_2O_5, 7MoO_3+12H_2O$.

Readily sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniotungstic acid, $3Sb_2O_5, 4WO_3+11H_2O$.

Sol. in H_2O. (Hallopeau, C. R. 1896, **123.** 1068.)

Potassium antimoniotungstate, $3K_2O, 3Sb_2O_5, 4WO_3+4H_2O$.

Much more sol. in hot than in cold H_2O. Decomp. by HCl, H_2SO_4 and HNO_3. (Hallopeau, C. R. 1896, **123.** 1066.)

$+16H_2O$. Much more easily sol. in hot than cold H_2O. Decomp. by HCl, H_2SO_4, and HNO_3. (Hallopeau, *l.c.*)

$6K_2O, 4Sb_2O_5, 12WO_3+25H_2O$

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimoniuretted hydrogen.

See **Antimony hydride.**

Antimonosomolybdic acid.

Ammonium antimonosomolybdate, $6(NH_4)_2O, 3Sb_2O_3, 17MoO_3+21H_2O$.

Insol. in cold H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonosophosphotungstic acid.

Potassium antimonosophosphotungstate, $12K_2O, 5Sb_2O_3, 6P_2O_5, 22WO_3+48H_2O$.,

Nearly insol. in cold or warm H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Antimonosotungstic acid.

Ammonium antimonosotungstate.

Sol. in H_2O.

Barium antimonosotungstate, $4BaO, 6Sb_2O_3, 22WO_3+36H_2O$.

Precipitate; very sl. sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Antimonous acid, $HSbO_2$.

(Long, J. Am. Chem. Soc. 1895, **17.** 87.)

$+1\frac{1}{2}H_2O$. Ppt. (Schaffner, A. **51.** 182.)

H_3SbO_3. Ppt. (Clarke and Stallo, B. **13.** 1793.)

Does not exist. (Guntz, C. R. **102.** 1472.)

$H_4Sb_2O_5$. When freshly pptd., is sol. in dil. KOH, and NaOH+Aq. Scarcely sol. in NH_4OH+Aq, or in $(NH_4)_2CO_3$, or $KHCO_3$+Aq.

Completely sol. in K_2CO_3, and Na_2CO_3+Aq, especially if warm. When recently pptd. is sl. sol. in succinic acid+Aq.

Calcium antimonite, $CaSb_2O_4$ (?).

Min. ***Romeite.*** Insol. in acids.

Cobaltous antimonite (?).

Sl. sol. in H_2O. (Berzelius.)

Cuprous antimonite, $Cu_6(SbO_3)_2$.

Insol. in H_2O. Sol. in acids; most easily in conc. HCl+Aq. (Hausmann and Stromeyer, Schw. J. **19.** 241.)

Cupric antimonite (?).

Insol. in H_2O. (Berzelius.)

$CuSb_2O_6$. Min. *Ammiolite.*

$CuSb_2O_4$. Sol. in HCl+Aq, tartaric and citric acids. (Harding, Z. anorg. 1899, **20.** 238.)

Iron (ferrous) antimonite (?).

More sol. in H_2O than the antimonate. (Dumas.)

Potassium antimonite, $K_2O, 3Sb_2O_3$.

Easily decomp. by cold H_2O. Not decomp. by KOH+Aq containing over 20.9% K_2O. (Cormimbœuf, C. R. **115.** 1305.)

$+3H_2O$. As above. (C.)

Potassium antimonite iodide, $K_2O, 8Sb_2O_3, 2KI$.

Insol. and not decomp. by cold or hot H_2O. Not decomp. by acids or alkalies. Aqua regia decomp. slowly. Tartaric acid dissolves gradually. (Grühl, Dissert. **1897.**)

Sodium antimonite, $NaSbO_2+3H_2O$.

Difficultly sol. in H_2O. (Terreil, A. ch. (4) **7.** 380.)

$2Na_2O, 3Sb_2O_3+H_2O$. Decomp. by H_2O, but not by NaOH+Aq containing 94.3 g. NaOH per l. (Cormimbœuf.)

$Na_2O, 2Sb_2O_3$. Decomp. by H_2O but not by NaOH+Aq containing 188.6 g. NaOH per l. (C.)

$Na_2O, 3Sb_2O_3$. Decomp. by H_2O, but not by NaOH+Aq containing 113.2 g. NaOH per l. (C.)

$+2H_2O = NaH_2(SbO_2)_3$. (Terreil.)

Antimony, Sb.

Does not decomp. H_2O. Not attacked by HCl+Aq (Berzelius); slowly sol. in conc. HCl+Aq (Debray); slowly sol. in conc. warm HCl+Aq (Troost). Attacked by very conc. HCl+Aq only when finely divided (Schützenberger, Willm); very sl. attacked by dil. or conc. acid (Guntz). Not attacked by boiling HCl+Aq (Gmelin). By careful experiments, pure Sb is absolutely insol. in dil. or conc., hot or cold HCl+Aq, except when in contact with oxygen. (Ditte and Metzner, A. ch. (6) **29.** 389.)

Insol. in dil. or cold conc., but sol. in hot conc. H_2SO_4. Oxidized but not dissolved by HNO_3+Aq. Easily and completely sol. in aqua regia.

Very slowly attacked by pure HNO_3+Aq of 1.51–1.42 sp. gr.: weaker acid has no marked action whether it contains NO_2 or not. HCl+HNO_3 has no action if dil. or at low temp., but when even very dil. and KNO_2 is added, the action will begin. (Millon, A. ch. (3) **6.** 101.)

Not attacked in 10 months by 2% HNO_3+Aq. Sb is not dissolved by HNO_3+Aq of any concentration, a white powder being always left, which is insol. in HNO_3+Aq or H_2O. (Montemartini, Gazz. ch. it. **22.** 384.)

Insol. in alkalies+Aq.

Somewhat sol. in distilled H_2O. More or less sol. in solutions of acids, alkalies and salts and in alcohol and ether. Only sl. sol. in a mixture of alcohol and ether. (Ruff and Albert, B. 1905, **38.** 54.)

Alkaline H_2O_2 converts Sb into antimonic acid, but neutral H_2O_2 is without action. (Clark, Chem. Soc. 1893, **63.** 886.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Easily attacked by pyrosulphuryl chloride. (Heumann and Köchlin, B. **16.** 479.)

Sb is sol. in a mixture of HNO_3 and tartaric acid or other polybasic acids. (Czerwek, Z. anal. 1906, **45.** 507.)

Not attacked by a mixture of alcohol and ether. (Cohen, Z. phys. Ch. 1904, **47.** 12.)

½ cc. oleic acid dissolves 0.0007 g. Sb in 6 days. (Gates, J. phys. Ch. 1911, **15.** 143.)

There are three modifications.

1. Ordinary gray metallic.
2. Black amorphous. Unstable at ord. temp. By boiling with H_2O is changed to metallic Sb.
3. Yellow. Very unstable. At —50° goes over rapidly into the ordinary black modification. Sol. in CS_2 at a little above —90°. (Stock, B. 1903, **37.** 898.)

Unstable above —90°. (Stock, B. 1905, **38.** 3837.)

Antimony arsenide, Sb_2As.

(Descamps, C. R. **86.** 1065.)

Antimony *tri*bromide, $SbBr_3$.

Deliquescent; decomp. by H_2O.

Very sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Very sol. in warm liquid $AsBr_3$, forming a solution with sp. gr. = 3.685 at 47°. (Retgers, Z. phys. Ch. 1893, **11.** 339.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in alcohol and CS_2.

Sol. in ether forming two layers. (Hayes, J. Chem. Soc. 1902, **24.** 360.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Solubility of $SbBr_3$ in organic liquids.
Data in parentheses indicate labile equilibrium.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzene	5.6°	0	65°	17.1	91.5°	73.7
	4.5	1.9	75	24.9	90	76.7
	15	3.0	80	30.7	85	84.9
	25	4.3	85	38.4	90	91.4
	35	6.0	90	48.2	92	94.8
	45	8.6	91.5	58.1	94	100
	55	12.1	92.5	66.6		
Chlorbenzene	—45.2°	0	0°	7.2	60°	37.6
	—47	1.7	10	9.2	70	50.0
	—40	2.2	20	11.8	80	66.6
	—30	3.2	30	15.4	90	89.6
	—20	4.3	40	20.8	94	100
	—10	5.6	50	28.1		
Brombenzene	—31°	0	15°	17.4	75°	65.2
	—32	2.6	25	22.2	85	81.1
	—25	4.4	35	22.7	90	90.0
	—15	6.9	45	34.4	94	100
	— 5	9.9	55	42.6		
	5	13.4	65	52.6		

Solubility of $SbBr_3$ in organic liquids.—*Cont.*

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Iodbenzene	—28.6°	0	10°	26.3	70°	67.0
	—30.5	4.0	20	31.5	80	78.2
	—32	8.7	30	37.3	90	91.9
	—20	13.5	40	43.7	94	100
	—10	17.5	50	50.7		
	0	21.7	60	58.5		
Paradichlorbenzene	54.5°	0	65°	29.5	85°	68.9
	51.5	6.3	70	37.0	90	85.2
	48.5	12.8	75	45.6	94	100
	55	18.7	80	56.2		
Paradibrombenzene	88°	0	65°	52.0	90°	91.8
	85	6.8	70	59.1	92	95.4
	80	18.0	75	66.5	94	100
	75	29.5	80	74.4		
	70	41.5	85	83.0		
Nitrobenzene	6°	0	—5°	32.3	55°	59.1
	1	8.6	5	35.3	65	66.4
	— 4	17.0	15	38.8	75	74.9
	— 9	24.0	25	42.8	85	86.0
	—15	29.7	35	47.4	90	93.0
	(—17)	(31.9)	45	52.8	94	100
Metadinitrobenzene	90°	0	55°	49.1	70°	70.8
	85	8.1	50	53.0	75	76.0
	80	16.2	47.5	54.4	80	81.7
	75	24.2	50	56.1	85	87.8
	70	31.8	55	58.8	90	94.2
	65	38.5	60	62.2	94	100
	60	44.3	65	66.2		
Toluene	—93°	0	10°	28.8	70°	69.4
	—93.5	0.3	20	36.7	80	79.4
	—70	1.2	30	47.5	85	85.2
	—50	2.6	(34)	(54.0)	90	92.6
	—30	5.2	40	51.5	94	100
	—10	13.3	50	56.3		
	— 1	22.4	60	62.3		
Ethylbenzene	—93°	0.1	10°	9.8	60°	59.8
	—60	0.4	20	19.5	70	67.4
	—40	1.0	25	28.6	80	77.4
	—20	2.3	29	37.8	85	85.[illegible]
	—10	3.9	40	44.6	90	92.6
	0	6.4	50	51.6	94	100
Propylbenzene	—80°	0.4	(—1.5°)	(33.3)	50°	44.3
	—60	1.2	(—20)	(23.3)	60	51.5
	—40	3.4	0	25.8	70	61.5
	—30	5.5	10	27.8	80	73.5
	—20	9.5	20	30.5	90	90
	—10	17.2	30	34.1	94	100
	— 5	24.3	40	38.6		
Isoamylbenzene	—70°	1.9	(—13°)	(24.9)	50°	35.8
	—50	3.6	—10	17	60	43.3
	—40	5.1	0	18.2	70	54.0
	—30	7.1	10	19.9	80	68.5
	—20	13.4	20	22.5	90	90
	—17	16.4	30	25.9	94	100
	(—15)	(19.4)	40	30.3		

(Menschutkin, Ann. Inst. Pol. P. le Gr. **13.** 1.)

Antimony bromide with MBr.

See **Bromantimonate, M.**
Also below.

Antimony hydrogen bromide, $SbBr_5$, $HBr + 3H_2O$.

Very hygroscopic. Decomp. by H_2O. (Weinland and Feige, B. 1903, **36.** 256.)

See ***Meta*bromantimonic acid.**

Antimony caesium bromide, $2SbBr_5, 3CsBr+2H_2O$.

Loses Br_2 in the air. (Weinland, B. 1903, **36.** 257.)

Antimony calcium bromide, $SbBr_3, CaBr_2+8H_2O$.

Easily decomp. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

Antimony glucinum bromide, $3SbBr_5, 2GlBr_2+18H_2O$.

Hydroscopic. Easily decomp. (Weinland, B. 1903, **36.** 258.)

Antimony magnesium bromide, $SbBr_3, MgBr_2+8H_2O$.

As Ca salt. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

Antimony potassium bromide, $10SbBr_3, 23KBr+27H_2O$.

(Herty, Am. Ch. J. 1894, **16.** 496.)

Antimony rubidium bromide, $2SbBr_3, 3RbBr$.

Decomp. by H_2O; can be recryst. from dil. $HBr+Aq$. (Wheeler, Z. anorg. **5.** 258.)

$SbRb_2Br_6$. Slowly loses Br_2 in the air. Decomp. by H_2O. (Weinland, B. 1903, **36.** 259.)

$10SbBr_3, 23RbBr$ (?). Cryst. from conc. $HBr+Aq$. (Wheeler.)

The composition assigned to this salt by Wheeler (Z. anorg. **5.** 253) is incorrect. (Ephraim, B. 1903, **36.** 1817.)

Antimony vanadium bromide, $SbBr_3, VBr_4+7H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dil. HCl and in tartaric acid. (Weinland, B. 1903, **36.** 260.)

Antimony bromide potassium chloride, $SbBr_3, 3KCl+1\frac{1}{2}H_2O$.

Slowly deliquescent. Very sol. in H_2O.

Sat. solution contains 120.5 g. to 100 cc. H_2O, and has sp. gr. = 1.9.

Decomp. by much H_2O. (Atkinson, Chem. Soc. **43.** 290.)

Does not exist. (Herty, Am. Ch. J. 1894, **16.** 497.)

See also **Antimony chloride potassium bromide.**

Antimony bromofluoride, SbF_5Br.

Decomp. by H_2O. (Ruff, B. 1906, **39.** 4319.)

Antimony *tri*chloride, $SbCl_3$.

Deliquescent. Decomp. by H_2O with precipitation of SbOCl. This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc. solutions of chlorides of alkalies and alkaline earths.

Solubility in H_2O.
100 pts. $SbCl_3$ sol. in pts. H_2O at t°.

t°	Pts. H_2O
0°	16.6
15°	12.3
20°	10.9
25°	10.1
30°	9.4
35°	8.7
40°	7.3
50°	5.2
60°	2.2

(Meerburg, Z. anorg. 1903, **33.** 299.)

Solubility in HCl+Aq.
100 mol. H_2O dissolve mol. $SbCl_3$ in presence of mol. HCl at 20°.

Mol. HCl	Mol. $SbCl_3$
0	72.1-72.8
2.4	73.0
6.5	67.5
8.4	67.6
8.6	66.5
9.8	65.0
12.2	65.3
29.6	54.5

(Meerburg, Z. anorg. 1903, **33.** 304.)

Solubility in HCl+Aq.

Solid phase	100 mol. H_2O dissolve at 20°			
	1	2	3	4
	Mol. $SbCl_3$	Mol. HCl	Mol. SbOCl	Mol. HCl
SbOCl	8.7	7.2	9.8	6.9
	8.6	7.5	16.1	7.9
	19.6	8.0	21.7	7.4
	19.8	8.9	25.0	8.8
			28.0	8.6
$(SbOCl)_x,(SbCl_3)_y$	37.5	8.7	32.0	7.9
	44.0	6.8	35.8	7.9
	63.7	6.2	59.5	6.4
	69.1	5.6	61.0	6.5
	66.1	4.6	62.7	4.4
	69.8	5.3		
$SbCl_3$ and $(SbOCl)_x,(SbCl_3)_y$	69.3	4.3		
	68.3	3.6		

1 & 2. (Meerburg, Z. anorg. 1903, **33.** 302.)
3 & 4. (Noodt, Z. anorg. 1903, **33.** 302.)

Somewhat sol. in liquid $(CN)_2$. (Centnerszwer, Bull. Soc. 1901, (3) **28.** 405.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in alcohol without decomp. Very sol. in hot CS_2, but solubility diminishes rapidly on cooling. (Cooke, Proc. Am. Acad. **13.** 72.)

1 g. $SbCl_3$ is sol. in 0.186 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 2.216. (Naumann, B. 1904, **37.** 4332.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

1 pt. sol. in 16.97 pts. of ethyl acetate at 18°. Sp. gr. of sat. solution 18°/4° = 1.7968. (Naumann, B. 1910, **43.** 320.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Solubility of $SbCl_3$ in organic liquids.
Data in parentheses indicate labile equilibrium.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzene	5.6°	0	50°	27.2	75°	78.5
	4	2.6	60	34.7	70	83.3
	1	7.1	70	45.2	62	89.3
	10	10.1	75	53.1	67.5	94.2
	20	13.1	77.5	58.7	73	100
	30	16.8	79	66.6		
	40	21.4	77.5	73.4		
Chlorbenzene	—45.2°	0	—10°	14.4	30°	47.1
	—47	2.2	—5	19.4	40	56.2
	—40	3.6	0	28.1	50	66.6
	—30	6.0	(4)	(41.1)	60	78.7
	—20	9.0	10	32.5	70	94.3
	—15	11.6	20	38.7	73	100
Brombenzene	—31°	0	—5°	21.7	40°	59.2
	—32.5	3.4	0	26.6	50	68.8
	(—35)	(6.4)	3	31.8	60	80.6
	—30	4.8	(6)	(41.9)	65	87.2
	—25	7.6	(7)	(50.0)	70	95.0
	—20	10.7	10	36.4	73	100
	—15	14.1	20	43.2		
	—10	17.8	30	50.8		
Iodbenzene	—28.6°	0	(—5)°	(40.7)	25°	53.9
	—30	2.4	—34.5	10.7	35	60.4
	(—35)	(11.7)	—25	16.4	45	67.5
	(—40)	(20.8)	—15	24.7	55	76.2
	(—45)	(27.2)	—5	39.1	65	87.4
	(—35)	(30.9)	(—3)	(47.2)	70	95.0
	(—25)	(33.9)	5	44.5	73	100
	(—15)	(37.2)	15	48.7		
Paradichlorbenzene	54.5°	0	39.5°	29.5	60°	66.5
	50	6.3	45	37.5	65	78.1
	45	15.5	50	46.4	70	91.1
	40	28.0	55	56.0	73	100
Paradibrombenzene	88°	0	65°	45.4	65°	87.1
	85	5.9	60	53.8	70	95.2
	80	15.8	49.5	64.9	73	100
	75	25.7	55	72.5		
	70	35.7	60	79.8		
Nitrobenzene	6°	0	—13.5°	27.3	15°	59.2
	2	7.0	—10.5	29.8	25	63.0
	—2	12.1	—7.5	35.2	35	67.6
	—6	16.5	—6.5	40.7	45	72.8
	—10	20.3	—6	50.0	55	79.0
	—14	23.5	—6.5	52.8	65	87.2
	(—18)	(26.2)	—5	53.0	70	92.7
	—16.5	25.2	5	55.8	73	100

Solubility of $SbCl_3$ in organic liquids—*Cont.*

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Metadinitrobenzene	90°	0	(—10°)	(57.7)	(0°)	(78.1)
	80	14.3	(10)	(62.4)	20	65.2
	70	25.3	(27.5)	(44.5)	30	68.8
	60	33.8	(28.5)	(50.0)	40	73.2
	40	45.6	27.5	55.0	50	78.5
	(20)	(53.6)	25	60.2	60	85.8
	(1)	(59.9)	(20)	(66.2)	70	95.2
	(—11)	(62.2)	(10)	(73.5)	73	100
Toluene	—93°	0	—10°	14.4	40°	59.3
	—94	0.5	0	22.1	42.5	66.6
	—70	1.4	6	28.6	40	71.1
	—50	3.3	11	35.7	50	77.1
	—40	5.1	(—8)	(27.0)	60	83.8
	—30	7.2	20	40.5	70	94.7
	—20	10	30	47.6	73	100
Ethylbenzene	—93°	0.1	35°	36.4	(36.8)°	(68.1)
	—50	0.6	39	50	(33)	(65.7)
	—30	1.1	37	57.7	40	70.3
	—10	3.6	35	61.8	50	77.3
	0	5.6	(33)	(65.7)	60	85.5
	10	9.4	(15)	(37.8)	65	90.3
	20	16.8	(25)	(47.5)	70	95.6
	30	27.2	37	66.6	73	100
Propylbenzene	(—70°)	(0.6)	—70°	0.2	8.5°	53.2
	(—50)	(2.8)	—50	1.5	10	53.6
	(—40)	(5.2)	—40	3.0	20	56.9
	(—30)	(8.8)	—30	5.5	30	60.6
	(—20)	(14.8)	—20	9.7	40	65.5
	(—10)	(25.1)	—10	16.2	50	72
	(—5)	(32.4)	—5	20.5	60	81
	(0)	(43.3)	0	26.2	65	86.8
	(1.5)	(50)	5	35.6	70	95.1
	(1)	(51.1)	7	41.6	73	100
Isoamylbenzene	—80°	3	(—45°)	(17.1)	0°	46.3
	—70	5.4	(—35)	(22.8)	10	48.8
	—60	8.4	—25	29.3	20	52.5
	—50	12.4	—15	36.6	30	57.3
	—40	17.9	—5	45.6	40	63.4
	(—30)	(27.3)	(0)	(52.3)	50	71.4
	(—25)	(34.4)	(5)	(60.3)	60	81.7
	(—22)	(40.7)	(7.5)	(66.6)	65	88
	(—20.5)	(50)	(—21)	(44.2)	70	95.5
	(—22)	(54)	(—10)	(44.9)	73	100

(Menschutkin, Ann. Inst. Pol. P.-le Gr., **13.** 1.)

Antimony hydrogen *tri*chloride, $2SbCl_3$, HCl $+2H_2O$.

Deliquescent. Decomp. by H_2O.

Melts in crystal H_2O at 16°. (Engel, C. R. **106.** 1797.)

Antimony *penta*chloride, $SbCl_5$.

Deliquesces to $SbCl_5+4H_2O$, which can be crystallized out of a little H_2O. Decomp. by more H_2O into SbO_2Cl. Sol. in a large amt. of H_2O, if it is added all at one time. Precipitation by H_2O is also hindered by presence of tartaric, or hydrochloric acid.

$+H_2O$. Deliquescent. Sol. in chloroform. (Anschütz and Evans, A. **239.** 285.)

$+4H_2O$. Insol. in chloroform. (Anschütz and Evans.)

Antimony *penta*chloride with MCl.

See **Chlorantimonate, M.**
See also below.

Antimony hydrogen *penta***chloride,** $SbCl_5$, $HCl+4\frac{1}{2}H_2O$.

"*Meta*chlorantimonic acid" according to Weinland and Schmid, (Z. anorg. 1905, **44.** 43.)

Very easily sol in H_2O, alcohol, acetone and glacial acetic acid. Aqueous solution decomp. on standing with separation of Sb_2O_5 but remains clear in presence of 10% HCl. (Weinland and Schmid, Z. anorg. 1905, **44.** 43.)

$SbCl_5$, $5HCl+10H_2O$. Not deliquescent. Decomp. by H_2O. Melts in crystal H_2O at about 55°. (Engel, C. R. **106.** 1797.)

Antimony antimonyl chloride, $SbCl_3$, $SbOCl$.

More easily attacked by H_2O than SbOCl. (Bemmelen, Z. anorg. 1903, **33.** 293.)

Antimony antimonyl potassium chloride, $SbCl_3$, $SbOCl$, $2KCl$.

Not deliquescent. Immediately decomp. by hot or cold H_2O; sol. in hot glacial $HC_2H_3O_2$, or in HCl, or tartaric acid+Aq.

Insol. in KCl+Aq, hot or cold alcohol, CS_2, or ligroine. (Benedikt, Proc. Am. Acad. **29.** 217.)

Antimony antimonyl rubidium chloride, $SbCl_3$, $SbOCl$, $2RbCl$.

Sol. in very dil. HCl+Aq. (Wells, Am. J. Sci. 1897, (4) **3.** 463.)

Antimony barium chloride, $SbCl_3$, $BaCl_2+{}^3/_2H_2O$.

Decomp. by H_2O.

Antimony cæsium chloride, $SbCl_3$, $6CsCl$.

Decomp. by H_2O. Cryst. from dil. HCl+Aq. (Godeffroy, Arch. Pharm. (3) **12.** 47.)

$2SbCl_3$, $3CsCl$. Decomp. by H_2O; sl. sol. in cold, easily in hot dil. HCl+Aq. This is identical with the above salt. (Saunders, Am. Ch. J. **14.** 152.)

$SbCl_4$, $2CsCl$. Sol. in boiling conc. HCl+Aq without decomp. (Setterberg, Oef. Vet. Akad. 1882, **6.** 23.)

$SbCl_5$, $CsCl$. Cryst. from HCl+Aq without decomp. Decomp. by H_2O. (Setterberg, Oef. Vet. Akad. 1882, **6.** 27.)

Antimony calcium chloride, $SbCl_3$, $CaCl_2+8H_2O$.

Easily decomp. (Benedict, Proc. Am. Acad. 1895, **30.** 9.)

$SbCl_6CaSbCl_5.OH+9H_2O$. Deliquescent; sl. sol. in H_2O. (Weinland, B. 1901, **34.** 2635.)

Antimony chromium chloride,

$CrCl_3$, $3SbCl_5+13H_2O$. (Weinland.) should be

$[SbCl_6]_3[Cr(OH_2)_6]+7H_2O$;

and $CrCl_3$, $SbCl_5+10H_2O$ should be

$[SbCl_6][Cr(OH_2)_4Cl_2]+6H_2O$.

(Pfeiffer, Z. anorg. 1903, **36.** 349.)

Antimony glucinum chloride, $SbCl_3$, $GlCl_2+3H_2O$.

Very hydroscopic. Decomp. by H_2O. Very easily sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

$+4H_2O$. Ppt. Decomp. by H_2O. Sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

Antimony hydrazine chloride, $SbCl_3$, $3N_2H_5Cl$.

Sol. in conc. HCl+Aq; decomp. by H_2O. (Ferratini, C. A. **1912,** 1613.)

Antimony lithium chloride, $SbCl_3$, $2LiCl+5H_2O$.

Hydroscopic. Decomp. by H_2O. Very easily sol. in HCl. (Ephraim, B. 1903, **36.** 1821.)

$+6H_2O$. Decomp. by H_2O; easily sol. in HCl. (Ephraim, B. 1903, **36.** 1822.)

Antimony magnesium chloride, $SbCl_3$, $MgCl_2+5H_2O$.

Hydroscopic. Decomp. by H_2O. Can be cryst. from HCl without decomp. (Ephraim, B. 1903, **36.** 1823.)

$2SbCl_3$, $MgCl_2$. Hygroscopic. Decomp. by H_2O. Very sol. in HCl. (Ephraim.)

$SbCl_7MgSbCl_6MgOH+17H_2O$. Hydroscopic. Sol. in H_2O with decomp. (Weinland, B. 1901, **34.** 2635.)

Antimony nitrosyl chloride, $SbCl_5$, $NOCl$.

Very deliquescent; decomp. by pure H_2O; sol. in H_2O containing tartaric acid. (Weber, Pogg. **123.** 347.)

$2SbCl_5$, $5NOCl$. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 661.)

Antimony phosphorus chloride, $SbCl_5$, PCl_5.

Deliquescent. (Weber, Pogg. **125.** 78.)

Antimony phosphoryl chloride, $SbCl_5$, $POCl_3$.

Deliquescent. (Weber.)

Antimony platinum potassium chloride, $(Sb, Pt)Cl_6K_2$.

Ppt. (Weinland, B. 1905, **38.** 1086.)

Antimony potassium chloride, $SbCl_3$, $2KCl$.

Sol. in H_2O without decomp. (Jacquelain, A. ch. (2) **66.** 128.)

Not deliquescent. Immediately decomp. by hot or cold H_2O. Sol. in HCl, or tartaric acid+Aq. (Benedikt, Proc. Am. Acad. **29.** 219.)

$+2H_2O$. Very efflorescent.

$SbCl_3$, $3KCl$. Deliquescent. Decomp. by hot H_2O. (Poggiale.)

$+2H_2O$. (Romanis, C. N. **49.** 273.)

Not obtained by Benedikt (*l.c.*)

$10SbCl_3,23KCl$. True composition of above salts. Sol. in H_2O. (Herty, Am. Ch. J. 1894, **16.** 495.)

$SbCl_3$, $2KCl$ is the only true compound, all

others being isomorphous mixtures. (Jordis, B. **1903**, **36**. 2539.)

$2SbCl_4$, 3KCl. Deliquescent. Decomp. by H_2O. (Bosek, Chem. Soc. 1895, **67**. 516.)

$SbCl_6KSbCl_6KOH$. Hydroscopic. Sol. in H_2O with decomp. (Weinland, B. 1901, **34**. 2635.)

See also **Antimony antimonyl potassium chloride.**

Antimony rubidium chloride, $SbCl_3$, RbCl.

Decomp. on air or with H_2O. (Saunders, Am. Ch. J. **14**. 162.)

$2SbCl_3$, $RbCl+H_2O$. Decomp. on air. (Wheeler, Z. anorg. **5**. 253.)

$SbCl_3$, 6RbCl. Decomp. by H_2O. (Godeffroy, Arch. Pharm. (3) **9**. 343.)

Formula is $10SbCl_3$, 23RbCl (?). (Saunders Am. Ch. J. **14**. 159.)

$10SbCl_3$, 23RbCl (?). Decomp. by H_2O; sol. in HCl+Aq. (Saunders.)

Formula is $3SbCl_3$,7RbCl. (Wells and Foote, Am. J. Sci. 1897, (4) **3**. 461.)

Composition assigned to this salt by Saunders (Am. Ch. J. **14**. 155) is incorrect. (Ephraim, B. 1903, **36**. 1817.)

$3SbCl_3$, 5RbCl. As above. (Saunders.)

Formula is $2SbCl_3$, 3RbCl. (Wheeler.)

Rb_2SbCl_6. Ppt. Decomp. by H_2O. (Weinland, B. 1905, **38**. 1083.)

Rb_2SbCl_6, $2Rb_3SbCl_6$. Ppt. Decomp. by H_2O. (Weinland, B, 1901, **34**. 2635.)

Antimony selenium chloride, $SbCl_5$, $SeCl_4$.

Deliquescent. (Weber.)

Antimony selenyl chloride, $SbCl_5$, $SeOCl_2$.

Very deliquescent. (Weber, Pogg. **125**. 325.)

Antimony sodium chloride, $SbCl_3$, 3NaCl (?).

Decomp. by much H_2O. (Poggiale.)

Antimony sulphur chloride, $2SbCl_5$, $3SCl_2$.

Decomp. by H_2O.

$SbCl_5$, SCl_4. Sol. in dil. HNO_3+Aq.

Mpt. 125–126° in an atmos. of chlorine. Violently decomp. by H_2O. (Ruff, B. 1904, **37**. 4515.)

Antimony thallium chloride, $SbCl_3$, 3TlCl.

Ppt. (Ephraim, Z. anorg. 1909, **61**. 249.)

$SbCl_4$, TlCl. (Ephraim and Barteczko, Z. anorg. 1909, **61**. 251.)

$2SbCl_4$, 2TlCl, $TlCl_3$. Slowly decomp. by cold H_2O. (Ephraim and Barteczko, Z. anorg. 1909, **61**. 253.)

Antimony ***tri*****chloride ammonia,** $SbCl_3$, NH_3.

Not very deliquescent. Decomp. by H_2O.

Antimony ***penta*****chloride ammonia,** $SbCl_5$, $6NH_3$.

Decomp. by H_2O. (Persoz.)

Antimony ***penta*****chloride cyanhydric acid,** $SbCl_5$,3HCN.

Deliquescent; decomp. by H_2O. (Klein, A. **74**. 85.)

Antimony ***penta*****chloride nitric oxide,** $2SbCl_5$, NO.

Decomp. by H_2O. (Besson, C. R. **108**. 1012.)

Antimony ***penta*****chloride nitrogen** ***per*****oxide,** $3SbCl_5$, $2NO_2$.

Decomp. by H_2O. (Besson.)

Antimony ***penta*****chloride nitrogen sulphide,** $SbCl_5$, N_4S_4.

Easily decomp. (Davis, Chem. Soc. 1906, **89**. 1577.)

Decomp. by cold H_2O, HCl, H_2SO_4 and warm alcohol, also by boiling with KOH+Aq. Almost insol. in organic solvents. (Wölbling, Z. anorg. 1908, **57**. 283.)

Antimony chloride potassium bromide, $SbCl_3$,$3KBr+1\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by much H_2O. (Atkinson, Chem. Soc. **43**. 289.)

$2SbCl_3$,$3KBr+2H_2O$. (Atkinson.)

$SbCl_3$,$KBr+H_2O$. (Atkinson.)

Above are mixtures. (Herty, Am. Ch. **J**. 1894, **16**. 497.)

See **Antimony bromide potassium chloride.**

Antimony chlorofluoride, $SbCl_3F_2$.

(Swarts, Z. anorg. 1896, **12**. 71.)

Antimony fluoiodide, SbF_6I.

Slowly decomp. by H_2O. (Ruff, B. 1906, **39**. 4321.)

$(SbF_5)_2I$. Sol. in H_2O with pptn. of I_2. (Ruff, B. 1906, **39**. 4321.)

Antimony ***tri*****fluoride,** SbF_3.

Deliquescent. Sol. in H_2O.

Solubility in H_2O at t°.

t°	100 g. of the solution contain g. SbF_3	100 g. H_2O contain g. SbF_3
0°	79.37	384.7
20	81.64	444.7
22.5	81.91	452.8
25	83.12	492.4
30	84.93	563.6

(Rosenheim, Z. anorg. 1909, **61**. 189.)

Solubility in HF+Aq at 0°.

Normality of HF+Aq	100 g. H_2O of the HF solution dissolve g. SbF_3
2	474.9
1	432.5
0.5	404.0

(Rosenheim, Z. anorg. 1909, **61**. 192.)

Solubility of SbF_3 in salts+Aq at 0°.

Salt	Normality of salt solution	100 g. H_2O of the salt solution dissolve g. SbF_3.
KCl	1	461.8
	0.5	448.3
	0.25	431.9
	0.125	407.3
KBr	1	448.7
	0.5	450.0
	0.25	455.6
	0.125	417.2
KNO_3	1	458.2
	0.5	451.9
	0.25	418.3
	0.125	401.4
$\frac{1}{2}K_2SO_4$	1	419.9
	0.5	408.5
	0.25	406.6
$\frac{1}{2}K_2C_2O_4$	1	465.7
	0.5	481.2
	0.25	451.3
	0.125	405.2
$\frac{1}{2}(NH_4)_2C_2O_4$	0.5	431.9
	0.25	442.3
	0.125	433.3
$\frac{1}{2}K_2C_4H_4O_6$	1	461.4
	0.5	430.5
	0.25	430.8
	0.125	435.2

(Rosenheim, Z. anorg. 1909, **61.** 192.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Antimony *penta*fluoride, SbF_5.

Sol. in H_2O. (Marignac, A. **145.** 239.)

Very hydroscopic; bpt. 155°. Sol. in H_2O with hissing. (Ruff, B. 1904, **37.** 678.)

$+2H_2O$. (Ruff, B. 1904, **37.** 679.)

Antimony *penta*fluoride *di*antimony *tri*fluoride, $Sb_3F_{11}=2SbF_3, SbF_5$.

Hydroscopic; bpt. 390°. Easily sol. in H_2O. (Ruff, B. 1904, **37.** 680.)

Antimony *penta*fluoride *penta*antimony *tri*fluoride, $SbF_5, 5SbF_3$.

B pt. 384° (corr.). (Ruff, B. 1904, **37.** 681.)

Antimony cæsium fluoride,

$CsF,2SbF_3$.
$CsF,3SbF_3$.
$4CsF,7SbF_3$.
CsF,SbF_3.
$2CsF,SbF_3$.
(Wells, Am. J. Sci. 1901, (4) **11.** 451.)

Antimony lithium fluoride, SbF_3, 2[illegible]

Sol. in more than 20 pts. H_2O. (Flückiger, Pogg. **87.** 245.)

SbF_3, LiF. Easily sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony potassium fluoride, $SbF_3, 2KF$.

Sol. in less than 2 pts. boiling, and in 9 pts. cold H_2O. Insol. in alcohol or ether.

SbF_3, KF. More sol. than $SbF_3, 2KF$. Sol. in 2.8 pts. H_2O. (Flückiger, Pogg. **87.** 245.)

SbF_5, KF. Easily sol. in H_2O.

$SbF_5, 2KF+2H_2O$. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimony sodium fluoride, $SbF_3, 3NaF$.

Sol. in 14 pts. cold, and 4 pts. boiling H_2O. Sol. in HF. (Flückinger, Pogg. **87** 245.)

SbF_3, NaF. 100 pts. cold H_2O dissolve 93 pts. 100 pts. hot H_2O dissolve 166 pts. (Stein, Wagners' J. B. **1887.** 1160.)

$4SbF_3, NaF$. As NH_4 salt. (Raad and Hauser, B. 1890, **23.** R. 125.)

$SbF_5, 2NaF$. Easily sol. in H_2O. (Marignac, A. **145.** 329.)

Antimony thallium fluoride, TlF,SbF_3.

Sol. in H_2O without decomp. (Ephraim, B. 1909, **42.** 4458.)

$TlF,2SbF_3$. Sol. in H_2O without decomp. (Ephraim.)

$TlF,3SbF_3$. Sol. in H_2O without decomp. Decomp. by cold conc. H_2SO_4. (Ephraim.)

Antimony *tri*fluoride ammonia, $SbF_3, 2NH_3$.

Sl. sol. in liquid NH_3. (Ruff, B. 1906, **39.** 4326.)

Antimony *tri*fluoride ammonium chloride. SbF_3, NH_4Cl.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Antimony *tri*fluoride ammonium sulphate, $SbF_3, (NH_4)_2SO_4$.

More sol. than K or Na salt. 1 pt. H_2O dissolves 1.4 pts. at 24° and 15 pts. at 100°. (de Haen, B. **21.** 902 R.)

Antimony fluoride lithium chloride, SbF_3, LiCl.

Sol. in H_2O. (Stein, Chem. Z. **13.** 357.)

Antimony *penta*fluoride nitrosyl fluoride, SbF_5, NOF.

Hydroscopic. Decomp. by H_2O. Sol. in liquid NH_3 with decomp. Sl. sol. in NOCl, $SiCl_4$, PCl_3, $AsCl_3$, SO_2Cl_2 and $SOCl_2$. (Ruff, Z. anorg. 1908, **58.** 334.)

Antimony *tri*fluoride potassium chloride, SbF_3, KCl.

100 pts. H_2O dissolve 51 pts. at 24°, and 300 pts. at 100°. (de Haen, B. **21.** 901 R.)

Antimony *tri***fluoride potassium sulphate,** SbF_3, K_2SO_4.

Sol. in H_2O. (de Haen.)

$2SbF_3$, K_2SO_4. Very sol. in H_2O. (Mayer, B. 1894, **27.** R. 922.)

Antimony *tri***fluoride sodium chloride,** SbF_3, $NaCl$.

Easily sol. in H_2O. (de Haen, B. **21.** 901 R.)

Antimony *tri***fluoride sodium sulphate,** SbF_3, Na_2SO_4.

Sol. in H_2O. (de Haen.)

Antimony fluoiodide, SbF_5I.

Mpt. 80°; slowly decomp. by H_2O. (Ruff, B. 1906, **39.** 4321.)

$(SbF_5)_2I$. Mpt. 110–115°; decomp. by H_2O. (Ruff.)

Antimony fluosulphide, SbF_5S.

Very hygroscopic. Decomp. by H_2O. Sol. with decomp. in alcohol. Sol. in CCl_4. (Ruff, B. 1906, **39.** 4322.)

Antimony gold, Au_3Sb.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 72.)

Antimony hydride, SbH_3.

Scarcely sol. in H_2O. 1000 ccm. H_2O absorb 4.12 cc. SbH_3 at 10.5°. Decomp. by long contact with H_2O; also by conc. H_2SO_4 or KOH+Aq. (Jones, Chem. Soc. **29.** 641.)

Antimony *tri***hydroxide,** Sb_2O_3, $2H_2O = Sb_2O(OH)_4$.

(Schaffner, A. **51.** 182.)

$Sb(OH)_3$. Ppt. (Clarke and Stolla, B. **13.** 1787.)

Does not exist. (Guntz, C. R. **102.** 1472.)

See **Antimonous acid** *and* **antimony** *tri***oxide.**

Antimony *tri***iodide,** SbI_3.

Decomp. by H_2O or 80% alcohol. Sol. in HI+Aq; sol. in boiling CS_2, and in boiling benzene, but separates out on cooling. Almost insol. in $CHCl_3$. (Cooke, Proc. Am. Acad. (2) **5.** 72.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in warm $AsBr_3$. Sp. gr. of a solution sat. at 40°, which solidifies at 37°, =3.720. This dissolves further AsI_3, whereby the mpt. sinks to 31° and sp. gr. rises to 3.801. By mixing the latter solution with a solution of AsI_3 in CH_2I_2, a liquid can be obtained with a sp. gr. of 3.702 at 20°. (Retgers, Z. phys. Ch. 1893, **11.** 340.)

Sol. in PCl_3. (Beckmann, Z. anorg. 1906, **51.** 110.)

Sol. in SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 215.)

Sol. in $SOCl_2$ and S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 216.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25.** 214.)

Sol. in $SnCl_4$. (Walden, Z. anorg. 1900, **25.** 218.)

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Partly sol. in, and partly decomp. by alcohol or ether. (M'Ivor, Chem. Soc. (2) **14.** 328.)

Insol. in oil of turpentine and CCl_4.

100 pts. methylene iodide dissolve 11.3 pts. SbI_3 at 12°; sp. gr. of solution = 3.453. (Retgers, Z. anorg. **3.** 343.)

Sol. in C_6H_6. (Retgers, Z. phys. Ch. 1893, **11.** 334.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Antimony *penta***iodide,** SbI_5.

Very unstable. (Pendleton, C. N. **48.** 97.)

Antimony barium iodide, SbI_3, BaI_2+9H_2O.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109.** 611.)

Antimony cæsium iodide, $2SbI_3$,$3CsI$.

Sl. sol. in HI+Aq. Exists in two distinct forms. (Wells, Am. J. Sci. 1901, (4) **11.** 455.)

Antimony potassium iodide, $2SbI_3$, $3KI+3H_2O$.

Decomp. by H_2O. Sol. in HCl, $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. CS_2 dissolves out SbI_3. (Schäffer, Pogg. **109.** 611.)

SbI_3, $2KI+2\frac{1}{2}H_2O$. Decomp. by H_2O. (Nicklès, J. Pharm. (3) **39.** 116.)

Antimony rubidium iodide, $2SbI_3$, $3RbI$.

Decomp. by H_2O. (Wheeler, Z. anorg. **5.** 259.)

Antimony sodium iodide, $2SbI_3$, $3NaI+12H_2O$.

As $2SbI_3$, $3KI$. (Schäffer, Pogg. **109.** 611.)

Antimony thallous iodide, $2SbI_3$, $3TlI$.

Decomp. by H_2O and by HCl+Aq, also by alcohol. (Ephraim, Z. anorg. 1908, **58.** 354.)

Antimony nitride, SbN.

Decomp. by heat. (Franz Fischer, B. 1910, **43.** 1471.)

Antimony *tri***oxide,** Sb_2O_3.

Very sl. sol. in H_2O. Sol. in 8900–10,000 pts. H_2O at 100°; 55,000–61,100 pts. at 15°. (Schulze, J. pr. (2) **27.** 320.)

Sol. in HCl+Aq. Insol. in HNO_3+Aq, but not as insol. as metastannic acid. Sol. in cold fuming HNO_3 or H_2SO_4. Insol. in dil., but sol. in conc. alkalies, or alkali carbonates+

Aq. Sol. in cold NH_4Cl, or NH_4NO_3+Aq. Sol. in 15 pts. boiling $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Sol. in $HC_2H_3O_2$, or $H_2C_4H_4O_6$+Aq. and not pptd. from these solutions by H_2O. Easily sol. in benzoic acid. Insol. in pyrotartaric acid. Very sol. in $KHC_4H_4O_6$+Aq. Sol. in glycerine.

Somewhat sol. in H_3PO_4+Aq. (Köhler, Dingl. 1885, **258.** **520.**)

Insol. in liquid NH_3. (Gore, Am. Ch. J 1898, **20.** 826.)

Sol. in lactic acid. (Kretzschmar, Ch. Z. 1888, **12.** 943.)

Sol. in grape sugar solution to which $Ca(OH)_2$ has been added. (Vogel, B. 1885, **18**, R. 38.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899, II.** 1014.)

Sol. in glycerine in presence of alkalies. (Köhler, Dingl. 1885, **258.** 520.)

Exists in a sol. colloidal modification. (Spring, B. **16.** 1142.)

Min. *Valentinite*, *Senarmontite*.

$+H_2O$. *See* **Antimonous acid.**

Antimony *tetr*oxide, Sb_2O_4.

Insol. in H_2O. Slightly attacked by acids; hot conc. HCl+Aq acts only slightly. (Fresenius.)

Min. *Cervantite*. Sl. sol. in HCl+Aq.

Antimony *pent*oxide, Sb_2O_5.

Insol. in H_2O. Easily sol. in HCl+Aq. Sl. sol. in conc. KOH+Aq.

"Antimonoxyd" is sol. in glycerine in presence of alkalies.

100 g. glycerine, to which have been added 10 g. NaOH+Aq (1 : 1), dissolve 20.6 g. at b.-pt.; 20 g. NaOH+Aq (1 : 1), dissolve 36.0 g. at b.-pt.; 40 g. NaOH+Aq (1 : 1), dissolve 68.5 g. at b.-pt.; 80 g. NaOH+Aq (1 : 1), dissolve 93.0 g. at b.-pt.; 120 g. NaOH +Aq (1 : 1), dissolve 119.2 g. at b.-pt. (Köhler, Dingl. **258.** 520.)

See also **Antimonic acid.**

Antimony nitrogen *pent*oxide, $2Sb_2O_5$, N_2O_5.

Not decomp. by H_2O. (Thomas, C. R. 1895, **120.** 1116.)

Antimony oxybromide.

See **Antimonyl bromide.**

Antimony oxychloride.

See **Antimonyl chloride.**

Antimony oxyfluoride.

See **Antimonyl fluoride.**

Antimony oxysulphide, Sb_2OS_2.

Min. *Antimony blende* (*kermesite*).

Insol. in H_2O or dil. acids, except HCl+Aq. (Schneider, Pogg. **110.** 147.)

Antimony palladium, Sb_2Pd.

Sl. sol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 69.)

Antimony platinum, Sb_2Pt.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z anorg. 1895, **9.** 67.)

Antimony phosphide, SbP.

Insol. in benzene, ether, or CS_2. (M'Ivor, B. **6.** 1362.)

Antimony selenide, SbSe.

(Chrétien, C. R. 1906, **142.** 1341.)

Sb_3Se_4. (Chrétien, *l.c.*)

Sb_4Se_5. (Chrétien, *l.c.*)

Sb_2Se_3. Sol. in KOH+Aq. (Hofacker, A. **107.** 6.)

Sb_2Se_5. (Hofacker.)

Antimony selenide, *with* M selenide.

See **Selenoantimonates, M.**

Antimony *tri*sulphide, Sb_2S_3 (*Kermes*).

Insol. in H_2O and dil. acids.

1 l. H_2O dissolves 5.2×10^{-6} mols. pptd. Sb_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Decomp. by conc. HNO_3 or H_2SO_4. Sol. in conc. HCl+Aq. Easily sol. in dil. KOH, NaOH, $(NH_4)_2S$, and K_2S+Aq. Sl. sol. in NH_4OH+Aq; very sl. sol. in $(NH_4)_2CO_3$+Aq; insol. in KSH+Aq. (Fresenius.)

Sol. in a mixture of 50 pts. H_2O and 18 pts. HCl (sp. gr. 1.16) even when completely sat. with H_2S. (Lang and Carson, J. Soc. Chem. Ind. 1902, **21.** 1018.)

Sl. sol. in H_2SO_3+Aq. (Guerout, C. R. 1872, **75.** 1276.)

Cryst. Sb_2S_3 is only sl. sol. in NH_4OH+Aq (1 pt. in about 2000 pts. NH_3).

Pptd. amorphous Sb_2S_3 is appreciably more sol. (1 pt. in 600 pts. NH_3). (Garot, J. pr. 1843, **29.** 83.)

Sl. sol. in hot 2% $Na_2B_4O_7$+Aq, still less sol. in cold. (Materne, C. C. **1906, II.** 557.)

Insol. in NH_4Cl+Aq.

Sol. in 14–15 pts. pure $SbCl_3$. (Schneider, Pogg. **108.** 407.)

Slowly sol. in $H_2C_4H_4O_6$+Aq.

Sol. in boiling Na_3SbS_4+Aq.

Sol. in hot citric, tartaric and oxalic acids. Sl. sol. in malic, benzoic, picric and pyrogallic acids. Insol. in formic and acetic acids. Especially easily sol. in citric and oxalic acids with addition of KNO_3, KNO_2 or $KClO_3$. (Bolton, C. N. 1878, **37.** 86 and 99.)

Sol. in ethylamine sulphydrate+Aq.

Min. *Stibnite*. Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

Soluble modification. Sb_2S_3 may be obtained in a colloidal state in aqueous solution containing 1 pt. Sb_2S_3 to 200 pts. H_2O. This can be boiled without decomp., but Sb_2S_3 is pptd. by acids and salts.

Table of maximum dilution of solutions of acids and salts which cause pptn. of Sb_2S_3.

HCl	1 : 270
H_2SO_4	1 : 140
$H_2C_2O_4$	1 : 45
K_2SO_4	1 : 65
$(NH_4)_2SO_4$	1 : 130
$MgSO_4$	1 : 1720
$MnSO_4$	1 : 2060
$NaCl$	1 : 135
$BaCl_2$	1 : 2050
$MgCl_2$	1 : 5800
$CoCl_2$	1 : 2500
KNO_3	1 : 75
Fe_2Cl_6	1 : 2500
$Ba(NO_3)_2$	1 : 1250
$K_2Al_2(SO_4)_4$	1 : 35,000
$(NH_4)_2Fe_2(SO_4)_4$	1 : 800
$K_2Cr_2(SO_4)_4$	1 : 40,000
$KSbOC_4H_4O_6$	1 : 18

(Schulze, J. pr. (2) **27.** 320.)

Antimony *tri*sulphide with M_2S.

See **Sulphantimonites, M.**

Antimony *penta*sulphide, Sb_2S_5.

Insol. in H_2O, or H_2O containing H_2S. Sol. in conc. HCl+Aq. Completely sol. in NH_4OH+Aq; traces dissolve in $(NH_4)_2CO_3$+Aq. Easily sol. in KOH, or NaOH+Aq, or in alkali sulphides+Aq. Sol. in 50 pts. cold dil. NH_4OH+Aq. (Geiger.)

Insol. in $(NH_4)_2CO_3$+Aq.

Insol. in cold, but sol. in hot alkali carbonates+Aq. (Berzelius.)

Insol. in Na_3SbS_4+Aq.

When boiled with alcohol, ether, CS_2, oil of turpentine, etc., portion of the S is dissolved out. (Berzelius.)

CS_2 dissolves about 5% of the sulphur. (Rammelsberg.)

Antimony *penta*sulphide with M_2S.

See **Sulphantimonates, M.**

Antimony sulphochloride, $SbSCl_3$.

Decomp. by moist air or H_2O. (Cloez, A. ch. (3) **30.** 374.)

SbS_2Cl. Easily attacked by acids; insol. in CS_2. (Ouvrard, C. R. **116.** 1516.)

Sb_2S_5Cl. (Ouvrard.)

$2SbSCl, 3Sb_2S_3$. Decomp. by dil. HCl+Aq. (Schneider.)

$SbSCl, 7SbCl_3$. Deliquescent; decomp. by H_2O. (Schneider, Pogg. **108.** 407.)

Antimony sulphofluoride, SbF_5S.

See **Antimony fluosulphide.**

Antimony sulphoiodide, SbSI.

Not attacked by H_2O, and decomp. only by conc. acids. Insol. in CS_2. (Schneider, Pogg. **110.** 147.)

$Sb_2S_3I_6$. (Henry and Garot.)

$Sb_2S_2I_3$. Sol. in dry CS_2. Very easily decomp. (Ouvrard, C. R. **117.** 108.)

Antimony sulphur *dioxide*, $SbSO_2$.

Ppt. (Faktor, C. C. **1900,** I. 1211.)

Antimony telluride, SbTe.

Insol. in H_2O.

Sb_2Te_3. Insol. in H_2O. (Oppenheim, J. pr. **71.** 277.)

Antimonyl bromide, SbOBr.

Insol. in CS_2. (Cooke, Proc. Am. Acad. **13.** 104.)

Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

$Sb_4O_5Br_2$. (M'Ivor, C. N. **29.** 179.)

$10Sb_4O_5Br_2, SbBr_3$.

Antimonyl chloride.

From $SbCl_3$. SbOCl. Insol. in H_2O. Decomp. by boiling with H_2O; sol. in HCl+Aq. Insol. in alcohol or ether; sol. in CS_2, $CHCl_3$, or C_6H_6. (Sabanajew, Zeit. Ch. **1871.** 204.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 826.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$Sb_4O_5Cl_2$. *Algaroth powder.* Decomp. by H_2O. Sol. in HCl+Aq (Cooke, Proc. Am. Acad. **13.** 1); tartaric acid+Aq. (Schäffer, A. **152.** 135.)

$Sb_8O_{11}Cl_2$. (Cooke.)

Sb_8OCl_{22}.

$Sb_{41}O_{50}Cl_{23}$.

From $SbCl_5$. $SbOCl_3$. Deliquescent. Decomposed by H_2O. Sol. in H_2O. (Daubrawa, A. **184.** 118.)

Does not exist. (Anschütz and Evans, A. **239.** 285.)

Sb_3OCl_{13}. Deliquescent. Insol. in CS_2; easily sol. in tartaric acid+Aq. (Williams, C. N. **24.** 224.)

$Sb_3O_4Cl_7$. (Williams.)

SbO_2Cl. Decomp. by hot H_2O into $HSbO_3$.

Antimonyl fluoride.

From SbF_3. $Sb_4O_3F_6$. Not deliquescent. (Flückiger, Pogg. **87.** 249.)

Antimonyl cæsium fluoride, SbF_4OH, CsF.

(Wells, Am. J. Sci. 1901, (4) **11.** 456.)

Antimonyl sodium fluoride, $SbOF_3$, NaF+H_2O.

Deliquescent. Easily sol. in H_2O. (Marignac, A. **145.** 239.)

Antimonyl iodide, $Sb_4O_5I_2$.

Difficultly sol. in solution of tartaric acid or tartrates. Decomp. by HCl, HNO_3, or H_2SO_4+Aq. Easily sol. in alkalies, or $(NH_4)_2S$+Aq.

SbOI. Insol. in CS_2. (Cooke, Proc. Am. Acad. (2) **5.** 72.)

Antimonyl sulphide.

See **Antimony oxysulphide.**

Argon, A.

100 cc. H_2O dissolve 4.05 cc. argon at 13.9°. Critical t.—121.6° under 50.6 atmos. Bpt. —186.9°. Sp. gr. 19.9. (Rayleigh, C. N. 1895, **71.** 51–62; 299–302; C. C. **1895.** 467.)

Coefficient of absorption in H_2O at 12° = 0.0394; at 13.9° = 0.0405. (Ramsay, Phil. Trans. 1895, **186.** A. 225.)

Absorption by H_2O at t°.

t°	Coefficient of absorption
0°	0.0561
10	0.0438
20	0.0379
30	0.0348
40	0.0338
50	0.0343

(Antropoff, Roy. Soc. Proc. 1910, **83.** A. 480.)

Absorption of argon by H_2O at t° and 760 mm. pressure.

t°	Coefficient of absorption
0°	0.05780
1	0.05612
5	0.05080
10	0.04525
15	0.04099
20	0.03790
25	0.03470
30	0.03256
35	0.03053
40	0.02865
45	0.02731
50	0.02567

(Estreicher, Z. phys. Ch. 1899, **31.** 184.)

1 l. H_2O at 38° absorbs 25.7 cc. A.

1 l. blood absorbs 25.3 cc. A. (Regnard and Schloesing, C. R. 1897, **124.** 303.)

Not absorbed by members of the fatty series of organic compounds; with members of the aromatic series absorption was observed varying from 8% of the volume employed for benzene to 1% for aniline. (Berthelot, C. R. 1899, **129.** 71.)

Arsenamide, $As(NH_2)_3$.

Insol. in liquid NH_3. Decomp. by H_2O. (Hugot, C. R. 1904, **139.** 55.)

Arsenic, As.

Unaltered by pure H_2O. Insol. in HCl+Aq if air is excluded, but sl. sol. in presence of air. Not attacked by dil. H_2SO_4+Aq. Oxidized by conc. H_2SO_4, HNO_3, or aqua regia. Not attacked at 20° by HNO_3, conc. or dil., or containing NO_2; nor by HNO_3+HCl, as long as they do not act on each other; but if treated with the above mixture in extremely dilute state, and a few drops of KNO_2+Aq are added, the As is attacked at once. (Millon, A. ch. (3) **6.** 101.)

Sol. in sea water; 0.009 mg. per liter off Brittany; 0.01 to 0.09 mg. per liter near Azores. (Gautier, C. R. 1903, **137.** 232.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in liquid NH_3. (Hugot, A. ch. 1900, (7) **21.** 31.)

Insol. in NaOH, KOH, or NH_4OH+Aq.

Sol. in S_2Br_2. (Hannay, Chem. Soc. (2) **11.** 823.)

Insol. in alcohol and ether.

Sol. in certain fatty oils.

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

½ ccm. oleic acid dissolves 0.0032 g. As in 6 days. (Gates, J. phys. Ch. 1911, **15.** 143.)

Yellow modification. Very unstable. (McLeod, C. N. 1894, **70.** 139.)

Fairly stable in liquid air. (Thomson, Chem. Soc. 1906, **90.** (2) 745.)

100 ccm. CS_2 dissolve at:

46°	20°	12°	0°	—15°	—60°
11	8	6	4	2.0–2.5	1.0 g. As.

Less sol. in benzene and ethyl acetate. (Erdmann, Z. anorg. 1902, **32.** 448.)

Arsenic acid. *See* page 59.

Arsenic bromide, $AsBr_3$.

Decomp. by H_2O. Completely sol. in about 3 pts. boiling H_2O, and much less, in presence of HBr. (Wallace, Phil. Mag. (4) **17.** 261.)

Sol. in CS_2.

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 26.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Arsenic cæsium bromide, $2AsBr_3$, $3CsBr$.

Decomp. by H_2O; can be recryst. from conc. HBr+Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium bromide, $2AsBr_3$, $3RbCl$.

As the corresponding Cs comp.

Arsenic bromide ammonia, $AsBr_3$, $3NH_3$.

Decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic bromide copper, $2AsBr_3$,7Cu.

Stable toward hot H_2O. Decomp. by KOH. (Hilpert and Herrman, B. 1913, **46.** 2224.)

Arsenic bromide silver, $AsBr_3$, 3Ag.

Scarcely decomp. by cold H_2O. (Hilpert and Herrmann.)

Arsenic chloride, $AsCl_3$.

Miscible with little H_2O, and with alcohol, ether, and volatile oils. Decomp. by much H_2O, or by boiling. (Gmelin.)

Miscible with oil of turpentine, and with olive oil. Somewhat sol. in HCl+Aq.
Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)
Sol. in liquid CN. (Centnerszwer, J. russ. phys. Ges. 1901, **33.** 545.)
Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Arsenic *penta*chloride, $AsCl_5$.

Fumes in the air with evolution of hydrogen chloride. Readily sol. in CS_2, and absolute ether cooled to —30°. (Baskerville, J. Am. Chem. Soc. 1902, **24.** 1070.)

Arsenic cæsium chloride, $2AsCl_3, 3CsCl$.

Decomp. by H_2O. 100 pts. HCl+Aq (1.2 sp. gr.) dissolve 0.429 pt. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic iridium phosphorus chloride.

See **Iridium phosphorus chloride arsenic chloride.**

Arsenic rubidium chloride, $2AsCl_3, 3RbCl$.

Decomp. by H_2O. 100 pts. HCl+Aq (sp. gr. 1.2) dissolve 2.935 pts. salt. (Wheeler, Z. anorg. **4.** 451.)

Arsenic sulphur chloride, $2AsCl_3, 3SCl_2$.

Decomp. by H_2O. (Rose.)
Above compound is a mixture. (Nilson, C. N. **81.** 81.)

Arsenic chloride ammonia, $2AsCl_3, 7NH_3$.

Decomp. by cold H_2O, with evolution of NH_3. From the solution crystallizes $As_4Cl_2N_2H_{10}O_8$.
Sol. in alcohol without decomp. (Rose, Pogg. **52.** 62.)
Composition is $AsCl_3, 4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic chloride copper, $2AsCl_3,7Cu$.

Somewhat decomp. by H_2O. Decomp. by KOH, or hot HCl. (Hilpert and Herrman, B. 1913, **46.** 2224.)

Arsenic chloride silver, $2AsCl_3, 7Ag$.

H_2O, NH_4OH and KOH split off Ag. (Hilpert and Herrmann.)

Arsenic *tri*fluoride, AsF_3.

Sol. in H_2O with evolution of heat and decomposition. (Berzelius.)
Easily sol. in benzene. (Moissan, C. R. **99.** 874.)
Miscible with alcohol and ether. (M'Ivor, C. N. **30.** 169.)

Arsenic *penta*fluoride, AsF_5.

Sol. in H_2O, alkalies+Aq and liquid AsF_3 with evolution of heat. Absorbed by ether, alcohol and benzene with evolution of heat. (Ruff, B. 1906, **39.** 67.)

Arsenic potassium fluoride, AsF_5, $KF+\frac{1}{2}H_2O$.

$AsF_5, 2KF+H_2O$.
$AsF_5, AsOF_3, 4KF+3H_2O$. (Marignac, A. **145.** 237.)

Arsenic fluoride ammonia, $2AsF_3, 5NH_3$.

Easily decomp. by H_2O. (Besson, C. R. **110.** 1258.)

Arsenic *penta*fluoride nitrosyl fluoride, AsF_5, NOF.

Decomp. by H_2O, fuming HCl, NaOH+Aq, dry ether and dry alcohol with evolution of NO. Sol. in conc. HNO_3, hot conc. H_2SO_4, boiling NOCl and AsF_3. Insol. in CCl_4 and CS_2. (Ruff, Z. anorg. 1908, **58.** 327.)

Arsenic *tri*fluoride sulphur *tetra*chloride, $2AsF_3, SCl_4$.

Very hydroscopic. Decomp. by H_2O and NaOH. Decomp. by thionyl chloride, CCl_4, CS_2, abs. alcohol and ether. Decomp. by ligroin, benzene and toluene. (Ruff, B. 1904, **37.** 4520.)

Arsenic hydride, AsH_3.

Sl. sol. in H_2O and alkali hydrates+Aq, with subsequent decomposition. H_2O absorbs $^1/_5$ vol. AsH_3. Decomp. by conc. acids. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether, or KOH+Aq. (Gmelin.)
Insol. in KOH+Alcohol. (Meissner.)
Not more sol. in alkaline solutions than in pure H_2O. (Berzelius.)
AsH. *Solid.* Insol. in H_2O, alcohol, ether, and CS_2. (Wiederhold, Pogg. **118.** 615.)
Insol. in H_2O; sol. in methylene iodide, xylene, or in conc. KOH+Aq. (Retgers, Z. anorg. **4.** 403.)

Arsenic hydride boron bromide, AsH_3, BBr_3.

Easily decomp. Decomp. by H_2O. Appreciably sol. in AsH_3 or BBr_3. Insol. in CS_2. (Stock, B. 1901, **34.** 949.)

Arsenic *di*iodide, As_2I_4.

Decomp. by H_2O or alkalies; easily sol. in alcohol, ether, chloroform, or carbon disulphide. (Bamberger and Phillip, B. **14.** 2643.)
Not attacked by cold conc. H_2SO_4 or by cold fuming HNO_3. The latter oxidizes on warming. Decomp. by pyridine. Sol. in boiling acetic anhydride. (Hewitt and Winmill, Chem. Soc. 1907, **91.** 962.)

Arsenic *tri*iodide, AsI_3.

Sol. in 3.32 pts. boiling H_2O, and solution if boiled down deposits pure AsI_3, but if left to cool slowly, deposits crystals of As_2O_3 and AsOI.
Sl. sol. in HCl+Aq.
Sol. in $POCl_3$, PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 212.)

Sol. in PCl_3. (Beckmann, Z. anorg. 1906, **51.** 110.)

Sol. in $SOCl_2$, S_2Cl_2 and SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 216.)

Sol. in $SnCl_4$. (Walden, *l.c.*)

Easily sol. in $AsBr_3$. (Walden, Z. anorg 1902, **29.** 374.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25.** 214.)

Sol. in alcohol without decomp.

Sol. in ether, benzene, chloroform, and CS_2

100 pts. methylene iodide dissolve 17.4 pts. AsI_3 at 12°. (Retgers, Z. anorg. **3.** 343.)

Arsenic *penta*iodide, AsI_5.

More or less sol. in H_2O, alcohol, $CHCl_3$, ether and CS_2. (Sloan, C. N. 1882. **46.** 194.)

Arsenic cæsium iodide, $2AsI_3$, $3CsI$.

Decomp. by H_2O; sol. in conc. HI + Aq. (Wheeler, Z. anorg. **4.** 451.)

Arsenic rubidium iodide, $2AsI_3$, $3RbI$.

As the corresponding Cs comp.

Arsenic sulphur iodide.

See **Arsenic sulphoiodide.**

Arsenic *tri*iodide ammonia, $2AsI_3$, $9NH_3$.

Insol. in benzene. (Bamberger and Phillip, B. **14.** 2643.)

AsI_3, $4NH_3$. (Besson, C. R. **110.** 1258.)

Arsenic nitride, AsN.

Easily decomp. into As and N. (Hugot, C. R. 1904, **139.** 56.)

Decomp. by heat. (Franz Fischer, B. 1910, **43.** 1471.)

Arsenic *sub*oxide, As_2O (?).

Insol. in H_2O; decomp. by dil. acids or NH_4OH + Aq.

Does not exist. (Geuther, A. **240.** 208.)

Arsenic *tri*oxide, As_2O_3.

"White arsenic" exists in two modifications: αAs_2O_3,—crystalline, octahedral, opaque, porcelaneous, etc.; βAs_2O_3,—amorphous, vitreous, "arsenic glass."

The data concerning the solubility of As_2O_3 are very contradictory, the reasons being that (1) the solubility of the two modifications is different; (2) that the length of time necessary to effect solution differs in the two modifications; and (3) that there is a tendency of the amorphous As_2O_3 to go over into the crystalline state during the process of solution. αAs_2O_3 is also not easily moistened, especially when in a pulverulent condition, which is not the case with the β modification. (Winkler, J. pr. (2) **31.** 247.)

The older data are very unreliable, but possess a certain historical interest.

1 pt. As_2O_3 is sol. in 10.55 pts. (Wenzel); 11.34 pts. (Fischer); 11.86 pts. in ¼ hour (Klaproth); 12.2 pts. (Bucholz); 15.0 pts. (Brandt; Bergman); 16.0 pts. (Vogel); 24 pts. (Lametherié); 40 pts. (Pörner); 64 pts. (Baumé); 80 pts. (Navier); 200 pts. (Aschof and Nasse, 1812); 640 pts. (Hagen, 1796) boiling H_2O.

1 pt. As_2O_3 is sol. in 7.72 pts. H_2O if α, or 9.33 pts. if β (Guibort); in 24 pts. H_2O if α, or 21 pts. if β (Taylor).

Sol. in 53.3 pts. H_2O at 18.75°. (Abl.)

Sol. in 30 pts. H_2O. (Nussembrock.)

After the solution in H_2O at 100° has been left standing at ordinary temperatures—

1 pt. As_2O_3 remains dissolved in 16 pts. H_2O at 16°, and 20 pts. H_2O at 7° (Bucholz); in 33 pts. H_2O at 7° (Klaproth), in 38.45 pts. H_2O after 3 days, 55 pts. H_2O after 8 days, 64.50 pts. H_2O after 2.3 weeks at 10° (Fischer); in 33.52 pts. if αAs_2O_3 was used, 55.06 pts. if βAs_2O_3 was used (Guibort); in 38 pts. if αAs_2O_3 after 6 months, 53.71 pts. if βAs_2O_3 after 48 hours (Taylor).

When an excess of pulverized As_2O_3 is left to digest for several days with cold H_2O—

1 pt. dissolves in 56 pts. (Bucholz); in 66 pts. (Fischer); in 80 pts. at 15° (Bergman); in 80 pts. if α, and 103 pts. if β (Guibort); 96 pts. at 10° (Spelman); 96 pts. at 35.5° (Hahnemann); 320 pts. H_2O at 20° (Aschof and Nasse, 1812.)

H_2O at 15.6° or below dissolves less than ¼% As_2O_3. (Dalton.)

To dissolve 1 pt. As_2O_3 in 12 pts. H_2O, it is necessary to boil an excess of As_2O_3 with H_2O; if 1 pt. As_2O_3 is boiled with 12 pts. H_2O, considerable remains undissolved; and even with 1 pt. As_2O_3 to 50–60 pts. H_2O long continued boiling is necessary to effect solution. If a clear solution saturated by long boiling with an excess of As_2O_3 is poured off and evaporated continuously to ½ its original bulk, no As_2O_3 separates out, and the solution contains 1 pt. As_2O_3 to 6 pts. H_2O. (Fischer.)

100 pts. aqueous solution of βAs_2O_3 sat. at 15° contain 0.96 pt. As_2O_3, and 9.68 pts. when sat. at 100°. (Guibort.)

If 1 pt. pulverized As_2O_3 be digested 10 days at 19–25° in 5–10 pts. H_2O the solution contains 1 pt. As_2O_3 to 50 pts. H_2O. A solution of same strength is obtained in 25 days by digesting 1 pt. As_2O_3 in 40 pts. H_2O. If 1 pt. As_2O_3 be immersed in 80 pts. H_2O, the resulting solution contains 1 pt. As_2O_3 to 90 pts. H_2O; if in 160 pts. H_2O, 1 pt. As_2O_3 to 180 pts. H_2O; if in 240 pts. H_2O, 1 pt. As_2O_3 to 280 pts. H_2O; if in 1000 pts. H_2O, 1 pt. As_2O_3 to 1200 pts. H_2O; and even when 1 pt. As_2O_3 is digested at ordinary temperatures for several days with 16,000–100,000 pts. H_2O, a portion remains undissolved. Pulverized αAs_2O was set aside with H_2O in closed bottles for 18 years; when 1 pt. As_2O_3 was present in 1000 pts. H_2O, a perfect solution was obtained; when 1 pt. As_2O_3 in 100 pts. H_2O, 0.017% As_2O_3 was undissolved; when 1 pt. As_2O_3 in 35 pts. H_2O, 0.35% As_2O_3 was undissolved, so that the solution contained 1 pt. As_2O_3 to 54 pts. H_2O. (Gmelin.)

Porcelaneous modification (αAs_2O_3) is much more sol. in H_2O than the vitreous (βAs_2O_3). 100 pts. H_2O at ordinary temperature dissolve 0.96 pt. BAs_2O_3 and 1.25 pts. αAs_2O_3; 100 pts. boiling H_2O dissolve 9.68 pts. βAs_2O_3 and 11.47 pts. αAs_2O_3; and when the temperature of this solution has fallen to 15°, the solution from βAs_2O_3 retains 1.78 pts., and that from αAs_2O_3 retains 2.9 pts. (Berzelius [citing Guibort].)

βAs_2O_3 dissolves more quickly and abundantly than αAs_2O_3. The same amount H_2O which will take up 36–38 pts. βAs_2O_3 at 12–13° will dissolve only 12–14 pts. αAs_2O_3, or 100 pts. H_2O dissolve 4 pts. βAs_2O_3 and 1.2–1.3 pts. αAs_2O_3. By long boiling with H_2O, αAs_2O_3 is converted into βAs_2O_3, and thus acquires the solubility of the latter, so that 100 pts. boiling H_2O can take up 11 pts. As_2O_3. But at low temperature βAs_2O_3 is converted into αAs_2O_3 when in contact with H_2O, so that the solution becomes weaker after a while, and retains only the proportion of As_2O_3 corresponding to the solubility of αAs_2O_3. Comminution, which hastens the rate of solubility of αAs_2O_3 without increasing the amount dissolved, diminishes the solubility of βAs_2O_3, as this is converted into αAs_2O_3

by the friction or contact with H_2O. As_2O_3, which has been rendered opaque by NH_4OH, and that which has been crystallized from an aqueous solution, are equally sol. in H_2O. (Bussy, C. R. **24.** 774; A. **64.** 286.)

100 pts. H_2O dissolve 1.707 pts. βAs_2O_3 in $2\frac{1}{2}$ years; 100 pts. boiling H_2O dissolve 11.46 pts. βAs_2O_3 in 3 hours, and 11.86 pts. in 12 hours; 10.14 pts. αAs_2O_3 in 3 hours, and 10.18 pts. in 12 hours. (Rose, Ann. Phys. (1) **36.** 494.)

A cold sat. solution which stood over excess of As_2O_3 for 10 months at 10–20° contains 1.2% As_2O_3; hot sat. solution a few days after saturation contains 2.25–2.50% As_2O_3. If trace of HCl is present, the solution contains 3.8% As_2O_3. Hot sat. solution of porcelain mod. of As_2O_3 contains 4 days after saturation 2.4% As_2O_3 at 24°; after 82 days at 14°, 1.5%; after 4 months at 12°, 1.3% As_2O_3. (Bacaloglo, J. pr. **83. 111.**)

According to later experiments, 1 pt. αAs_2O_3 dissolves in 355 pts. H_2O in 1 day at 15°, while 1 pt. βAs_2O_3 dissolves in 108 pts. H_2O under the same conditions. 1 pt. αAs_2O_3 dissolves in 46 pts. H_2O, if solution is prepared at 100°, and allowed to stand 24 hours at 15°, while 1 pt. βAs_2O_3 dissolves in 30 pts. H_2O under the same conditions. (Büchner, N. Rep. Pharm. **22.** 265.)

100 pts. H_2O dissolve pts. αAs_2O_3 and βAs_2O_3 at ordinary temperature:

Time	αAs_2O_3	βAs_2O_3
1 hour	0.023	1.589
3 hours	0.088	2.356
6 hours	0.353	3.666
12 hours	0.364	3.361
24 hours	0.956	3.306
2 days	1.627	2.629
4 days	1.814	2.429
1 week	1.673	1.763
3 weeks	1.776	1.713
$2\frac{1}{4}$ years	1.712	1.707

In the solution of βAs_2O_3, octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of αAs_2O_3.

From the maxima in the above table, 100 pts. H_2O can dissolve 3.7 pts. βAs_2O_3 and 1.7 pts. αAs_2O_3 at ordinary temperature.

100 pts. boiling H_2O dissolve 11.46 pts. βAs_2O_3 and 10.140 pts. αAs_2O_3 in 3 hours; 11.86 pts. βAs_2O_3 and 10.176 pts. αAs_2O in 12 hours. (Cl. Winkler, J. pr. (2) **31.** 247.)

100 pts. H_2O dissolve 1.75 pts. of a third modification (hexagonal crystalline) at ordinary temperature, and 2.75 pts. at 100°. (Claudet, Chem. Soc. (2) **6.** 179.)

βAs_2O_3 dissolves more rapidly in HCl+Aq than αAs_2O_3. (Schultz-Sellac, B. **4.** 109.)

While 100 ccm. H_2O dissolve 0.8507 g. βAs_2O_3 at 18.5°, 100 ccm. H_2O containing 1.3195 g. HCl dissolve 1.1513 g. βAs_2O_3; containing 6.09 g. HCl, 1.2724 g. βAs_2O_3. (Chodounsky, Listy Chemické, **13.** 114.)

100 ccm. H_2O dissolve 1.495 g. As_2O_3 at 15°. (Wood, Chem. Soc. 1908, **93.** 412.)

Solubility of crystalline As_2O_3 in H_2O.

1 l. of the sat. solution contains at:

2°	15°	25°	39.8°	bpt.	
12.006	16.566	20.384	29.302	60+g.	As_2O_3

(Bruner, Z. anorg. 1903, **37.** 456.)

Much more easily sol. in many acids than in H_2O. Easily sol. in fuming H_2SO_4. (Schultz-Sellac.)

100 pts. dilute H_2SO_4+Aq of various strengths dissolve at t°.

t°	Pts. βAs_2O_3	t°	Pts. βAs_2O_3	Ratios of amts. dissolved at 80° : 18.5°
80°	1.0195	18.5°	0.5422	1.88 : 1
..	1.3664	....	0.7203	1.89 : 1
..	1.1933	....	0.6522	1.84 : 1

(Chodounsky, *l.c.*)

Decomp. by HNO_3 or aqua regia into As_2O_5.

Sol. in H_3PO_4+Aq. (Bergman.)

More sol. in HCl+Aq than in H_2SO_4, or HNO_3+Aq, and still less in $HC_2H_3O_2$+Aq.

Solubility in HCl+Aq.

Conc. of HCl+Aq	Grams of As_2O_3 per 100 cc. of solution
0.46N	1.52
0.98N	1.41
2.03N	1.17
3.13N	1.11
3.81N	1.13
5.32N	2.20
6.50N	5.11
7.85N	12.28
9.17N	18.16

As the concentration of the acid increases, the solubility of the oxide decreases, a minimum being reached when the concentration of the solvent is about 3.2N. Beyond this point, an increase in the concentration of the solvent leads to a corresponding increase in the solubility. (Wood, Chem. Soc. 1908, **93.** 413.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Easily sol. in cold $H_2C_2O_4$+Aq. (Bergman.)

When pulverized, it dissolves in hot $H_2C_2O_4$+Aq, but separates out on cooling.

Easily sol. in hot benzoic acid+Aq.

Sol. in tartaric acid+Aq.

Easily sol. in alkali hydrates, or carbonates +Aq.

Easily sol. in NH_4 arsenite+Aq at 70–80°, crystallizing out on cooling. (Berzelius.)
Sol. in hot $K_2C_2O_4$+Aq.
Sol. in $AsCl_3$. (Penney and Wallace.)
More sol. in $Na_2B_4O_7$+Aq than in H_2O.
Very sl. sol. in absolute alcohol. (Vogel.)

Sol. in 80 pts. highly rectified spirit. (Wenzel.)
When 1 pt. powdered As_2O_3 is digested 30 days in 10–40 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 60 pts. alcohol; when 1 pt. As_2O_3 is digested with 60–150 pts. alcohol, a solution is formed containing 1 pt. As_2O_3 to 124–140 pts. alcohol. (Fischer.)
Sol. in 70–80 pts. alcohol. (Thompson.)

Alcohol dissolves 0.446 pt. βAs_2O_3. (Rose, A. Phys. (1) **52.** 455.)

100 pts. alcohol dissolve pts. As_2O_3:

Vol. % of alcohol	αAs_2O_3 at 15°	αAs_2O_3 at b.-pt. of alcohol	βAs_2O_3 at 15°
56	1.680	4.895	0.504
79	1.430	4.551	0.540
84	....	....	0.565
86	0.715	3.197	....
88	....	....	0.717
100	0.025	3.402	1.060

(Girardin, J. Pharm. (3) **46.** 269.)

100 pts. absolute alcohol dissolve 0.446 pt. βAs_2O_3 in 2¼ years. (Winkler, J. pr. (2) **31.** 347.)
Nearly insol. in ether.
100 pts. ether dissolve 0.454 pt. βAs_2O_3. (Winkler.)
Ether extracts 1 mg. As_2O_3 from sat. As_2O_3+Aq for every 15 cc. ether used; less is extracted when the solution is acidified with HCl, and almost none if acidified with H_2SO_4 or $H_2C_4O_6$. (Selmi, B. **13.** 206.)
αAs_2O_3 is sol. in 50 pts. boiling nitrobenzol. βAs_2O_3 is insol. in boiling nitrobenzol. (Auerbach, Z. anorg. 1903, **37.** 353.)
βAs_2O_3 dissolves in oil of turpentine, but αAs_2O_3 is insol. therein. αAs_2O_3 is very sl. sol. in benzene or petroleum ether, but more sol. in methyl alcohol, ethyl alcohol, ether, or chloroform. (Selmi.)
100 pts. CS_2 dissolve 0.001 pt. βAs_2O_3 in 2¼ years. (Winkler.)
Sl. sol. in the fatty oils.
1000 pts. castor-oil dissolve 1.33 pts. As_2O_3 at ordinary temperature, and 9 pts. at boiling temperature. 1000 pts. other oils dissolve 0.6–0.8 pt. As_2O_3 in the cold, and about 1.7 pts. on boiling. (Berzelius.)
Insol. in chinoline or aniline. (Hoffmann, A. ch. (3) **9.** 143, 169.)
Moderately sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014.)
Sol. in amyl alcohol and is divided between it and H_2O in the constant ratio of 1 : 5.47 at 25°. (Auerbach, Z. anorg. 1903, **37.** 376.)
Min. ***Arsenolite.***

Arsenic *tri*oxide *pent*oxide, $3As_2O_3$, $2As_2O_5$ $+3H_2O$.

Decomp. by H_2O. (Joly, C. R. **100.** 1221.)
$2As_2O_3$, $As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)
As_2O_3, $As_2O_5+H_2O$. (Joly.)

Arsenic *tetr*oxide, As_2O_4.

Sl. sol. in HCl from which it is partially pptd. by alcohol. More easily sol. in alkali carbonates or HCl+Aq. Most easily sol. in NaOH or KOH+Aq. (Herbst, Dissert. **1894.**)

Arsenic *pent*oxide, As_2O_5.

Deliquescent in moist air, slowly sol. in H_2O, forming H_3AsO_4, which see. Easily sol. in alcohol; much more sol. in alcohol than As_2O_3. Very sl. sol. in the fatty oils, 100 pts. of oil dissolving 0.2 pt. As_2O_5 in the cold, and 1 pt. with partial decomp. on boiling. (Berzelius.)
1000 pts. boiling poppy-oil dissolve 27 pts. As_2O_5; 1000 pts. boiling castor-oil dissolve 34 pts. As_2O_5. (Heimpel and Grundner.)

$+4H_2O$. Solubility in H_2O at t°.

t°	Pts. H_3AsO_4 in 100 pts. solution	t°	Pts. H_3AsO_4 in 100 pts. solution
—55°	69.9	—5°	80.0
—50	70.9	0	81.0
—45	71.9	+5	82.1
—40	72.9	10	83.3
—35	73.9	15	84.7
—30	74.9	20	86.3
—25	75.9	25	88.0
—20	76.9	30	90.1
—15	77.9	35	92.8
—10	78.9	..	....

(Menzies and Potter, J. Am. Chem. Soc. 1912, **34.** 1464.)

$+{}^5/_3H_2O$. Solubility in H_2O at t°.

t°	Pts. H_3AsO_4 in 100 pts. of solution
+10°	88.4
20	89.1
30	89.8
40	90.5
50	91.2
60	91.9
70	92.6
80	93.2
90	93.8
100	94.4
110	95.0
120	95.6
130	96.2
140	96.8

(Menzies and Potter, J. Am. Chem. Soc. 1912, **34.** 1464.)

$As_2O_5+4H_2O$ and $3As_2O_5+5H_2O$ are the only hydrates that can be isolated. (Menzies and Potter.)

See also **Arsenic Acid.**

Arsenic *tri*oxide, *with* alkali haloid.

See **Arsenite, alkali haloid.**

Arsenic sulphur *tri*oxide, As_2O_3, SO_3.

Deliquescent; decomp. by H_2O. (Adie, Chem. Soc. **55.** 157.)

As_2O_3, $2SO_3$. As above. (Adie.)

As_2O_3, $3SO_3$. (Weber, B. **19.** 3186.)

As_2O_3, $4SO_3$. As above. (Adie.)

As_2O_3, $6SO_3$. (Weber.)

As_2O_3, $8SO_3$. As above. (Adie.)

Arsenic oxychloride, etc.

See **Arsenyl chloride,** etc.

Arsenic phosphide, AsP.

Decomp. by H_2O. Not attacked by cold H_2SO_4 or HCl, and only sl. sol. therein on warming. Easily decomp. by HNO_3, KOH, NaOH, BaO_2H_2+Aq. Insol. in alcohol, ether, chloroform; sl. sol. in CS_2.

$P_2As_3O_2$. Product of action of H_2O on above compound, which it resembles. (Janowsky, B. **6.** 216.)

Arsenic *mono*selenide, As_2Se.

Insol. in most organic and inorganic solvents. Sol. very slowly in conc. HCl and H_2SO_4. Sol. in boiling alkali hydroxides+Aq. (Szarvasy, B. 1897, **30.** 1245.)

Arsenic *tri*selenide, As_2S_3.

Partially sol. in KOH+Aq if boiled with it for a long time. (Uelsmann, A. **116.** 123.)

Arsenic *penta*selenide, As_2Se_5.

Insol. in most solvents, as conc. HCl. Sol. in alkali hydrates and sulpho-hydrates+Aq. (Szarvasy, B. 1895, **28.** 2655–2656.)

Insol. in H_2O, in dil. acids and in conc. HCl. Sl. sol. in warm HNO_3+Aq. Oxidized by cold fuming HNO_3. Sol. in alkalies and in hot alkali carbonates+Aq. Insol. in alcohol, ether, CS_2, etc. (Clever, Z. anorg. 1895, **10.** 129.)

Arsenic selenosulphide.

See **Arsenic sulphoselenide.**

Arsenic sulphide, As_3S.

Ppt. Insol. in NH_4OH or in colorless $(NH_4)_2S$+Aq. Sol. in yellow NH_4SH+Aq. (Scott, Chem. Soc. 1900, **77.** 652.)

Arsenic *di*sulphide, As_2S_2.

Min. *Realgar.* Difficultly sol. in alkali sulphides+Aq. Partly dissolved by KOH+Aq with decomposition. Sol. at 150° in a sealed tube in $NaHCO_3$+Aq, and crystallizes out on cooling. (Senarmont, A. ch. (3) **32.** 158.)

Arsenic *tri*sulphide, As_2S_3.

Insol. in H_2O when prepared in the dry way, but when prepared moist is very liable to go into the colloidal modification mentioned below. Insol. in H_2O containing H_2SO_4, HNO_3, HCl, $H_2C_2O_4$, $HC_2H_3O_2$, $H_2C_4H_4O_6$, CO_2, NH_4Cl, KNO_3, $(NH_4)_2SO_4$, $MgSO_4$. (Bontigny.)

Insol. in H_2O. Traces are dissolved by H_2S+Aq. Sl. decomp. by boiling with H_2O, or long contact with cold H_2O. (Fresenius.)

1 l. H_2O dissolves 2.1×10^{-6} mols. pptd. As_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in dil. acids. Insol. in cold, and scarcely attacked by hot conc. HCl+Aq.

Easily decomp. by HNO_3 or aqua regia.

Easily sol. in cold KOH, NaOH, or NH_4OH+Aq, also in alkali carbonates, or sulphates+Aq.

Sol. in hot $KHSO_3$+Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Slowly sol. in cold 2% $Na_2B_4O_7$+Aq. Easily sol. on heating. (Materne, C. C. **1906,** II. 557.)

Insol. in CS_2.

Min. *Orpiment.*

As_2S_3 may also be obtained in a colloidal form, sol. in H_2O. Sat. solution contains 34.46% As_2S_3; it is decomp. by standing, but may be boiled without undergoing decomposition; most acids and many salts ppt. As_2S_3 (Schulze, J. pr. (2) **25.** 431.)

The following solutions cause pptn. of As_2S_3 in a solution of the colloidal modification, when added in the given state of dilution:—

HCl+Aq	1 : 555
HNO_3+Aq	1 : 276
H_2SO_4+Aq	1 : 255
H_2SO_3+Aq	1 : 138
$H_2C_2O_4$+Aq	1 : 65
H_3PO_4+Aq	1 : 26
$HC_2H_3O_2$+Aq	1 : 0.18
K_2SO_4+Aq	1 : 76
Na_2SO_4+Aq	1 : 129
$(NH_4)_2SO_4$+Aq	1 : 188
$CaSO_4$+Aq	1 : 2780
$MgSO_4$+Aq	1 : 2630
$ZnSO_4$+Aq	1 : 3330
$MnSO_4$+Aq	1 : 2860
$NiSO_4$+Aq	1 : 3440
$FeSO_4$+Aq	1 : 2380
$Al_2(SO_4)_3$+Aq	1 : 52600
Tl_2SO_4+Aq	1 : 799
KCl+Aq	1 : 137
KBr+Aq	1 : 103
KI+Aq	1 : 55
LiI+Aq	1 : 127
NaCl+Aq	1 : 212
NH_4Cl+Aq	1 : 207
$BaCl_2$+Aq	1 : 2860
$CaCl_2$+Aq	1 : 4370
$MgCl_2$+Aq	1 : 10000

$FeCl_3+Aq$	1 : 50000
$AlCl_3+Aq$	1 : 83000
$CrCl_3+Aq$	1 : 20000
KNO_3+Aq	1 : 84
$NaNO_3+Aq$	1 : 117
NH_4NO_3+Aq	1 : 138
$Ba(NO_3)_2+Aq$	1 : 2080
$KClO_3+Aq$	1 : 88
$CaH_2(CO_3)_2+Aq$	1 : 3120
$K_2C_2H_4O_6+Aq$	1 : 85
$K_2C_2O_4+Aq$	1 : 81
$NaC_2H_3O_2+Aq$	1 : 78
Urea+Aq	1 : 25
$(NH_4)_2Fe(SO_4)_2+Aq$	1 : 1160
$K_2Al_2(SO_4)_4+Aq$	1 : 50000
$K_2Fe_2(SO_4)_4+Aq$	1 : 55500
$K_2Cr_2(SO_4)_4+Aq$	1 : 25000
$K_4Fe(CN)_6+Aq$	1 : 67
$K_3Fe(CN)_6+Aq$	1 : 81

Cold conc. solutions of boric, arsenious, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn. (Schulze, J. pr. (2) **25.** 442.)

$+6H_2O$; decomp. completely into As_2S_3 under a pressure of 6000 to 7000 atmos. (Spring, Z. anorg. 1895, **10.** 186.)

Arsenic *penta*sulphide, As_2S_5.

Insol. in H_2O. Sol. in NH_4OH, KOH, $NaOH+Aq$, and solutions of alkali sulphides and carbonates. Sol. in BaO_2H_2, and CaO_2H_2+Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Alcohol dissolves out S on boiling. (Berzelius.)

Sol. in alkali arsenates+Aq. (Nilson, J. pr. (2) **14.** 155.)

$+H_2O$. (Nilson, *l.c.*)

Arsenic *tri*sulphide, *with* M_2S.
See **Sulpharsenites, M.**

Arsenic *penta*sulphide, *with* M_2S.
See **Sulpharsenates, M.**

Arsenic sulphobromide, $AsS_2Br_3=AsSBr+SBr_2$.

Decomp. by H_2O. (Hannay, Chem. Soc. **33.** 284.)

Arsenic sulphochloride, As_2S_5Cl.

Slowly decomp. by boiling H_2O. Sol. in hot $AsCl_3$ without decomp. (Ouvrard, C. R. **116.** 1516.)

AsS_2Cl. Decomp. by H_2O. Sol. in NH_4OH, and alkali carbonates+Aq. (Ouvrard.)

AsS_2Cl. Slowly decomp. by boiling H_2O. Sol. in alkali carbonates and in NH_4OH+Aq. (Ouvrard, C. R. 1893, **116.** 1517.)

Arsenic sulphoiodide, AsSI.

Insol. in alcohol, chloroform or carbon disulphide. (Schneider, J. pr. (2) **23.** 486.)

Formula is probably As_2S_3, AsI_3.

Slowly attacked by HCl+Aq; somewhat more easily by HNO_3+Aq. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **34.** 505.)

$2AsI_3$, SI_6. Decomp. on air. (Schneider, J. pr. (2) **36.** 509.)

$As_4S_5I_2$. Less sol. in CS_2 than AsI_3. (Ouvrard, C. R. **117.** 107.)

As_2SI_4. (Ouvrard.)

See also **Arsenyl sulphoiodide.**

Arsenic sulphoselenide, As_2SeS_2.

Easily sol. in cold NH_4SH+Aq. Nearly completely sol. in $(NH_4)_2CO_3+Aq$. (v. Gerichten, B. **7.** 29.)

As_2SSe_2. More difficultly sol. than the preceding comp. in NH_4SH+Aq. (v. Gerichten.)

$As_2Se_2S_3$. Sp. gr.=6.402 at ca. 750°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, **28.** 2661.)

$As_2Se_3S_2$. Sp. gr.=11.35 at 550-600°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, **28.** 2659.)

Arsenic telluride, As_2Te_2.

Sol. in HNO_3 and $HNO_3+HCl+Aq$. (Oppenheim, J. pr. **71.** 266.)

As_2Te_3. As above. (Oppenheim.)

Arsenic acid, anhydrous, As_2O_5.

See **Arsenic *pent*oxide.**

*Meta*arsenic acid, $HAsO_3$.

Slowly sol. in cold, quite easily sol. in hot H_2O, with considerable evolution of heat, and conversion into H_3AsO_4. (Kopp, A. ch. (3) **48.** 196.)

*Ortho*arsenic acid, H_3AsO_4.

Sol. in H_2O, with absorption of heat.

1 pt. As_2O_5 dissolves in 0.405 pt. H_2O at 12.5°, or 100 pts. H_2O dissolve 244.81 pts. As_2O_5 at 12.5°. (Vogel.)

Sol. in 0.5 pt. H_2O. (Thénard.)

Sol. in 6 pts. cold H_2O, and more quickly in 2 pts. hot H_2O. (Bucholz.)

100 pts. H_2O at 15.56° dissolve 150 pts. As_2O_5. (Ure's Dict.)

H_3AsO_4+Aq sat. at 15° contains 15% As_2O_5.

Sp. gr. of H_3AsO_4+Aq at 15°: a=sp. gr. if % is As_2O_5; b=sp. gr. if % is H_3AsO_4.

%	*a*	*b*	%	*a*	*b*
5	1.042	1.0337	45	1.540	1.3973
10	1.085	1.0690	50	1.635	1.4617
15	1.134	1.1061	55	1.742	1.5320
20	1.187	1.1457	60	.....	1.6086
25	1.245	1.1882	65	.....	1.6919
30	1.306	1.2342	70	.....	1.7827
35	1.378	1.2840	75	.....	......
40	1.453	1.3382	..	.....	......

(Schiff, A. **113.** 183, calculated by Gerlach, Z. anal. **27.** 303.)

Sp. gr. of H_3AsO_4+Aq at 15°: a = sp. gr. if % is As_2O_5; b = sp. gr. if % is H_3AsO_4.

%	a	b	%	a	b
1	1.008	1.006	47	1.564	1.412
2	1.016	1.013	48	1.582	1.425
3	1.023	1.019	49	1.601	1.437
4	1.031	1.026	50	1.620	1.450
5	1.039	1.032	51	1.642	1.464
6	1.048	1.039	52	1.663	1.478
7	1.057	1.046	53	1.685	1.491
8	1.065	1.052	54	1.706	1.505
9	1.074	1.059	55	1.728	1.519
10	1.083	1.066	56	1.752	1.534
11	1.092	1.073	57	1.777	1.549
12	1.102	1.081	58	1.801	1.564
13	1.111	1.088	59	1.825	1.579
14	1.121	1.096	60	1.850	1.594
15	1.130	1.103	61	1.880	1.610
16	1.140	1.111	62	1.910	1.626
17	1.150	1.119	63	1.940	1.643
18	1.160	1.126	64	1.970	1.659
19	1.170	1.134	65	2.000	1.675
20	1.180	1.142	66	2.030	1.693
21	1.191	1.150	67	2.060	1.712
22	1.203	1.158	68	2.090	1.730
23	1.214	1.167	69	2.120	1.749
24	1.226	1.175	70	2.150	1.767
25	1.237	1.183	71	..	1.788
26	1.249	1.192	72	.....	1.809
27	1.261	1.201	73	.....	1.830
28	1.274	1.210	74	.....	1.851
29	1.286	1.219	75	.....	1.872
30	1.298	1.228	76	.....	1.897
31	1.312	1.238	77	.....	1.921
32	1.325	1.248	78	.....	1.946
33	1.339	1.257	79	.....	1.970
34	1.352	1.267	80	.....	1.995
35	1.366	1.277	81	.....	2.020
36	1.381	1.288	82	.....	2.045
37	1.396	1.299	83	.....	2.070
38	1.411	1.309	84	.....	2.095
39	1.426	1.320	85	.....	2.120
40	1.441	1.331	86	.....	2.149
41	1.458	1.342	87	.....	2.178
42	1.475	1.353	88	.....	2.207
43	1.492	1.366	89	.....	2.236
44	1.509	1.376	90	.....	2.265
45	1.526	1.387	91	.....	2.295
46	1.545	1.400	..	.....	.....

(Kopp, calculated by Gerlach, Z. anal. **27.** 316.)

See also **Arsenic *pent*oxide.**

_Pyro_arsenic acid, $H_4As_2O_7$.

Very deliquescent; easily sol. in H_2O with evolution of much heat, and conversion into H_3AsO_4.

Arsenates.

Arsenates of the alkali metals, and acid arsenates of the alkaline-earth metals are sol. in H_2O. Neutral and basic arsenates are easily sol. in mineral acids, including H_3AsO_4; less sol. in $HC_2H_3O_2+Aq$. The neutral alkaline-earth arsenates are less sol. in NH_4OH+Aq than in H_2O, but more sol. in NH_4Cl+Aq (Field). The alkali arsenates are sol. in hot glycerine. (Lefèvre, C. R. **108.** 1058.)

Aluminum arsenate, $Al_2(AsO_4)_2$.

Ppt. Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$2Al_2O_3$, $3As_2O_5$. Nearly unattacked by boiling H_2O; sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Aluminum potassium arsenate, $2Al_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Aluminum sodium arsenate, $2Al_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Ammonium arsenate, $(NH_4)_3AsO_4+3H_2O$.

Difficultly sol. in H_2O. Less sol. in H_2O than $(NH_4)_2HAsO_4$. (Mitscherlich.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Ammonium hydrogen arsenate, $(NH_4)_2HAsO_4$.

Effloresces, giving off NH_3; more sol. in H_2O than $(NH_4)_3AsO_4$. (Salkowsky, J. pr. **104.** 129.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Ammonium *di*hydrogen arsenate, $NH_4H_2AsO_4$.

Not efflorescent. Very sol. in H_2O.

Ammonium barium arsenate, $NH_4BaAsO_4+\frac{1}{2}H_2O$.

Sol. by 10 days' contact in 1391 pts. H_2O; in 18,832 pts. of a mixture of 1 pt. NH_4OH+Aq and 3 pts. H_2O; in 227 pts. of a solution of 1 pt. NH_4Cl in 10 pts. H_2O; and in 2169 pts. of a solution of 1 pt. NH_4Cl in 10 pts. NH_4OH+Aq and 60 pts. H_2O. (Lefèvre, A. ch. 1892, (6) **27.** 13.)

$(NH_4)_2BaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

Ammonium calcium arsenate, $NH_4CaAsO_4+\frac{1}{2}H_2O$.

1000 pts. pure H_2O dissolve 0.20 pt. this salt; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 4.15 pts. this salt; 900 pts. H_2O+100 pts. NH_4OH (sp. gr. = 0.880) dissolve 0.01 pt. this salt. (Field, Chem. Soc. **11.** 6.)

Soluble by 10 days' contact in 2167 pts. H_2O at 15°; in 381 pts. NH_4Cl+Aq (1 : 7); in

43478 pts. NH_4OH+Aq (1 : 3); in 10570 pts. NH_4Cl+NH_4OH+Aq (1 : 10 : 60). (Lefèvre, A. ch. 1892, (6) **27.** 13.)

$+6H_2O$. Sol. in hot, very sl. sol. in cold H_2O; sl. sol. in NH_4Cl, and NH_4OH+Aq. (Wach, Schw. J. **12.** 285.)

$+7H_2O$. (Bloxam, C. N. **54.** 163.)

$(NH_4)_2CaH_2(AsO_4)_2$. Efflorescent. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Baumann, Arch. Pharm. **36.** 36.)

$(NH_4)Ca_3H_2(AsO_4)_3+3H_2O$.

$(NH_4)Ca_6H_5(AsO_4)_6+3H_2O$. (Bloxam, C. N. **54.** 163.)

Ammonium glucinum arsenate, $NH_4GlAsO_4+4\frac{1}{2}H_2O$.

More stable than the corresponding potassium salt. (Bleyer, Z. anorg. 1912, **75.** 291.)

Ammonium iron (ferric) *di*hydrogen arsenate, $NH_4H_2AsO_4$, $FeAsO_4$.

Hydrolyzed by H_2O.

Sol. in cold conc. HCl, hot HNO_3, hot dil. H_2SO_4, and in hot arsenic acid+Aq containing 75% arsenic pentoxide.

Sol. in hot conc. NH_4OH+Aq. Completely hydrolyzed by caustic alkalies.

Insol. in conc. NH_4Cl+Aq and in 50% acetic acid. (Curtman, J. Am. Chem. Soc. 1910, **32.** 628.)

Ammonium magnesium arsenate, NH_4MgAsO_4.

Sl. sol. in H_2O. Sol. in acids.

Anhydrous salt is sol. in 2784 pts. H_2O at 15°; in 15,904 pts. NH_4OH+Aq (1 : 3) (0.96 sp. gr.); in 1386 pts. NH_4Cl+Aq (1 : 70); in 886.7 pts. NH_4Cl+Aq (1 : 7); in 3014 pts. NH_4Cl (1 pt.)+NH_4OH (0.96 sp. gr.) (10 pts.)+Aq (60 pts.); in 32,827 pts. magnesia mixture. (Fresenius, Z. anal. **3.** 206.)

Anhydrous salt is sol. in 4389 pts. NH_4NO_3+Aq (1 : 50); in 2561.5 pts. KCl+Aq (1 : 165); in 1422 pts. ammoniacal solution of 3.5 g. tartaric acid in 250 cc. H_2O; in 933.5 pts. ammoniacal solution of 2.5 g. citric acid in 250 cc. H_2O. (Puller, Z. anal. **10.** 62.)

$+\frac{1}{2}H_2O$.

Sol. in 2656 pts. H_2O at 15°; in 15,038 pts. NH_4OH+Aq (1 : 3) (0.96 sp. gr.); in 844 pts. NH_4Cl+Aq (1 : 7); in 1315 pts. NH_4Cl+Aq (1 : 70); in 2871 pts. NH_4Cl (1 pt.)+NH_4OH (0.96 sp. gr.) (10 pts.)+Aq (60 pts.). (Fresenius.)

1000 pts. pure H_2O dissolve 0.14 pt. salt; 1000 pts. NH_4Cl+Aq (containing 100 pts. NH_4Cl) dissolve 0.95 pt. salt; 900 pts. H_2O +100 pts. NH_4OH (sp. gr. 0.880) dissolve 0.07 pt. salt. (Field, Chem. Soc. **11.** 6.)

$+6H_2O$. Sl. efflorescent. Sl. sol. in H_2O. Very sl. sol. in NH_4OH+Aq.

Solubility of $NH_4MgAsO_4+6H_2O$ in H_2O and NH_4 salts+Aq.
Grams salt dissolved in 100 g. solvent.

t°	H_2O	5% NH_4NO_3+Aq	5% NH_4Cl+Aq	NH_4OH+Aq 1 pt. NH_4OH+Aq (0.96) +4 pts. H_2O	4% NH_4OH+Aq +5% NH_4Cl+Aq	4% NH_4OH+Aq +10% NH_4Cl+Aq
0°	0.03388	0.09216	0.08397	0.00874	....	....
20	0.02066	0.11358	0.12284	0.00958	0.01331	0.03165
30	....	0.11758	0.11264	....	....	....
40	0.02746	0.13936	0.19016	0.01173	....	....
50	0.02261	0.18945	0.18889	0.01005	....	....
60	0.02103	0.21115	0.21952	0.00902	0.04691	0.05353
70	0.01564	0.18880	0.22092	0.00949	....	....
80	0.02364	0.18945	0.23144	0.00912	....	....

(Wenger, Dissert. **1911.**)

Ammonium manganous arsenate, $NH_4MnAsO_4+6H_2O$.

Nearly insol. in cold H_2O; easily sol. in dil. acids; insol. in alcohol. (Otto, J. pr. **2.** 414.)

Ammonium sodium arsenate, $NH_4NaHAsO_4+4H_2O$.

Sol. in H_2O. (Uelsmann, Zeit. f. ges. Nat. **23.** 347.)

Ammonium sodium hydrogen arsenate, $(NH_4)_3Na_3H_6(AsO_4)_4+6H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **94.** 649.)

Ammonium strontium arsenate, $NH_4SrAsO_4+\frac{1}{2}H_2O$.

Sol. by 10 days' contact in 3229 pts. H_2O, in 11,586 pts. dil. NH_4OH+Aq, in 199 pts. of a mixture of 1 pt. NH_4Cl in 7 pts. H_2O, and in 1519 pts. of a solution of 1 pt. NH_4Cl in 10 pts. NH_4OH+Aq and 60 pts. H_2O. (Lefèvre, A. ch. 1892, (6) **27.** 13.)

Ammonium uranyl arsenate, $NH_4(UO_2)AsO_4+xH_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions as NH_4Cl+Aq; sol. in mineral acids. (Puller, Z. anal. **10.** 72.)

Ammonium vanadium arsenate, $NH_4(VO_2)_2AsO_4$, and $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$.

See **Arseniovanadate, ammonium.**

Ammonium arsenate tellurate.

See **Arseniotellurate, ammonium.**

Antimony arsenate (?).

Insol. in H_2O; insol. in acids after ignition, but when fresh is sol. in conc. boiling HCl+Aq, and sl. sol. in HNO_3+Aq. (Dumas.)

Barium arsenate, $Ba_3(AsO_4)_2$.

1000 pts. pure H_2O dissolve 0.55 pt. $Ba_3(AsO_4)_2$; 1000 pts. NH_4Cl+Aq (containing 50 pts. NH_4Cl) dissolve 1.95 pts. $Ba_3(AsO_4)_2$; 900 pts. H_2O+100 pts. NH_4OH+Aq (sp. gr. =0.88) dissolve 0.03 pt. $Ba_3(AsO_4)_2$. (Field, Chem. Soc. **11.** 6.)

Sol. in cold HNO_3, and HCl+Aq (Berzelius); $H_2C_4H_4O_6$, and $HC_2H_3O_2$+Aq. (Anthon.)

Solubility in H_2O is not increased by presence of NH_4, Na, or K salts. (Laugier.)

Not pptd. in presence of Na citrate. (Spiller.)

$+1\frac{1}{2}H_2O$. (Salkowsky, J. pr. **104.** 129.)

Barium hydrogen arsenate, $BaHAsO_4$+$1\frac{1}{2}H_2O$.

Very sl. sol. in H_2O, but decomp. thereby into $Ba_3(AsO_4)_2$ and $BaH_4(AsO_4)_2$. (Berzelius.)

Sl. sol. in cold acids.

$+H_2O$. Sl. sol. in either $BaCl_2$+Aq or Na_2HAsO_4+Aq. (Maumené, J. B. **1864.** 237.)

Barium *tetra***hydrogen arsenate,** $BaH_4(AsO_4)_2$ $+2H_2O$.

Easily sol. in H_2O. (Setterberg, Berz. J. B. **26.** 206.)

Difficultly sol. in little, but decomp. by much H_2O. Easily sol in HCl+Aq, less easily in $HC_2H_3O_2$+Aq (Hörmann, Dissert, **1879.**)

Barium arsenate, acid, $BaO, 2As_2O_5+4H_2O$.

Very sl. sol. in H_2O. (Mitscherlich.)

Barium *pyro***arsenate,** $Ba_2As_2O_7$.

Insol. in H_2O, but decomp. thereby into $BaHAsO_4+H_2O$. (Lefèvre, C. R. **108.** 1058.)

Barium potassium arsenate, $BaKAsO_4$.

Sl. decomp. by cold H_2O; rapidly sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 1.)

Barium sodium arsenate, $BaNaAsO_4$+$9H_2O$.

(Joly, C. R. 1887, **104.** 1702.)

Barium arsenate chloride, $3Ba_3(AsO_4)_2, BaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Bismuth arsenate, basic, $BiAsO_4, 3Bi_2O_3$.

Insol. in H_2O. Sol. in mineral acids. (Cavazzi, Gazz. ch. it. **14.** 289.)

$5Bi_2O_3, 2As_2O_5+8H_2O$. Min. *Rhagite.*

Easily sol. in HCl+Aq; sl. sol. in HNO_3+Aq.

Bismuth arsenate, $BiAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. Insol. in HNO_3+Aq in presence of H_3AsO_4, or alkali arsenates+Aq; sol. in HCl+Aq. (Salkowsky, J. pr. **104.** 129.)

Not wholly insol. in HNO_3+Aq. (Schneider, J. pr. (2) **20.** 418.)

Very sol. in H_3AsO_4+Aq. (Dumas.)

Insol. in $Bi(NO_3)_3$+Aq. (Dumas.)

Sol. in $Bi(NO_3)_3$+Aq. (Salkowsky.)

Insol. in conc. $Bi(NO_3)_3$+Aq containing a small quantity of HNO_3. (Schneider.)

Bismuth copper arsenate, $Bi_2Cu_{20}As_{10}H_{44}O_{70}$ $=Bi_2O_3, 20CuO, 5As_2O_5+22H_2O$.

Min. *Mixite.* Decomp. by dil. HNO_3+Aq into insol. $BiAsO_4$, and $Cu_3(AsO_4)_2$, which goes into solution. (Dana.)

Bismuth uranyl arsenate, $Bi_2(AsO_4)_2$, $8BiO_3H_3, (UO_2)_3(AsO_4)_2$.

Min. *Walpurgite.*

Cadmium arsenate, $Cd_3(AsO_4)_2$.

Ppt. (Salkowsky, J. pr. **104.** 129.)

$2CdO, As_2O_5$. (Lefèvre, C. R. **110.** 405.)

$5CdO, 2As_2O_5+5H_2O$. Ppt. (Salkowsky.)

Cadmium *pyro***arsenate,** $Cd_2As_2O_7$.

(de Schulten.)

Cadmium hydrogen arsenate, $CdHAsO_4$+H_2O.

Decomp. by H_2O. (Demel, B. **12.** 1279.)

$CdH_4(AsO_4)_2+2H_2O$. Decomp. by excess of H_2O. (de Schulten, Bull. Soc. (3) **1.** 473.)

Cadmium potassium arsenate, $2CdO, K_2O, As_2O_5$.

(Lefèvre, C. R. **110.** 405.)

Cadmium sodium arsenate, $CdO, 2Na_2O, As_2O_5$.

Slowly sol. in dil. acids. (Lefèvre, C. R. **110.** 405.)

$2CdO, 4Na_2O, 3As_2O_5$. (Lefèvre.)

Cadmium arsenate bromide, $3Cd_3(AsO_4)_2$, $CdBr_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten, Bull. Soc. (3) **1.** 472.)

Cadmium arsenate chloride, $3Cd_3(AsO_4)_2$, $CdCl_2$.

Sol. in very dil. HNO_3+Aq. (de Schulten.)

Cæsium arsenate, $Cs_2O, 2As_2O_5+5H_2O$.

Ppt. (Ephraim, Z. anorg. 1910, **65.** 246.)

Calcium arsenate, $Ca_3(AsO_4)_2+3H_2O$.

Ppt. Insol. in H_2O; sol. in H_3AsO_4+Aq. (Kotschoubey, J. pr. **49.** 182.)

Calcium *pyro***arsenate,** $Ca_2As_2O_7$.

Slowly decomp. by cold H_2O into $CaHAsO_4$ $+1\frac{1}{2}H_2O$. (Lefèvre.)

Calcium hydrogen arsenate, $CaHAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. (Debray, A. ch. (3) **61.** 419.)

$+H_2O$. Min. *Haidingerite.* Easily sol. in acids.

$+2\frac{1}{2}H_2O$. Min. *Pharmacolite.* Easily sol. in acids.

$+3H_2O$. Insol. in H_2O; sol. in HCl, HNO_3, or H_3AsO_4+Aq; also in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Pfaff.)

Calcium *tetra*hydrogen arsenate, $CaH_4(AsO_4)_2$.

Sol. in H_2O. (Graham.)

$+H_2O$. Sl. sol. in H_2O. Decomp. by much hot H_2O into H_3AsO_4 and $Ca_3(AsO_4)_2$. (Hörmann, Dissert. **1879.**)

Calcium iron (ferric) arsenate, $6CaO$, $4Fe_2O_3$, $5As_2O_5+15H_2O$ (?).

Min. *Arseniosiderite.* Sol. in acids.

Calcium magnesium arsenate, $Ca_5H_2(AsO_4)_4$, $Mg_5H_2(AsO_4)_4+10H_2O$.

Min. *Picropharmacolite.* Easily sol. in acids.

$Ca_3(AsO_4)_2$, $Mg_3(AsO_4)_2$. Sol. in HNO_3+Aq. (Kühn.)

Min. *Berzeliite.* Sol. in HNO_3+Aq.

$Ca_8Mg_6H_{14}(AsO_4)_{14}+49H_2O$. Min *Wapplerite.*

Calcium potassium arsenate, $CaKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Calcium sodium arsenate, $CaNaAsO_4$.

(Lefèvre, A. ch. (6) **27.** 1.)

$4CaO$, $2Na_2O$, $3As_2O_5$. Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Calcium uranyl arsenate, $Ca(UO_2)_2(AsO_4)_2+8H_2O$.

Min. *Uranospinite.*

Calcium vanadium arsenate, $CaHAsO_4$, $2(VO_2)H_2AsO_4+8H_2O$.

See **Arseniovanadate, calcium.**

Calcium arsenate chloride, $Ca_3(AsO_4)_2$, $CaCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

$3Ca_3(AsO_4)_2$, $CaCl_2$. As above. (Lechartier.)

Cerous arsenate, $CeHAsO_4$.

Insol. in H_2O. Sol. in arsenic acid+Aq. (Berzelius.)

Ceric hydrogen arsenate, $Ce(HAsO_4)_2+6H_2O$.

Ppt. Insol. in H_2O and dil. acids. (Barbieri, B. 1910, **43.** 2216.)

Ceric *di*hydrogen arsenate, $Ce(H_2AsO_4)_4+4H_2O$.

Sol. in conc. HNO_3. (Barbieri *l. c.*)

Chromic arsenate, $2Cr_2O_3$, $3As_2O_5$.

Insol. in H_2O and conc. boiling acids. (Lefèvre, A. ch. (6) **27.** 5.)

Chromic potassium arsenate, $2Cr_2O_3$, $3K_2O$, $3As_2O_5$.

(Lefèvre.)

Chromic sodium arsenate, $2Cr_2O_3$, $3Na_2O$, $3As_2O_5$.

(Lefèvre.)

Cobaltous arsenate, basic, $4CoO$, As_2O_5.

Easily sol. in acids. (Gentele, J. B. **1851.** 359.)

$Co(CoOH)AsO_4$. Insol. in H_2O; difficultly sol. in acids. (Coloriano.)

Cobaltous arsenate, $Co_3(AsO_4)_2+8H_2O$.

Ppt. Insol. even in boiling H_2O; easily sol. in HNO_3, HCl, and NH_4OH+Aq; sol. in H_3AsO_4+Aq (Proust); sol. in dil. $FeSO_4$+Aq. (Karsten, Pogg. **60.** 266.)

Min. *Cobalt bloom, Erythrite.* Easily sol. in acids.

$5CoO$, $2As_2O_5+3H_2O$. Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103.** 273.)

$2CoO$, As_2O_5. Sl. attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Cobaltous hydrogen arsenate, $CoH_4(AsO_4)_2$.

Sol. in H_2O.

Cobaltous potassium arsenate, $CoKAsO_4$.

(Lefèvre.)

Cobaltous sodium arsenate, $CoNaAsO_4$.

(Lefèvre.)

$4CoO$, $2Na_2O$, $3As_2O_5$. (Lefèvre.)

Cobaltous vanadium arsenate, $Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

See **Arseniovanadate, cobaltous.**

Cobaltous arsenate ammonia, $Co_3(AsO_4)_2$, NH_3+7H_2O.

(Ducru, A. ch. 1901, (7) **22.** 185.)

$Co_3(AsO_4)_2$, $2NH_3+6H_2O$. (Ducru, *l. c.*)

$Co_3(AsO_4)_2$, $3NH_3+5H_2O$. (Ducru, *l. c.*)

Cuprous arsenate, $2Cu_2O$, As_2O_5.

(Hampe, Dissert. **1874.**)

$4Cu_2O$, As_2O_5. (Hampe, *l. c.*)

Cuprous *pyro*arsenate, $Cu_4As_2O_7$.

Ppt. Sol. in NH_4OH or KOH+Aq. (Reichard, B. 1898, **31.** 2166.)

Cupric arsenate, basic, $8CuO$, $As_2O_5+12H_2O$.

Min. *Chalcophyllite.* Easily sol. in acids and NH_4OH+Aq.

$6CuO$, $As_2O_5+3H_2O$. Min. *Aphanesite, Clioclasite.* Sol. in acids and ammonia.

$5CuO$, $As_2O_5+2H_2O$. Min. *Erinite.* Sol. in HNO_3+Aq.

$+5H_2O$. Min. *Cornwallite*. Sol. in acids, and NH_4OH+Aq.
$+9H_2O$. Min. *Tirolite*.
$4CuO, As_2O_5+H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61.** 423.)
Min. *Olivenite*. Sol. in acids, and NH_4OH+Aq; decomp. by hot KOH+Aq.
$+7H_2O$. Min. *Euchroite*. Sol. in HNO_3+Aq.
$+4\frac{1}{2}H_2O$. (Hirsch, C. C. **1891,** I. 15.)

Cupric arsenate, $Cu_3(AsO_4)_2$.
Insol. in H_2O. Easily sol. in HCl+Aq; sl. sol. in other acids; sol. in NH_4OH+Aq. (Coloriano, C. R. **103.** 273.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
$+4H_2O$. Decomp. by hot H_2O. (Debray.)
$+5H_2O$. Min. *Trichalcite*. Easily sol. in cold HCl+Aq.

Cupric arsenate, acid, $5CuO, 2As_2O_5$.
Sol. in H_2SO_3+Aq. (Vogel.)
$+3H_2O$. (Salkowsky.)
+8, $9\frac{1}{2}$, and $12\frac{1}{2}H_2O$. (Hirsch.)
$CuHAsO_4+H_2O$. Insol. in H_2O. (Coloriano.)
$+1\frac{1}{2}H_2O$. Insol. in H_2O. (Debray, A. ch. (3) **61.** 419.)
$8CuO, 3As_2O_5+12H_2O$. (Hirsch.)

Cupric lead arsenate, $3CuO, PbO, As_2O_5+2H_2O$.
Min. *Bayldonite*. Nearly insol. in HNO_3+Aq.

Cupric potassium arsenate, $CuKAsO_4$.
Slowly sol. in NH_4OH+Aq; easily sol. in acids. (Lefèvre, A. ch. (6) **27.** 5.)
$8CuO, K_2O, As_2O_5$. Easily sol. in dil. acids. (Lefèvre.)

Cupric sodium arsenate, $CuNaAsO_4$.
(Lefèvre.)
$3CuO, Na_2O, 2As_2O_5$. Very sol. in dil. acids. (Lefevre.)
$2Cu_3(AsO_4)_2, NaH_2AsO_4+5H_2O$. Ppt. (Hirsch, C. C. **1891,** I. 15.)
$6Cu_3(AsO_4)_2, 2NaH_2AsO_4, Na_2HAsO_4+13\frac{1}{2}H_2O$, or $16H_2O$. Ppt. (Hirsch.)
$3Cu_3(AsO_4)_2, Na_2HAsO_4+9\frac{1}{2}H_2O$. Ppt. (Hirsch.)
$4Cu_3(AsO_4)_2, Na_2HAsO_4+11H_2O$. Ppt. (Hirsch.)

Cupric uranyl arsenate, $Cu(UO_2)_2(AsO_4)_2+8H_2O$.
(Werther, A. **68.** 312.)
Min. *Zeunerite*.

Cupric vanadium arsenate, $Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.
See **Arseniovanadate, cupric.**

Cupric arsenate ammonia, $Cu_3(AsO_4)_2$, $3NH_3+4H_2O$.
Insol. in cold or hot H_2O. (Damour, J. pr. **37.** 485.)
$2CuO, As_2O_5, 4NH_3+3H_2O$. Decomp. by H_2O. (Schiff, A. **123.** 42.)

Cupric arsenate calcium carbonate, $5CuO, As_2O_5, CaCO_3+4H_2O$, or $9H_2O$.
Min. *Tyrolite*. Easily sol. in acids, and NH_4OH+Aq.

Cupric arsenate sodium chloride, $2Cu_3(AsO_4)_2, NaCl+7\frac{1}{2}H_2O$.
Decomp. by hot H_2O. (Hirsch, Dissert. **1891.**)
$3Cu_3(AsO_4)_2, 2NaCl+13\frac{1}{2}H_2O$.
$+17\frac{1}{2}H_2O$. (Hirsch, *l.c.*)
$5Cu_3(AsO_4)_2, 3NaCl+23H_2O$. (Hirsch.)

Didymium arsenate, $Di_2H_3(AsO_4)_3$.
Ppt. Insol. in H_2O; sl. sol. in weak acids. (Marignac, A. ch. (3) **38.** 164.)
$5Di_2(AsO_4)_2, As_2O_5+3H_2O$. Ppt.

Glucinum arsenate, $Gl_3(AsO_4)_2$.
Insol. in H_2O; sol. in H_3AsO_4+Aq. (Berzelius.)

Glucinum hydrogen arsenate, $GlHAsO_4$.
Obtained in impure state by heating As_2O_5 with $Gl(OH)_2$ in a sealed tube at 220°. (Bleyer, Z. anorg. 1912, **75.** 287.)

Glucinum *tetra*hydrogen arsenate, $GlH_4(AsO_4)_2$.
Very hydroscopic. (Bleyer, Z. anorg. 1912, **75.** 287.)

Glucinum potassium arsenate, $KGlAsO_4$, $\frac{1}{2}GlO+5H_2O$.
Unstable. Amorphous. Easily hydrolyzed, giving more basic salts. (Bleyer, Z. anorg. 1912, **75.** 289.)

Glucinum sodium arsenate, $NaGlAsO_4$, $\frac{1}{2}GlO+6H_2O$.
Unstable. Easily hydrolyzed. (Bleyer, Z. anorg. 1912, **75.** 290.)

Iron (ferrous) arsenate, $Fe_3(AsO_4)_2+6H_2O$ (?).
Ppt. Sl. sol. in NH_4OH+Aq. Insol. in $(NH_4)_3AsO_4$+Aq or other NH_4 salts+Aq. (Wittstein.)
$+8H_2O$. Min. *Symplesite*. Sol. in HCl+Aq.

Iron (ferric) arsenate, basic, $16Fe_2O_3, As_2O_5+24H_2O$.
Insol. in NH_4OH+Aq. (Berzelius.)
$2Fe_2O_3, As_2O_5+12H_2O$. Insol. in NH_4OH+Aq.
$3Fe_2O_3, 2As_2O_5$.
$3Fe_2(AsO_4)_2, Fe_2O_6H_6+12H_2O$. Min. *Pharmacosiderite*. Easily sol. in acids; decomp. by KOH+Aq.

Iron (ferric) arsenate, Fe_2O_3, As_2O_5.

Ppt. Insol. in H_2O. Decomp. by hot H_2O. Sol. in HCl, H_2SO_4 and HNO_3. (Metzke, Z. anorg. 1898, **19.** 473.)

$+4H_2O$. Min. *Scorodite.* Easily sol. in HCl+Aq; insol. in HNO_3+Aq.

$+8H_2O$. Insol. in H_2O. When freshly pptd., sol. in NH_4OH+Aq. Sol. in HCl, or HNO_3+Aq. Insol. in $HC_2H_3O_2$, or NH_4 salts+Aq. (Wittstein.)

Sol. in warm H_2SO_3+Aq or $(NH_4)_2SO_3$+Aq. (Berthier, A. ch. (3) **7.** 79.)

Iron (ferric) arsenate, acid, $Fe_2O_3,3As_2O_5$ $+16.7H_2O$.

Ppt.; sl. sol. in acids with a yellow color, and in NH_4OH+Aq with a red color. (Metzke, Z. anorg. 1898, **19.** 476.)

$2Fe_2O_3$, $3As_2O_5+12H_2O$. Insol. in H_2O or $HC_2H_3O_2$+Aq.

Sol. in mineral acids.

Sol. only in conc. H_3AsO_4+Aq.

Sol. in $(NH_4)_3AsO_4$, and other NH_4 salts +Aq. (Wittstein.)

Sol. in NH_4OH+Aq.

$+22\frac{1}{2}H_2O$. Ppt. Sl. sol. in acids with a yellow color, and in NH_4OH+Aq with a red color. (Metzke, Z. anorg. 1898, **19.** 475.)

Iron (ferroferric) arsenate, 6FeO, $3Fe_2O_3$, $4As_2O_5+32H_2O$.

Insol. in H_2O. Sol. in HCl+Aq. Decomp. by KOH+Aq. (Wittstein, J. B. **1866.** 243.)

Iron (ferric) lead arsenate, $5Fe_2(AsO_4)_2$, $Pb_3(AsO_4)_2$.

Min. *Carmine Spar. Carminite.* Sol. in acids; KOH+Aq dissolves out As_2O_5. (Sandberger.)

Iron (ferric) potassium arsenate, $2Fe_2O_3$, $3K_2O$, $3As_2O_5$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre.)

Fe_2O_3, K_2O, $2As_2O_5$. (Lefèvre.)

Iron (ferric) sodium arsenate, Fe_2O_3, Na_2O, $2As_2O_5$.

(Lefèvre.)

$2Fe_2O_3$, $3Na_2O$, $3As_2O_5$. (Lefèvre.)

Lanthanum arsenate, $La_2H_3(AsO_4)_3$.

(Frerichs and Smith.)

Doubtful. (Cleve, B. **11.** 910.)

Lead arsenate, basic, $15PbO,2As_2O_5$ (?).

Ppt. (Strömholm, Z. anorg. 1904, **38.** 446.)

Lead arsenate, $Pb_3(AsO_4)_2$.

Insol. in H_2O, NH_4OH, or NH_4 salts+Aq. (Wittstein.)

Sol. in 2703.5 pts. $HC_2H_3O_2$+Aq containing 38.94% $HC_2H_3O_2$. (Bertrand, Monit. Scient. (3) **10.** 477.)

Sol. in sat. NaCl+Aq. (Becquerel, C. R. **20.** 1523.)

Not pptd. in presence of Na citrate. (Spiller.)

Lead *pyro*arsenate, $Pb_2As_2O_7$.

Insol. in H_2O or $HC_2H_3O_2$+Aq. Sol. in HCl, or HNO_3+Aq. (Rose.)

Decomp. by cold H_2O. (Lefèvre.)

$+H_2O=PbHAsO_4$. Ppt. (Salkowsky, J. pr. **104.** 109.)

Lead potassium arsenate, $PbKAsO_4$.

(Lefèvre, A. ch. (6) **27.** 5.)

Lead sodium arsenate, $PbNaAsO_4$.

(Lefèvre.)

4PbO, $2Na_2O$, $3As_2O_5$. Superficially decomp. by cold H_2O. (Lefèvre.)

Lead arsenate chloride, $3Pb_3(AsO_4)_2$, $PbCl_2$.

Sol. in dil. HNO_3+Aq. (Lechartier.)

Min. *Mimetite.* Sol. in HNO_3, and KOH+Aq.

Lithium arsenate, Li_3AsO_4.

Ppt. Sol. in dil. acids and in $HC_2H_3O_2$+Aq. (de Schulten, Bull. Soc. (3) **1.** 479.)

$LiH_2AsO_4+{}^3/_2H_2O$. Decomp. by H_2O into H_3AsO_4 and Li_3AsO_4. (Rammelsberg, Pogg. **128.** 311.)

Magnesium arsenate, $Mg_3(AsO_4)_2$.

Ppt.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+7H_2O$, $+8H_2O$, $+10H_2O$, and $+22H_2O$. (Grühl, Dissert. **1897.**)

$+8H_2O$. Min. *Hörnesite.* Insol. in H_2O; easily sol. in acids.

Magnesium hydrogen arsenate, $MgHAsO_4$.

$+\frac{1}{2}H_2O$. Insol. in H_2O. (de Schulten, C. R. **100.** 263.)

$+5H_2O$. (Schiefer.)

$+6\frac{1}{2}H_2O$. Insol. in H_2O. 1000 pts. boiling H_2O dissolve 1.5 pts. (Thompson.)

Sol. in HNO_3+Aq before ignition, but insol. in acids after ignition. (Graham, A. **29.** 29.)

$+7H_2O$. Min. *Roesslerite.* Sol. in HCl+Aq.

Magnesium *tetra*hydrogen arsenate, $MgH_4(AsO_4)_2$.

Very deliquescent; sol. in H_2O. (Schiefer.)

Magnesium potassium arsenate, $MgKAsO_4$.

Insol. in, but decomp. by cold H_2O. (Rose.) Easily sol. in dil. acids. (Lefèvre.)

$+7H_2O$. (Kinkelin, Dissert, **1883.**)

4MgO, $2K_2O$, $3As_2O_5$. Not attacked by boiling H_2O; slowly sol. in dil. acids. (Lefèvre.)

Magnesium potassium hydrogen arsenate, $KMgH(AsO_4)_2+xH_2O$.

Decomp. by H_2O. (Kinkelin, Dissert. **1883.**)

$Mg_3KH_2(AsO_4)_3+5H_2O$. (Chevron and Droixhe, J. B. **1888**, 523.)

Magnesium potassium sodium arsenate, $Mg_2KNa(AsO_4)_2+10H_2O$.

(Kinkelin, Dissert. **1883.**)

Magnesium sodium arsenate, $MgNaAsO_4$.

Insol. in H_2O. Very sl. sol. in dil. acids. (Lefèvre.)

$4MgO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Magnesium vanadium arsenate,

$MgH_2(VO_2)_2(AsO_4)_2+9H_2O$ and

$MgHAsO_4, 2(VO_2)H_2AsO_4+9H_2O$.

See **Arseniovanadate, magnesium.**

Magnesium arsenate chloride, $Mg_3(AsO_4)_2, MgCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65**. 172.)

Magnesium arsenate fluoride, $Mg_3(AsO_4)_2, MgF_2$.

Insol. in H_2O, sol. in dil. HNO_3+Aq. (Lechartier.)

Manganous arsenate, basic, $6MnO, As_2O_5+3H_2O$ (?).

Min. *Chondroarsenite.* Easily and completely sol. in dil. HCl, and HNO_3+Aq.

Manganous arsenate, $Mn_3(AsO_4)_2+H_2O$.

Insol. in H_2O; sl. sol. in acids. (Coloriano, C. R. **103**. 273.)

$5MnO, 2As_2O_5+5H_2O$. Insol. in H_2O. (Coloriano.)

$2MnO, As_2O_5$. Sl. decomp. by cold H_2O, but rapidly on heating. (Lefèvre.)

$MnHAsO_4+H_2O$. Decomp. by boiling H_2O into $5MnO, 2As_2O_5+5H_2O$. Sol. in HNO_3, H_2SO_4, or H_3AsO_4+Aq.

Manganous ***tetra*****hydrogen arsenate,** $MnH_4(AsO_4)_2$.

Deliquescent. Easily sol. in H_2O. (Schiefer.)

Manganous potassium arsenate, $MnKAsO_4$.

(Lefèvre, A. ch. (6) **27**. 5.)

Manganous sodium arsenate, $MnNaAsO_4$.

Very sol. in dil. acids. (Lefèvre.)

$2MnO, 4Na_2O, 3As_2O_5$. Not attacked by boiling H_2O; very sol. in dil. acids. (Lefèvre.)

Manganous arsenate chloride, $Mn_3(AsO_4)_2, MnCl_2$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Lechartier, A. **58**. 259.)

Manganic arsenate, $Mn_2(AsO_4)_2+2H_2O$.

Insol. in H_2O; sol. in acids.

Mercurous arsenate, $(Hg_2)_3(AsO_4)_2$.

Insol. in H_2O; difficultly sol. in acids. (Coloriano, C. R. **103**. 273.) Ppt. (Haack, C. C. **1890**, II. 736.)

$Hg_2(AsO_3)_2$. Insol. in H_2O, $HC_2H_3O_2$, or alcohol. Decomp. by cold $HCl+Aq$. Sl. sol. in cold HNO_3+Aq, from which it is precipitated by NH_4OH as Hg_2HAsO_4. (Simon, Pogg. **41**. 424.)

Mercurous hydrogen arsenate, Hg_2HAsO_4.

Insol. in H_2O, $HC_2H_3O_2$, or NH_4OH+Aq. Decomp. by cold $HCl+Aq$; sol. in cold HNO_3+Aq without decomp; very sl. sol. without decomp. in NH_4NO_3+Aq. (Simon, Pogg. **41**. 424.)

Mercuric arsenate, $Hg_3(AsO_4)_2$.

Ppt. Sol. in H_3AsO_4 or HNO_3+Aq. (Bergman.) Very sl. sol. in H_2O. Easily sol. in $HCl+Aq$. Sl. sol. in HNO_3+Aq. Insol. in H_3AsO_4+Aq. (Haack, C. C. **1890**, II. 736.)

Mercurous silver arsenate, Hg_2AgAsO_4.

Sol. in hot conc. HNO_3. (Jacobsen, Bull. Soc. 1909, (4) **5**. 948.)

Mercurous arsenate nitrate, $Hg_3AsO_4, HgNO_3+H_2O$.

Insol. in H_2O or $HC_2H_3O_2$; sol. in HNO_3+Aq. (Simon, Pogg. **41**. 424.)

$3Hg_3AsO_4, 2HgNO_3, 2Hg_2O$. Ppt. (Haack.)

Molybdenum arsenate.

Ppt.

Nickel arsenate, basic, $5NiO, As_2O_5$.

Min. —— (Bergemann.)

$Ni(NiOH)AsO_4$. Difficultly attacked by acids or alkalies. (Coloriano, Bull. Soc. (2) **45**. 241.)

$5NiO, 2As_2O_5+3H_2O$. As above.

Nickel arsenate, $Ni_3(AsO_4)_2$.

Min. —— (Bergemann.)

$+xH_2O$. Insol. in H_2O. Sol. in H_3AsO_4, and conc. mineral acids. Easily sol. in NH_4OH+Aq.

$+2H_2O$. Insol. in H_2O; difficultly sol. in acids (Coloriano, Bull. Soc. **45**. 241.)

$+8H_2O$. Min. *Nickel-bloom, Annabergite.* Easily sol. in acids.

$NiHAsO_4+H_2O$. Sol. in H_2O. Difficultly attacked by acids. (Coloriano, C. R. **103**. 274.)

Nickel potassium arsenate, $12NiO, 3K_2O, 5As_2O_5$.

(Lefèvre.)

$2NiO, K_2O, As_2O_5$. Rapidly sol. in dil. acids. (Lefèvre.)

Nickel sodium arsenate, $NiNaAsO_4$.

Very slowly sol. in dil. acids. (Lefèvre.)

$4NiO, 2Na_2O, 3As_2O_5$. (Lefèvre.)

Nickel arsenate ammonia,

$Ni_3(AsO_4)_2, NH_3+7H_2O$.

$Ni_3(AsO_4)_2, 2NH_3+6H_2O$.

$Ni_3(AsO_4)_2, 3NH_3+5H_2O$. (Ducru, C. R. 1900, **131**. 703.)

Palladium arsenate (?).

Ppt.

Platinum arsenate (?).

Ppt. Sol. in HNO_3+Aq.

Potassium arsenate, K_3AsO_4.

Deliquescent. Very sol. in H_2O. (Graham, Pogg. **32.** 47.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Potassium hydrogen arsenate, K_2HAsO_4.

Sol. in H_2O.

Potassium ***di*****hydrogen arsenate,** KH_2AsO_4.

Sol. in 5.3 pts. H_2O at 6°, forming a solution of sp. gr. 1.1134. Much more sol. in hot H_2O. Insol. in alcohol.

Sol. in 26,666 pts. boiling conc. alcohol. (Wenzel.)

Potassium sodium hydrogen arsenate, $KNaHAsO_4+16H_2O$.

Sol. in H_2O.

$K_3Na_3H_6(AsO_4)_4+9H_2O$. Sol. in H_2O, and not easily decomp. thereby into its constituents. (Filhol and Senderens, C. R. **95.** 343.)

Potassium strontium arsenate, $KSrAsO_4$.

(Lefèvre, C. R. **108.** 1058.)

Potassium vanadium arsenate, $K(VO_2)_2AsO_4+2\frac{1}{2}H_2O$.

See **Arseniovanadate, potassium.**

Potassium zinc arsenate, $KZnAsO_4$.

(Lefèvre.)

Potassium arsenate sulphate.

See **Arseniosulphate, potassium.**

Rhodium arsenate (?).

Ppt.

Rubidium ***meta*****arsenate,** $RbAsO_3$.

Sol. in H_2O. (Bouchonnet, C. R. 1907, **144.** 642.)

Rubidium arsenate, $Rb_3AsO_4+2H_2O$.

Very hydroscopic; sol. in H_2O to give an alkaline solution. Absorbs CO_2 from the air. (Bouchonnet, *l.c.*)

Rubidium ***pyro*****arsenate,** $Rb_4As_2O_7$.

(Bouchonnet, *l.c.*)

Rubidium hydrogen arsenate, Rb_2HAsO_4+ $+H_2O$.

Absorbs CO_2 from the air. Very hydroscopic; sol. in H_2O. Insol. in alcohol. (Bouchonnet, *l.c.*)

Rubidium ***di*****hydrogen arsenate,** RbH_2AsO_4.

Not hydroscopic. Very sol. in H_2O; aq. solution is acid to litmus. (Bouchonnet, *l.c.*)

Silver arsenate, Ag_3AsO_4.

Insol. in H_2O. Sol. in acids; easily sol. in H_3AsO_4+Aq. (Joly, C. R. **103.** 1071.)

1 l. H_2O dissolves 0.0085 g. Ag_3AsO_4 at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)

Much less sol. in H_3AsO_4 than Ag_3PO_4. (Graham.)

Sol. in NH_4OH+Aq. (Scheele.)

Sol. in $(NH_4)_2CO_3$+Aq. Insol. in NH_4 sulphate, nitrate, or succinate+Aq. (Wittstein.)

Very sl. sol. in NH_4NO_3+Aq, more easily in $HC_2H_3O_2$+Aq. (Graham.)

Sol. in $Na_2S_2O_3$+Aq, but not so easily as Ag_3PO_4.

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Silver hydrogen arsenate, Ag_2HAsO_4.

Decomp. by H_2O, with formation of Ag_3AsO_4. (Setterberg, Berz. J. B. **26.** 208.)

AgH_2AsO_4. Decomp. by H_2O. (Joly, C. R. **103.** 1071.)

$Ag_2O, 2As_2O_5$. Decomp. by H_2O. Rather sl. sol. in HNO_3+Aq. Very easily sol. in NH_4OH+Aq. (Hurtzig and Geuther, A. **111.** 168.)

Silver arsenate ammonia, $Ag_3AsO_4, 4NH_3$.

Easily sol. in H_2O. (Widmann, Bull. Soc. (2) **20.** 64.)

Silver arsenate sulphate, $3Ag_2O, As_2O_5, SO_3$.

Decomp. by H_2O, with separation of Ag_3AsO_4; decomp. by dil. H_2SO_4+Aq. (Setterberg, Berz. J. B. **26.** 209.)

Sodium arsenate, $Na_3AsO_4+12H_2O$.

Permanent in dry air. Sol. in 3.57 pts. H_2O at 15.5°. (Graham.) 100 pts. H_2O at 15.5° dissolve 28 pts. $Na_3AsO_4+12H_2O$. (Berzelius.) Sol. in 3.75 pts. H_2O at 17°; or 100 pts. H_2O at 17° dissolve 26.7 pts.; or sat. Na_3AsO_4+Aq at 17° contains 21.1% $Na_3AsO_4+12H_2O$ or 10.4% Na_3AsO_4, and has sp. gr. 1.1186. (Schiff, A. **113.** 350.)

Melts in crystal H_2O at 85.5°.

Sp. gr. of Na_3AsO_4+Aq at 17°.
% = % $Na_3AsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0053	9	1.0490	17	1.0945
2	1.0107	10	1.0547	18	1.1003
3	1.0161	11	1.0603	19	1.1061
4	1.0215	12	1.0659	20	1.1121
5	1.0270	13	1.0716	21	1.1179
6	1.0325	14	1.0773	22	1.1238
7	1.0380	15	1.0830	..	......
8	1.0435	16	1.0887	..	......

(Schiff, calculated by Gerlach, Z. anal. **8.** 286.)

"Arseniate of soda" dissolves in 60 pts. boiling alcohol. (Wenzel.)

$+4\frac{1}{2}H_2O$. (Hall, Chem. Soc. **51.** 93.)

$+10H_2O$. Efflorescent. (Hall.)

Sodium hydrogen arsenate, $Na_2HAsO_4+7H_2O$.

Not efflorescent. (Schiff.)

Solubility in $Pb(NO_3)_2$+Aq. A table is given which records the g. of As_2O_5 in 100 cc. of the filtrate. (Curry, J. Am. Chem. Soc. **1915, 37.** 1685.)

$+7\frac{1}{2}H_2O$. (Lescoeur, C. R. **104.** 1171.)

$+12H_2O$. Efflorescent. Sol. in H_2O; sol. in 1.79 pts. H_2O at 14°; or 100 pts. H_2O at 14° dissolve 56 pts. $Na_2HAsO_4+12H_2O$. Sat. Na_2HAsO_4+Aq contains 35.9% $Na_2HAsO_4+12H_2O$, or 16.5% Na_2HAsO_4, and has sp. gr. = 1.1722. (Schiff, A. **113.** 350.)

100 pts. H_2O at 7.2° dissolve 22.268 pts. (Thompson.)

100 pts. H_2O dissolve 17.2 pts. $Na_2HAsO_4+12H_2O$ at 0°, and 140 7 pts. at 30°. (Tilden, Chem. Soc. **45.** 409.)

Melts in crystal H_2O at 28°. (Tilden.)

Sp. gr. of Na_2HAsO_4+Aq at 14°.
% = % $Na_2HAsO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0042	15	1.0665	29	1 1358
2	1.0084	16	1 0712	30	1.1410
3	1.0126	17	1.0759	31	1.1463
4	1.0168	18	1.0807	32	1.1516
5	1.0212	19	1.0855	33	1.1569
6	1.0256	20	1.0904	34	1 1623
7	1.0300	21	1.0953	35	1.1677
8	1.0344	22	1.1003	36	1.1731
9	1.0389	23	1.1052	37	1.1786
10	1.0434	24	1 1103	38	1.1841
11	1.0479	25	1.1153	39	1 1896
12	1.0525	26	1.1204	40	1.1952
13	1.0571	27	1 1255	.	.
14	1.0618	28	1.1306	. .	. . . . .

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Insol. in alcohol.

$+13\frac{1}{2}H_2O$. (Setterberg.)

Sodium *di*hydrogen arsenate, $NaH_2AsO_4+H_2O$.

More sol. in H_2O than Na_3AsO_4 or Na_2HAsO_4. (Schiff.)

$+2H_2O$. Efflorescent. (Joly and Duffet, C. R. **102.** 1391.)

Sodium *tri*hydrogen *di*arsenate, $Na_3H_3(AsO_4)_2+3H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **95.** 343.)

Sodium strontium arsenate, $NaSrAsO_4$.

Not attacked by boiling H_2O. (Lefèvre.)

$+9H_2O$. Scarcely sol. in H_2O. (Joly, C. R. **104.** 905.)

$+18H_2O$. (Joly.)

Sodium uranyl arsenate, $Na(UO_2)AsO_4$.

Ppt. (Werther, A. **68.** 312.)

Sodium zinc arsenate, $NaZnAsO_4$.

Slowly sol. in dil. acids. (Lefèvre.)

$Na_2ZnAs_2O_7$. As above. (Lefèvre.)

Sodium arsenate fluoride, Na_3AsO_4, $NaF+12H_2O$.

Sol. in 9.5 pts. H_2O at 25°, and 2 pts. at 75°. (Briegleb, A. **97.** 95.)

Sodium arsenate stannate, $6Na_2O$, $2As_2O_5$, SnO_2+50H_2O.

More difficultly sol. than sodium stannate. (Haeffely, Phil. Mag. (4) **10.** 290.)

$5Na_3AsO_4$, $Na_2SnO_3+60H_2O$. (Prandtl, B. 1907, **40.** 2133.)

Sodium arsenate sulphate, $Na_8As_6O_{19}$, $2Na_2SO_4$.

Sol. in H_2O. (Mitscherlich.)

$Na_4As_2O_7$, Na_2SO_4. (Setterberg.)

Sodium arsenate tungstate, $Na_4As_2O_7$, $Na_2W_3O_{10}+20H_2O$.

See **Arseniotungstate, sodium.**

Strontium arsenate, $Sr_3(AsO_4)_2$.

Not attacked by boiling H_2O; easily sol. in dil. acids. (Lefèvre, A. ch. (6) **27.** 5.)

Strontium *pyro*arsenate, $Sr_2As_2O_7$.

Decomp. by cold H_2O into $SrHAsO_4+1\frac{1}{2}H_2O$. (Lefèvre.)

Strontium hydrogen arsenate, $SrHAsO_4+1\frac{1}{2}H_2O$.

Insol. in cold, but decomp. by hot H_2O into a basic, and a sol. acid salt. 100 pts. H_2O at 15.5° dissolve 0.284 pt. (Thompson, **1831.**)

Sol. in $HC_2H_3O_2$, and very easily in HCl+Aq. (Kotschoubey, J. pr. **49.** 182.)

Sol. in HNO_3+Aq.

$SrH_4(AsO_4)_2+2H_2O$. Partly sol. in H_2O. (Hörmann, Dissert. **1879.**)

Strontium vanadium arsenate, $SrHAsO_4$, $2(VO_2)H_2AsO_4+7\frac{1}{2}H_2O$.

See **Arseniovanadate, strontium.**

Strontium arsenate chloride, $3Sr_3(AsO_4)_2$, $SrCl_2$.

Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (Lechartier, C. R. **65.** 172.)

Thallous arsenate, Tl_3AsO_4.

Sol. in H_2O. (Willm, A. ch. (4) **5.** 5.)

Thallous hydrogen arsenate, Tl_2HAsO_4.

Very easily sol. in H_2O. (Willm.)

Thallous *di*hydrogen arsenate, TlH_2AsO_4.

Easily sol. in H_2O. (Willm.)

Thallic arsenate, $TlAsO_4+2H_2O$.

Insol. in H_2O; sol. in HCl+Aq; decomp. by NH_4OH, or KOH+Aq. (Willm.)

Thorium hydrogen arsenate, $Th(HAsO_4)_2+6H_2O$.

Insol. in H_2O or H_3AsO_4+Aq. (Berzelius.)

Ppt.; insol. in H_2O. (Barbieri, C. A. **1911.** 3385.)

$Th(H_2AsO_4)_4+4H_2O$. Decomp. by H_2O. (Barbieri, *l. c.*)

Tin (stannous) arsenate, $SnHAsO_4+\frac{1}{2}H_2O$.

Insol. in H_2O. (Lenssen, A. **114.** 113.)

Tin (stannic) arsenate, $2SnO_2$, As_2O_5.

Ppt. Insol. in H_2O and dil. HNO_3+Aq. (Haeffely, Phil. Mag. (4) **10.** 290.)

$Sn_3(AsO_4)_4+6H_2O$. Insol. in H_2O; sol. in conc. $HCl+Aq$, and in aqua regia; insol. in HNO_3+Aq or H_2SO_4. (Williams, Proc. Soc. Manchester, **15.** 67.)

Colloidal.. Very slowly sol. in H_2O, from which it is pptd. by HCl, HNO_3, or H_2SO_4+Aq; also by $BaCl_2$, $CaCl_2$, NH_4Cl, and $FeCl_3+Aq$, and by $AgNO_3$, or $KI+Aq$. Not pptd. by alcohol, $HC_2H_3O_2$, $HgCl_2$, Na_2CO_3, K_2CO_3, or $(NH_4)_2CO_3+Aq$. The pptd. jelly is readily sol. in conc. acids, and KOH, or $NaOH+Aq$. (Williams, *l.c.*)

Tin (stannous) arsenate chloride, $Sn_3(AsO_4)_2$, $SnCl_2+2H_2O$.

Decomp. on air. (Lenssen, A. **114.** 113.)

Titanium arsenate (?).

Insol. in H_2O. Sol. in titanic acid, arsenic acid, or $HCl+Aq$. Sol. in Ti salts+Aq. (Rose.)

Titanyl arsenate, $5TiO_2$, $2As_2O_5$.

Sol. in acids without decomp. Scarcely attacked by KOH or by NH_4OH+Aq. (Reichard, B. 1894, **27.** 1026.)

Uranous arsenate, $U_3(AsO_4)_2$.

Ppt.

Uranous hydrogen arsenate, $UH_2(AsO_4)_2+3H_2O$.

Ppt. Sol. in $HCl+Aq$.

Uranyl arsenate, $(UO_2)HAsO_4+4H_2O$.

Insol. in H_2O, $HC_2H_3O_2$, and saline solutions, as NH_4Cl+Aq; sol. in the mineral acids; sol. in K_2CO_3+Aq. (Werther, A. **68.** 313.)

$(UO_2)H_4(AsO_4)_2+3H_2O$. (Werther.)

$(UO_2)_2As_2O_7$. Insol. in H_2O; sol. in acids.

$(UO_2)_3(AsO_4)_2+12H_2O$.

Min. *Troegerite.*

Vanadium *di*hydrogen arsenate, $(VO_2)H_2AsO_4+4H_2O$.

Easily sol. in H_2O. (Friedheim, B. **23.** 2600.)

See **Arseniovanadic acid.**

Vanadium zinc arsenate, $(VO_2)_2ZnH_2(AsO_4)_2+5\frac{1}{2}H_2O$, and $2(VO_2)H_2AsO_4+6\frac{1}{2}H_2O$.

See **Arseniovanadate, zinc.**

Vanadyl arsenate, $(VO)_2HAsO_4+H_2O$.

Very slowly sol. in H_2O; insol. in alcohol; easily sol. in $HCl+Aq$. (Berzelius.)

Composition given by Friedheim (B. **23.** 2600).

Yttrium arsenate, $YtHAsO_4$.

Ppt. Insol. in acetic, easily sol. in mineral acids.

Zinc arsenate, basic, $4ZnO$, $As_2O_5+H_2O$.

(Friedel, J. B. **1866.** 949.)

Min. *Adamite.* Easily sol. in dil. $HCl+Aq$, and is attacked by $HC_2H_3O_2$.

Zinc arsenate, $Zn_3(AsO_4)_2$.

(deSchulten, Bull Soc. (3) **2.** 300.)

$+3H_2O$. Ppt. Sol. in HNO_3, and H_3AsO_4+Aq. (Köttig, J. pr. **48.** 182.)

$+8H_2O$.

Min. *Köttigite.*

Zinc arsenate, acid, $Zn_5H_2(AsO_4)_4$.

Easily sol. in cold $HCl+Aq$, less easily in cold HNO_3. Sol. in KOH, or $NaOH+Aq$ (Gorguel, Dissert, **1894.**)

$+3H_2O$. Insol. in H_2O; sol. in H_3AsO_4, or HNO_3+Aq. (Mitscherlich.)

$+5H_2O$. Sol. in dil. $HCl+Aq$. (Demel, B. **12.** 1279.) Could not be obtained, (Coloriano, Bull. Soc. (2) **45.** 709.)

$2ZnO$, As_2O_5. Very slowly decomp. by cold, rapidly by boiling H_2O. (Lefèvre.)

$ZnHAsO_4+H_2O$. Insol. in H_2O. (Debray, Bull. Soc. (2) **2.** 14.)

Decomp. by hot H_2O into $4ZnO$, $As_2O_5+H_2O$. (Coloriano, C. R. **103.** 273.)

$Zn(ZnOH)_2As_2O_7+7H_2O$ (Gorgeul.)

Zinc arsenate ammonia, $Zn_3(AsO_4)_2$, $2NH_3+3H_2O$.

Insol. in H_2O; sol. in acids, NH_4OH, or $KOH+Aq$. (Bette, A. **15.** 141.)

Zirconium arsenate, $2ZrO_2$, $As_2O_5+{}^5/_2H_2O=(ZrO)HAsO_4+\frac{3}{4}H_2O$.

Ppt. Insol. in H_2O or $HCl+Aq$. (Paykull, B. **6.** 1467.)

*Per*arsenic acid.

See **Perarsenic acid.**

Arsenicotungstic Acid.

Ammonium vanadium arsenicotungstate.

See **Arsenicovanadicotungstate, ammonium.**

Arsenicovanadicotungstic acid.

Ammonium arsenicovanadicotungstate, $16(NH_4)_2O$, $5As_2O_3$, $15V_2O_3$, $26WO_3+101H_2O$.

Sl. sol. in cold, readily sol. in hot H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 308.)

Arsenimide, $As_2(NH)_3$.

Decomp. by H_2O. (Hugot, C. R. 1904, **139.** 56.)

Arsenioarsenic acid, $3As_2O_3$, $2As_2O_5+3H_2O$.

Decomp. by H_2O. (Joly, C. R. **100.** 1221.)

$3As_2O_3$, $As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

As_2O_3, $As_2O_5+H_2O$. Decomp. by H_2O. (Joly.)

See also **Arsenic** *tri***oxide** *pent***oxide.**

Arseniochromic acid.

Ammonium arseniochromate, $2(NH_4)_2O$, As_2O_5, $4CrO_3+H_2O$.

Insol. in H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 280.)

$3(NH_4)_2O$, As_2O_5, $8CrO_3$. Decomp. by recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 281.)

Potassium arseniochromate, $2K_2O$, As_2O_5, $4CrO_3$.

Decomp. by recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 275.)

$2K_2O$, As_2O_5, $4CrO_3+H_2O$. Decomp. by recryst. from H_2O. (Friedheim and Mozkin, *l. c.*)

Arseniomolybdic acid, As_2O_5, $6MoO_3+10H_2O$.

By recryst. from H_2O the comp. with $18H_2O$ is formed. (Pufahl, Dissert. **1888.**)

$+16H_2O$. Sol. in H_2O. (Debray.)

$+18H_2O$. Completely sol. in H_2O. Sp. gr. of sat. solution at 18.8° is 2.21. Easily sol. in abs. alcohol. Insol. in CS_2, liq. hydrocarbons and $CHCl_3$. (Pufahl, *l.c.*)

As_2O_5, $7MoO_3+14H_2O$. (Seyberth, B. **7.** 391.)

As_2O_5, $18MoO_3+28H_2O$. Very sol. in H_2O. Sp. gr. of sat. solution at 18.3° = 2.45 and 1 cc. contains 2.16 g. acid. Easily sol. in absolute alcohol; insol. in CS_2, liquid hydrocarbons and $CHCl_3$. (Pufahl, *l.c.*)

Sol. in ether with subsequent separation into two layers. *See* Phosphotungstic acid. (Drechsel, B. **20.** 1452.)

$+38H_2O$. Efflorescent. When recryst. comp. with $28H_2O$ is formed. (Pufahl, *l.c.*)

As_2O_5, $20MoO_3+27H_2O$. Sl. sol. in HNO_3+Aq. (Debray, C. R. **78.** 1408.)

Ammonium arseniomolybdate, $(NH_4)_2O$, As_2O_5, $2MoO_3+3H_2O$.

(Friedheim, Z. anorg. 1894, **6.** 28.)

$+4H_2O$. (Friedheim, *l.c.*)

$(NH_4)_2O$, As_2O_5, $6MoO_3+2H_2O$. Sl. sol. in cold H_2O; sol. in acids. (Debray.)

$+4H_2O$. Sl. sol. in cold, very easily sol. in hot H_2O. (Pufahl, *l.c.*)

$2(NH_4)_2O$, As_2O_5, $6MoO_3+6H_2O$. Sl. sol. in H_2O. Cannot be recryst. therefrom. (Pufahl.)

$+12H_2O$. (Friedheim, Z. anorg. 1894, **6.** 31.)

$3(NH_4)_2O$, As_2O_5, $6MoO_3+4H_2O$. (Friedheim, *l.c.*)

$+8H_2O$. (Friedheim, *l.c.*)

$(NH_4)_2O$, $2H_2O$, $7MoO_3$, $As_2O_5+4H_2O$. Sol. in hot H_2O. (Seyberth, B. **7.** 391.)

Not obtained. (Pufahl.)

$7(NH_4)_2O$, $2As_2O_5$, $14MoO_3+28H_2O$. (Friedheim, *l.c.*)

$5(NH_4)_2O$, As_2O_5, $16MoO_3+5H_2O$. (Friedheim, Z. anorg. 1894, **6.** 31.)

$5(NH_4)_2O$, As_2O_5, $16MoO_3+9H_2O$.. Nearly insol. in cold, sol. in boiling H_2O. Easily sol. in NH_4OH+Aq. (Gibbs, Am. Ch. J. **3.** 402.)

$+12H_2O$. (Pufahl, *l.c.*)

$2(NH_4)_2O$, As_2O_5, $18MoO_3+17H_2O$. (Pufahl, *l.c.*)

$3(NH_4)_2O$,As_2O_5,$18MoO_3+14H_2O$. Very sol. in H_2O and alcohol. (Kehrmann, Z. anorg. 1894, **7.** 421.)

$3(NH_4)_2O$, As_2O_5, $20MoO_3$. Easily sol. in H_2O. (Debray, C. R. **78.** 1408.)

$3(NH_4)_2O$, As_2O_5, $24MoO_3+12H_2O$. Decomposed by H_2O, especially when boiling. Easily sol. in NH_4OH+Aq, less easily sol. in warm H_2SO_4 and boiling H_3AsO_4+Aq. Sl. sol. in molybdic acid+Aq, HNO_3, and conc. NH_4NO_3+Aq. (Pufahl, *l.c.*)

Barium arseniomolybdate, BaO, As_2O_5, $6MoO_3+10H_2O$.

Sl. sol. in H_2O. Partially decomp. by boiling. (Pufahl, *l.c.*)

$3BaO$, As_2O_5, $6MoO_3$. Sl. sol. in H_2O. (Pufahl, *l.c.*)

$3BaO$, As_2O_5, $7MoO_3$. Ppt. (Seyberth.)

$3BaO$, As_2O_5, $18MoO_3$. Decomp. by H_2O. (Pufahl, *l.c.*)

Cadmium arseniomolybdate, CdO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3CdO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Cæsium arseniomolybdate, Cs_2O, As_2O_5, $6MoO_3$.

Sl. sol. in H_2O. (Pufahl, *l.c.*)

$4Cs_2O$, As_2O_5, $26MoO_3+15H_2O$. Ppt. (Ephraim, Z. anorg. 1910, **65.** 246.)

Calcium arseniomolybdate, CaO, As_2O_5, $6MoO_3+10H_2O$.

Rather difficultly sol. in cold H_2O. (Pufahl, *l.c.*)

$3CaO$, As_2O_5, $6MoO_3$. As Ba salt. (Pufahl, *l.c.*)

$3CaO$, As_2O_5, $18MoO_3+32H_2O$. Very sol. in H_2O. Solution sat. at 18° has sp. gr. = 2.163. (Pufahl, *l.c.*)

Cobalt arseniomolybdate, CoO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3CoO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Cupric arseniomolybdate, CuO, $2H_2O$, As_2O_5, $6MoO_3+15H_2O$. (Pufahl.)

$3CuO$, $3H_2O$, As_2O_5, $18MoO_3+34H_2O$. (Pufahl.)

Lithium arseniomolybdate, Li_2O, As_2O_5, $6MoO_3+14H_2O$.

Very sol. in H_2O. (Pufahl, *l.c.*)

$3Li_2O$, As_2O_5, $18MoO_3+34H_2O$. Solution sat. at 15° has sp. gr. of 2.481. (Pufahl, *l.c.*)

Magnesium arseniomolybdate, MgO, As_2O_5, $6MoO_3+13H_2O$.

Very sol. in H_2O. (Pufahl, *l.c.*)

$3MgO$, As_2O_5, $18MoO_3+36H_2O$. Sol. in H_2O. (Pufahl, *l.c.*)

Manganese arseniomolybdate, MnO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3MnO$, $3H_2O$, As_2O_5, $18MoO_3+33H_2O$. (Pufahl.)

Nickel arseniomolybdate, NiO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3NiO$, $3H_2O$, As_2O_5, $18MoO_3+34H_2O$. (Pufahl.)

Potassium arseniomolybdate, K_2O, As_2O_5, $2MoO_3+5H_2O$.

Sol. in H_2O. (Friedheim, Z. anorg. **2.** 314.)

K_2O, As_2O_5, $6MoO_3+5H_2O$. Sol. in hot H_2O without decomp. (Friedheim, Z. anorg. 1892, **2.** 330.)

K_2O, As_2O_5, $18MoO_3+25H_2O$. Easily sol. in cold H_2O. Decomp. on dilution. (Pufahl, *l.c.*)

$3K_2O$, As_2O_5, $18MoO_3+26H_2O$. Easily sol. in H_2O. (Pufahl, *l.c.*)

$3K_2O$, As_2O_5, $20MoO_3$. Insol. in H_2O. (Debray, C. R. **78.** 1408.)

$3K_2O$, As_2O_5, $24MoO_3+12H_2O$. Somewhat sol. in H_2O acidified with HNO_3. (Pufahl, *l.c.*)

Rubidium arseniomolybdate, $3Rb_2O$, $3As_2O_5$, $5MoO_3+9H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **65.** 241.)

Rb_2O, As_2O_5, $6MoO_3$. Sl. sol. in H_2O. (Pufahl, *l.c.*)

$4Rb_2O$, As_2O_5, $18MoO_3+40H_2O$. Pptd. (Ephraim, Z. anorg. 1910, **65.** 241–4.)

Silver arseniomolybdate, $3Ag_2O$, As_2O_5, $6MoO_3+xH_2O$.

(Pufahl, Leipzig, **1888.**)

$6Ag_2O$, As_2O_5, $18MoO_3+22H_2O$. Sl. sol. in H_2O. Very sol. in NH_4OH and in dil. HNO_3. (Pufahl, *l.c.*)

$7Ag_2O$, $2As_2O_5$, $36MoO_3+30H_2O$. Sl. sol. in cold, easily sol. in hot H_2O strongly acidified with HNO_3. (Pufahl, *l.c.*)

Sodium arseniomolybdate, Na_2O, As_2O_5, $2MoO_3+8H_2O$.

(Friedheim, Z. anorg. 1892, **2.** 357.)

Na_2O, As_2O_5, $6MoO_3+12H_2O$. Very sol. in H_2O. Solution sat. at 19.8° has sp. gr. = 1.678. (Friedheim, *l.c.*)

$3Na_2O$, As_2O_5, $6MoO_3+11H_2O$, $+12H_2O$, and $+13H_2O$. Sl. sol. in cold H_2O. (Pufahl, *l.c.*)

$3Na_2O$, As_2O_5, $18MoO_3+24H_2O$. Easily sol. in H_2O. (Pufahl, *l.c.*)

$+30H_2O$. Sl. sol. in cold H_2O. (Pufahl, *l.c.*)

Strontium arseniomolybdate, SrO, As_2O_5, $6MoO_3+10H_2O$.

As Ba salt. (Pufahl, *l.c.*)

$3SrO$, As_2O_5, $6MoO_3$. As Ba salt. (Pufahl, *l.c.*)

$3SrO$, As_2O_5, $18MoO_3+32H_2O$. Very sol. in H_2O. (Pufahl, *l.c.*)

Thallium arseniomolybdate, $6Tl_2O$, As_2O_5, $18MoO_3+xH_2O$.

Ppt. (Pufahl.)

$3Tl_2O$, $3H_2O$, As_2O_5, $18MoO_3+3H_2O$. Ppt. (Pufahl.)

Zinc arseniomolybdate, ZnO, $2H_2O$, As_2O_5, $6MoO_3+11H_2O$.

(Pufahl.)

$3ZnO$, As_2O_5, $18MoO_3+37H_2O$. Very sol. in H_2O. (Pufahl.)

Arseniophosphovanadicotungstic acid.

Ammonium arseniophosphovanadicotungstate, $88(NH_4)_2O$, $2As_2O_5$, $12P_2O_5$, $69V_2O_3$, $148WO_3+484H_2O$.

Sol. in H_2O. Insol. in alcohol and ether. (Rogers, J. Am. Chem. Soc. 1903, **25.** 313.)

Arseniophosphovanadicovanadiotungstic acid.

Ammonium arseniophosphovanadicovanadiotungstate, $99(NH_4)_2O$, $2As_2O_5$, $12P_2O_5$, $6V_2O_3$, $66V_2O_5$, $191WO_3+522H_2O$.

Sl. sol. in cold H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 314.)

Arseniophosphovanadiotungstic acid.

Ammonium arseniophosphovanadiotungstate, $82(NH_4)_2O$, $3As_2O_5$, $12P_2O_5$, $52V_2O_5$, $201WO_3+567H_2O$.

Very sol. in warm H_2O. Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, **25.** 312.)

Arseniosulphuric acid.

Ammonium arseniosulphate, $2(NH_4)_2O$, As_2O_5, $2SO_3+3H_2O$.

Can be recryst. from H_2O. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 290.)

Potassium arseniosulphate, $2K_2O$, As_2O_5, $2SO_3+3H_2O$.

(Friedheim and Mozkin, Z. anorg. 1894, **6** 289.)

$5K_2O$, As_2O_5, $8SO_3+6H_2O$. (Friedheim and Mozkin, Z. anorg. 1894, **6.** 291.)

Sodium arseniosulphate, $2Na_2O$, As_2O_5, $2SO_3+3H_2O$.

(Friedheim and Mozkin, Z. anorg. 1894, **6.** **290.**)

Arseniotelluric acid.

Ammonium arseniotellurate, $2(NH_4)_2O$, As_2O_5, TeO_3+4H_2O.

Sol. in H_2O. (Weinland, Z. anorg. 1901, **28.** 65.)

$4(NH_4)_2O$, $3As_2O_5$, $2TeO_3+11H_2O$. Sol. in H_2O. (Weinland.)

Sodium arseniotellurate, $2Na_2O$, As_2O_5, $2TeO_3+9H_2O$.

Ppt. (Weinland, *l.c.*)

Arseniotungstic acid, $3H_2O$, As_2O_5, $16WO_3+32H_2O=H_3AsW_8O_{28}+16H_2O$ (α-anhydroarsenioluteotungstic acid).

Sol. in H_2O. (Kehrmann, A. **245.** 45.)

$3H_2O$, As_2O_5, $19WO_3$ (?). Sp. gr. of sat. solution in H_2O is 3.279. (Fremery, B. **17.** **296.**)

Is a mixture containing principally $H_3AsW_8O_{28}+16H_2O$. (Kehrmann.)

As_2O_5, $18WO_3+xH_2O$. Sol. in H_2O. (Kehrmann, Z. anorg. 1899, **22.** 292.)

Aluminum ammonium arseniotungstate.

See **Aluminicoarseniotungstate, ammonium.**

Ammonium arseniotungstate, $4(NH_4)_2O$, $2H_2O$, As_2O_5, $6WO_3+3H_2O$.

Sl. sol. in cold H_2O or HNO_3+Aq; easily sol. in boiling H_2O. (Gibbs, Proc. Am. Acad. **16.** 135.)

$7(NH_4)_2O$, As_2O_5, $14WO_3$, $+17H_2O$. Very sl. sol. even in boiling H_2O. (Fremery, *l. c.*)

$3(NH_4)_2O$, As_2O_5, $16WO_3+16H_2O=(NH_4)_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$5(NH_4)_2O$, As_2O_5, $17WO_3+8H_2O$. Can be recryst. from H_2O without decomp. Decomp. by long boiling with H_2O. (Kehrmann, Z. anorg. 1899, **22.** 294.)

$3(NH_4)_2O$, As_2O_5, $18WO_3+14$, or $18H_2O$. Very sol. in cold H_2O. Can be recryst. from H_2O. (Kehrmann, *l.c.*)

$3(NH_4)_2O$, As_2O_5, $21WO_3+xH_2O$. Easily sol. in H_2O. Easily decomp. on recryst. (Kehrmann, *l.c.*)

$3(NH_4)_2O$, As_2O_5, $24WO_3+12H_2O$. More sol. in H_2O than corresponding phosphotungstate. (Kehrmann, *l.c.*)

Barium arseniotungstate, $2BaO$, As_2O_5, $16WO_3+xH_2O$.

Sol. in H_2O. (Péchard, A. ch. (6) **22.** 262.)

$7BaO$, As_2O_5, $22WO_3+54H_2O$. Sol. in H_2O. Can be recryst. therefrom. (Kehrmann, *l.c.*)

Potassium arseniotungstate, $3K_2O$, $3H_2O$, As_2O_5, $6WO_3$.

Insol. in H_2O. Readily sol. in alkali hydroxides+Aq. (Gibbs.)

$3K_2O$, As_2O_5, $16WO_3+16H_2O=K_3AsW_8O_{28}+8H_2O$. Sol. in H_2O. (Kehrmann.)

$5K_2O$, As_2O_5, $17WO_3+22H_2O$. Scarcely sol. in cold H_2O. (Kehrmann, Z. anorg. 1899, **22.** 295.)

$3K_2O$, As_2O_5, $18WO_3+14H_2O$. Efflorescent. (Kehrmann, *l.c.*)

$3K_2O$, As_2O_5, $19WO_3+16H_2O$ (?). Sol. in H_2O. (Fremery.)

Silver arseniotungstate, $Ag_5AsW_8O_{29}$.

Insol. in H_2O (Kehrmann, A. **245.** 55); perhaps identical with—

$6Ag_2O$, As_2O_5, $16WO_3+11H_2O$. Insol. in H_2O. (Gibbs.)

Sodium arseniotungstate, $3Na_2O$, As_2O_5, $3WO_3+20H_2O$.

Very sol. in H_2O. (Lefort, C. R. **92.** 1461.)

Arsenious acid, $HAsO_2$.

Solubility of $HAsO_2$ in amyl alcohol+Aq. at 25°.

a_w = mol. of $HAsO_2$ in 1 l. of H_2O.
a_a = mol. of $HAsO_2$ in 1 l. of amyl alcohol.
h = partition coefficient.

a_w	a_a	h
0 0449	0.0082	5.48
0 0446	0.0083	5 38
0.0887	0.0164	5 41
0.0892	0.0161	5.53
0.1800	0.0324	5.55

(Auerbach, Z. anorg. 1903, **37.** 356.)

Solubility of $HAsO_2$ in sat. H_3BO_3+Aq and amyl alcohol.

a_w = mol. of $HAsO_2$ in 1 l. of H_2O.
a_a = mol. of $HAsO_2$ in 1 l. of amyl alcohol.
h = partition coefficient.

a_w	a_a	h
0.0859	0.0161	5.33
0.1720	0.0321	5.35

(Auerbach, *l.c.*)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

See **Arsenic** ***trioxide.***

Arsenites.

All arsenites, except those of the alkali metals, are partially or wholly insol. in H_2O, but easily sol. in acids; several are sol. in $(NH_4)_2SO_4$, NH_4NO_3, or NH_4Cl+Aq.

All basic arsenites are sol. in acids except those that give an insol. salt with the bases. Many are sol. in excess of As_2O_3+Aq.

Aluminum arsenite, Al_2O_3, As_2O_3.

Sl. sol. in boiling H_2O. Easily sol. in NaOH +Aq and in acids. (Reichard, B. 1894, **27.** 1029.)

Aluminum arsenite iodide, AlI_3, $6As_2O_3$+ $16H_2O$.

(Grühl, Dissert. **1897.**)

Ammonium arsenite, NH_4AsO_2.

Very sol. in H_2O. (Luynes, J. pr. **72.** 180.) Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014); (Naumann, B. 1904. **37.** 4328.)

$(NH_4)_3AsO_3$ (?). Sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 11.)

$(NH_4)_4As_2O_5$. Very sol. in H_2O. Insol. in alcohol or ether. (Stein, A. **74.** 218.)

Could not be obtained. (Stavenhagen.)

Ammonium arsenite bromide, $2As_2O_3$, NH_4Br.

Sl. sol. in H_2O. (Rüdorff, B. **19.** 2679.)

Ammonium arsenite chloride, As_2O_3, NH_4Cl.

Sl. sol. in H_2O. Sol. in warm dil. NH_4OH +Aq. (Rüdorff.)

Ammonium arsenite iodide, $2As_2O_3$, NH_4I.

Sl. sol. in boiling H_2O. Sol. in warm dil. NH_4OH+Aq. (Rüdorff.)

Antimony arsenite (?).

Ppt. Sol. in a small amount H_2O, but insol. in a large quantity. (Berzelius.)

Completely sol. in KOH+Aq. (Reynolds.)

Barium arsenite, $Ba(AsO_2)_2$.

Easily sol. in H_2O when recently pptd., but insol. after being dried. Pptd. from aqueous solution by boiling. (Filhol, A. **68.** 308.)

Only sl. sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 18.)

$Ba_3(AsO_3)_2$. Sl. sol. in cold H_2O; sol. in hot H_2O and dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 17.)

$BaH_4(AsO_3)_2$. Ppt. (Bloxam, Chem. Soc. **15.** 281.)

$+34H_2O$. Moderately sol. in cold, more easily sol. in hot H_2O. Insol. in alcohol. (Perper, Dissert. **1894.**)

$Ba_2As_2O_5+2H_2O$. Easily sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 18.)

$+4H_2O$. Sl. sol. in H_2O; also somewhat sol. in alcohol. (Stein, A. **74.** 218.)

Sl. sol. in H_3AsO_4+Aq and BaO_2H_2+Aq. (Dumas.)

Sol. in NH_4Cl+Aq. (Wackenroder, A. **41.** 316.)

Not pptd. from solutions containing Na citrate. (Spiller.)

$BaAs_4O_7$. Sol. in H_2O. Less sol. in alcohol. (Reichard, B. 1894, **27.** 1033.)

Bismuth arsenite, $BiAsO_3+5H_2O$ (?).

Easily sol. in HNO_3+Aq. (Schneider, J. p. (2) **20.** 419.)

Sl. sol. in H_2O. (Stavenhagen, J. pr. 1895, (2) **51.** 35.)

Cadmium arsenite, $Cd_3(AsO_3)_2$.

Sl. sol. in H_2O; easily sol. in NH_4OH+Aq and dil. acids. (Stavenhagen, *l.c.*)

$Cd_2As_2O_5$. Ppt. (Reichard, B. 1898, **31.** 2168.)

Sol. in acids without decomp.; insol. in alkalis. (Reichard, B. 1894, **27.** 1033.)

$5CdO$, $As_2O_3+12H_2O$. Not attacked by KOH, $Ba(OH)_2$ or alkali carbonates+Aq. Insol. in KCN+Aq. (Reichard, Ch. Z. 1902, **26.** 1145.)

Cæsium arsenite bromide, As_2O_3, CsBr.

Sol. in H_2O. (Wheeler, Z. anorg. **4.** 451.)

Cæsium arsenite chloride, As_2O_3, CsCl.

As above.

Cæsium arsenite iodide, As_2O_3, CsI.

As above.

Calcium arsenite, $Ca(AsO_2)_2$.

Somewhat sol. in H_2O; sol. in $Ca(OH)_2$+Aq or As_2O_3+Aq. (Simon, Pogg. **47.** 417.)

$Ca_3(AsO_3)_2$. Ppt. (Kühn, J. B. **1852.** 379.)

Only sl. sol. H_2O; readily sol. in dil. acids. (Stavenhagen, *l.c.*)

Sol. in H_2O, insol. in alcohol. (Reichard, B. 1894, **27.** 1036.)

$3CaO$, $2As_2O_3+3H_2O$. Sl. sol. in H_2O; easily sol. in NH_4Cl+Aq; sol. in As_2O_3+Aq. (Stein.)

$CaH_4(AsO_3)_2+xH_2O$. Moderately sol. in H_2O. Insol. in abs. alcohol. (Perper, Dissert. **1894.**)

$Ca_2As_2O_5$. Sl. sol. in H_2O; 1 pt. in 3000–4000 pts. H_2O. Alkali chlorides increase solubility slightly. (Stavenhagen, *l.c.*)

Sl. sol. in H_2O; insol. in H_2O containing CaO_2H_2. (Berzelius.)

Not pptd. in presence of 4000–5000 pts. H_2O. (Harting, Lassaigne.)

Not pptd. from solutions containing NH_4 salts; and when pptd. is sol. in $(NH_4)_2SO_4$, NH_4NO_3, $NH_4C_2H_3O_2$, and NH_4Cl+Aq. (Gieseke and Schweigger.)

Sol. in NH_4AsO_2+Aq. (Schweigger.)

Sol. in $CaCl_2$+Aq. (Ordway.)

Easily sol. in dil. acids. Not pptd. from solutions containing sodium citrate. (Spiller.)

Calcium arsenite iodide, CaI_2, $3As_2O_3$+ $12H_2O$.

Sl. sol. in H_2O. Decomp. on heating. (Grühl, Dissert. **1897.**)

Chromic arsenite, $CrAsO_3$.

Sol. in H_2O, but slowly decomp. by boiling. (Neville, C. N. **34.** 220.)

Sol. in HCl; repptd. by NH_4OH+Aq; sol. in KOH+Aq. (Reichard, B. 1894, **27.** 1028.)

Cobaltous arsenite basic, $7CoO$, As_2O_3.

Very sol. in dil., difficultly sol. in conc. H_2SO_4. Sol. in conc. NaOH and in conc. NH_4OH+Aq. (Reichard, Z. anal. 1903, **42.** 10.)

Cobaltous arsenite, $3CoO,As_2O_3$.

Sol. KOH+Aq with decomp. (Identical with salt of Girard). (Reichard, B. 1894, **27.** **1031.**)

$+4H_2O$. Sl. sol. in H_2O; easily sol. in acids. (Stavenhagen, J. pr. 1895, (2) **51.** 39).

$3CoO, 2As_2O_3+4H_2O$. Sol. in HNO_3. (Girard, C. R. 1852, **34.** 918.)

$Co_3H_6(AsO_3)_4$. Insol. in H_2O; sol. in HNO_3, HCl, or NH_4OH+Aq. (Proust.)

Only sol. in KOH, or NaOH+Aq when formed in a solution containing an excess of those reagents. (Reynoso, C. R. **31.** 68.)

$Co_2As_2O_5$. Ppt. (Reichard, B. 1898, **31.** 2165.)

Sol. in HNO_3 and HCl+Aq. (Proust.)

Cupric arsenite, $Cu(AsO_2)_2$.

(Avery, J. Am. Chem. Soc. 1906, **28.** 1161.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

$+H_2O$. Sl. sol. in H_2O. (Stavenhagen, *l.c.*)

$+2H_2O$. Sl. sol in H_2O; insol. in alcohol. (Stavenhagen, *l.c.*)

$3CuO, As_2O_3$. Ppt. (Stavenhagen, *l.c.*)

$2CuO,As_2O_3$. (Scheele's green.) Insol. in H_2O; sol. in KOH+Aq, NH_4OH+Aq, and in most acids. Formula is $Cu_3(AsO_3)_2+2H_2O$. (Sharples, C. N. **35.** 89.)

Sol. in NH_4OH+Aq without decomp. Sol. in KOH+Aq with decomp. (Reichard, B. 1894, **27.** 1026.)

Insol. in pyridine. (Schroeder, Dissert. **1901.**)

$5CuO, As_2O_3$. Insol. in H_2O, sol. in acids, NH_4OH+Aq and conc. MOH+Aq. (Reichard, Ch. Z. 1902, **26.** 1142.)

$xCuO, yAs_2O_3$. Min. *Trippkeite*. Easily sol. in HNO_3 and in HCl+Aq.

Didymium arsenite, $Di_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Glucinum arsenite iodide, $GlI_2, 3As_2O_3+8H_2O$.

Decomp. by H_2O. (Grühl, Dissert. **1897.**)

Gold (aurous) arsenite, $3Au_2O,As_2O_3$.

Decomp. by light. (Reichard, B. 1894, **27.** 1027.)

Gold (auric) arsenite, $AuAsO_3+H_2O$.

Very sol. in H_2O, NH_4OH+Aq and dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 28.)

Iron (ferrous) arsenite, FeO,As_2O_3.

Decomp. in the air when moist; sol. in NH_4OH+Aq when freshly pptd. (Reichard, B. 1894, **27.** 1029–30.)

$Fe_2As_2O_5$. Ppt. Sol. in NH_4OH+Aq; insol. in NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

Iron (ferric) arsenite, basic, $4Fe_2O_3, As_2O_3+5H_2O$.

Ppt. H_2O extracts As_2O_3. Sol. in conc. acids with separation of As_2O_3. Acetic acid is without action. (Bunsen and Berthold, **1834.**)

Sol. in KOH, or NaOH+Aq.

Iron (ferric) arsenite, Fe_2O_3,As_2O_3.

Sol. in NH_4OH+Aq when freshly pptd. (Reichard, B. 1894, **27.** 1030.)

$Fe_4As_2O_9$. Ppt. (Reichard, B. 1898, **31.** 2170.)

$+7H_2O$. Sol. in NaOH, and KOH+Aq.

"Ferric arsenite" is sl. sol. in $Al_2(SO_4)_3$+Aq. (Kynaston, Dingl. **235.** 326.)

Lanthanum arsenite, $La_2H_3(AsO_3)_3$.

Ppt. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve, B. **11.** 910.)

Lead arsenite, $Pb(AsO_2)_2+xH_2O$.

Sl. sol. in H_2O. Insol. in KOH, but sol. in NaOH+Aq. (Berzelius.)

$Pb_2As_2O_5$. Insol. in H_2O, NH_4OH, NH_4 arsenite, or other NH_4 salts+Aq. (Wittstein.)

$Pb_3(AsO_3)_2$. Scarcely sol. in H_2O; easily sol. in HNO_3, or $HC_2H_3O_2$+Aq. Boiling H_2O dissolves some As_2O_3. Not completely insol. in KOH+Aq. (Streng, A. **129.** 238.)

Sol. in acetic acid; insol. in H_2O in the presence of ammonium salts; sol. in NaOH+Aq; sl. sol. in KOH+Aq. (Reichard, B. 1894, **27.** 1024.)

$+H_2O$. Sl. sol. in H_2O; easily sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 33.

Lead arsenite chloride, $Pb_5As_2O_8, 2PbCl_2$.

Min. *Ekdemite*. Easily sol. in HNO_3+Aq, and warm HCl+Aq.

Magnesium arsenite, $Mg_3(AsO_3)_2$.

Insol. in NH_4OH+Aq, but sol. in a large excess of NH_4Cl+Aq. (Rose.)

Very sol. in boiling H_2O and in dil. acids. Sol. in NH_4Cl+Aq. (Reichard, B. 1894, **27.** 1032.)

Very sol. in H_2O and dil. acids. (Stavenhagen, *l.c.*)

$Mg_2As_2O_5+4H_2O$. Hydroscopic. Very sol. in H_2O and acids. (Stavenhagen, *l.c.*)

$3MgO,2As_2O_3+3H_2O, +15H_2O$, and $+18H_2O$. (Perper, Dissert. **1894.**)

Magnesium arsenite iodide, $MgI_2, 3As_2O_3+12H_2O$.

Moderately sol. in H_2O. (Grühl, Dissert. **1897.**)

Manganous arsenite, $Mn_3(AsO_3)_2+3H_2O$.

Sol. in H_2O; insol. in alcohol; easily oxidized by moist air. (Stavenhagen, *l.c.*)

$3MnO,2As_2O_3$. (Reichard, B. 1894, **27.** 1032.)

$Mn_3H_2As_4O_{10}+4H_2O$. Sl. sol. in H_2O. Very sol. in acids and alkali. (Stavenhagen, *l.c.*)

$Mn_5As_2O_8$. Ppt. (Reichard, B. 1898, **31.** 2165.)

Mercurous arsenite, Hg_2O,As_2O_3.

Decomp. by light. Decomp. by H_2O. (Reichard, B. 1894, **27.** 1022.)

Hg_3AsO_3. Only sl. sol. in H_2O; sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 24.)

Gradually and completely decomposed by H_2O. (Reichard, Ch. Z. 1902, **26.** 1143.)

Mercuric arsenite, $Hg_3(AsO_3)_2$.

Sl. sol. in H_2O. (Stavenhagen, *l.c.*)

Decomp. more easily by H_2O than is the mercurous comp. (Reichard, Ch. Z. 1902, **26.** 1143.)

$2HgO,As_2O_3$. Not decomp. by boiling with H_2O. Undecomp. by boiling acids. Decomp. by $KOH+Aq$, K_2CO_3+Aq and NH_4OH+Aq. (Reichard, B. 1894, **27.** 1021.)

$Hg_5As_2O_8$. Ppt. Decomp. by boiling H_2O. Very sl. sol. in H_2SO_4+HCl. (Reichard, B. 1898, **31.** 2170.)

Nickel arsenite, $Ni_3(AsO_3)_2$.

Insol. in H_2O; easily sol. in NH_4OH+Aq (Proust.)

Ppt. (Reichard, B. 1898, **31.** 2165.)

$3NiO,2As_2O_3$. Sol. in NH_4OH+Aq (identical with salt of Girard). (Reichard, B. 1894, **27.** 1031.)

$+4H_2O$. Insol. in H_2O; sol. in NH_4OH+Aq. (Proust.)

Sol. in $KOH+Aq$. (Girard, C. R. **34.** 918.)

$2NiO, As_2O_3$. Insol. in H_2O; sol. in NH_4OH+Aq; sol. in $KOH+Aq$. (Reynoso, C. R. **31.** 68.)

Platinum arsenite, $Pt_3(AsO_3)_4$.

Sol. in H_2O and alcohol; very unstable. (Stavenhagen, *l.c.*)

Potassium arsenite, $KAsO_2$.

Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Does not exist. (Stavenhagen, *l.c.*)

K_3AsO_3. Very sol. in H_2O; sol. in alcohol. (Stavenhagen, *l.c.*)

$K_4As_2O_5+6H_2O$. Very sol. in H_2O; sol. in alcohol. (Stavenhagen, *l.c.*)

$K_2As_4O_7+2H_2O$. Sol. in H_2O; sl. sol. in alcohol. (Pasteur, A. **68.** 309.)

Potassium arsenite bromide, $4As_2O_3, 2KBr$.

More sol. in H_2O than iodide. (Schiff and Sestini, A. **228.** 72.)

$2As_2O_3, KBr$. (Rüdorff, B. **19.** 2675.)

Potassium arsenite chloride, $2As_2O_3, KCl$.

Much more quickly sol. in hot H_2O than bromide or iodide. (Rüdorff, B. **19.** 2675.)

As_2O_3, KCl. Decomp. by H_2O.

Potassium arsenite iodide, $3As_2O_3, 2KI+H_2O$.

Sl. sol. in cold H_2O; sol. in 20 pts. boiling, and 40 pts. cold H_2O. (Emmet, Sill. Am. J. (2) **18.** 583.)

$6KAsO_2, 2KI+3H_2O$. Sol. in H_2O and alcohol. Decomp. by acids. (Harms.)

$2KH(AsO_2)_2, As_2O_3, 2KI$. Sl. sol. in H_2O. (Harms, A. **91.** 371.)

$2As_2O_3, KI$. Very difficultly sol. even in boiling H_2O. Very easily sol. in $KOH+Aq$, but much less so in K_2CO_3+Aq. (Rüdorff, B. **19.** 2670.)

Sol. in 40 pts. cold, 20 pts. hot H_2O; sol. in alkalies (Schiff and Sestini, A. **228.** 72.)

Potassium arsenite sulphate, $K_3AsO_3, 10K_2SO_4$.

(Stavenhagen, Zeit. angew. ch. 1894, **8.** 166.)

Rubidium arsenite, $RbAsO_2$.

Sol. in H_2O; aq. solution is alkaline to litmus. Insol. in alcohol. (Bouchonnet, C. R. 1907, **144.** 641.)

Rubidium arsenite bromide, $As_2O_3, RbBr$.

Decomp. by H_2O. (Wheeler, Z. anorg. **4.** 451.)

Rubidium arsenite chloride, $As_2O_3, RbCl$.

As above.

Rubidium arsenite iodide, As_2O_3, RbI.

As above.

Silver arsenite, Ag_3AsO_3.

Insol. in H_2O. Not pptd. in presence of 20,000 pts. H_2O. (Harting.)

1 l. H_2O dissolves 0.0115 g. Ag_3AsO_3 at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)

Only sl. sol. in H_2O and in dil. acids; readily sol. in NH_4OH+Aq and conc. acids. (Stavenhagen, *l.c.*)

Decomp. by light, by $KOH+Aq$ and by NH_4OH+Aq. (Reichard, B. 1894, **27.** 1022–23.)

Easily sol. in HNO_3+Aq and other acids. (Marcet.)

More easily sol. in $HC_2H_3O_2+Aq$ than Ag_3PO_4; sl. sol. in $HC_2H_3O_2+Aq$. (Santos, C. N. **38.** 94.)

Insol. in $KOH+Aq$. (Kühn, Arch. Pharm. (2) **69.** 267.)

Easily sol. in NH_4OH+Aq. (Marcet.)

Insol. in NH_4OH+Aq, but sol. therein in presence of alkali nitrates. (Santos, *l.c.*)

Incompletely sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Wittstein, Repert. **51.** 41.)

Decomp. by NH_4Cl+Aq. Sol. in $KAsO_2$+Aq. (Kühn, *l.c.*)
Not pptd. in solutions containing sol. citrates. (Spiller.)
Sol. in methyl acetate. (Naumann, B. **1909, 42.** 3790.)
Sl. sol. in methyl acetate. (Bezold, Dissert. **1908.**)
Insol. in ethyl acetate. (Hamers, Dissert. **1906**); (Naumann, B. 1910, **43.** 314.)
$+H_2O$. Very sol. in H_2O, NH_4OH+Aq and in dil. acids. (Stavenhagen, J. pr. 1895, (2) **51.** 29.)
$2Ag_2O$, As_2O_3. Ppt. (Pasteur, J. Pharm. (3) **13.** 395.)
Could not be obtained. (Stavenhagen, *l.c.*)
$3Ag_2O$, $2As_2O_3$. Sol. in cold $HC_2H_3O_2$+Aq. (Santos.)
Sol. in NH_4OH+Aq and in potassium arsenite+Aq. (Girard, C. R. **34.** 918.)
Ppt. (Reichard, B. 1898, **31.** 2167.)
Could not be obtained. (Stavenhagen, *l.c.*)

Silver arsenite ammonia, $2Ag_2O$, As_2O_3, $4NH_3$.

Insol. in H_2O or alcohol. (Girard.)

Sodium arsenites.

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol. in H_2O. (Pasteur, A. **68.** 308.
Na_3AsO_3. Very sol. in H_2O. (Stavenhagen, *l.c.*)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Sodium arsenite bromide, $2As_2O_3$, NaBr.

Decomp. by warm H_2O. (Rüdorff, B. **21.** 3052.)

Sodium arsenite iodide, $2As_2O_3$, NaI.

Decomp. by hot H_2O. (Rüdorff.)

Strontium arsenite, $Sr_3(AsO_3)_2$.

Sol. in H_2O. (Stavenhagen, *l.c.*)
Sol. in H_2O, insol. in alcohol (identical with Stein). (Reichard, B. 1894, **27.** 1036.)
$Sr_2As_2O_5+2H_2O$. Quite easily sol. in H_2O. (Stein.)
Sl. sol. in H_2O, SrO_2H_2+Aq, or H_3AsO_4+Aq. (Dumas.)
Very sl. sol. in alcohol. (Stein.)
Easily sol. in H_2O and in acids. (Stavenhagen, J. pr. 1895, (2) **51.** 17.)
$Sr_3As_4O_9$. Moderately sol. in H_2O. (Reichard, B. 1894, **27.** 1036.)

Strontium arsenite iodide, SrI_2, $3As_2O_3+12H_2O$.

As Ba comp. (Grühl, Dissert. **1897.**)

Thallium arsenite, Tl_3AsO_3.

Sl. sol. in H_2O and alcohol; easily sol. in acids, especially in dil. H_2SO_4. (Stavenhager, *l.c.*)

Tin (stannous) arsenite, $Sn_3(AsO_3)_2$.

Ppt.; decomp. by acids and alkali. (Reichard, B. 1898, **31.** 2169.)
$+2H_2O$. Sl. sol. in H_2O. Easily sol. in dil. acids and alkalies. (Stavenhagen, *l.c.*)

Tin (stannic) arsenite, $Sn_3(AsO_3)_4+5\frac{1}{2}H_2O$.

Sl. sol. in H_2O. (Stavenhagen, *l.c.*)
$5SnO_2$, $2As_2O_3$. Ppt. Sol. in acids without decomp. (Reichard, B. 1894, **27.** 1025.)
$Sn_7As_2O_{17}$. Ppt. (Reichard, B. 1898, **31.** 2169.)

Uranium arsenite, UO_2, As_2O_3.

Insol. in NH_4OH+Aq; only sl. sol. KOH+Aq. Sol. in acids. (Reichard, B. 1894, **27.** 1029.)

Zinc arsenite, ZnO, As_2O_3.

Ppt. (Avery, J. Am. Chem. Soc. 1906, **28.** 1163.)
$3ZnO,As_2O_3$. Sol. in acids without decomp. Easily sol. in NH_4OH+Aq. (Reichard, B. 1894, **27.** 1033.)

Arseniovanadic acid, As_2O_5, $V_2O_5+2H_2O$.

Easily sol. in H_2O, but solution easily decomposes; crystallizes from H_2O with $10H_2O$. Composition is vanadium dihydrogen arsenate $(VO_2)H_2AsO_4$. (Friedheim, B. **23.** 2600.)
+14, and $+18H_2O$. (Ditte, C. R. **102.** 757.) Could not be obtained. (Friedheim.)
$3As_2O_5$, $2V_2O_5$. (Berzelius.) Correct formula is as above. (Friedheim.)
$3H_2O$, $7As_2O_5$, $6V_2O_5$. (Gibbs, Am. Ch. J. **7.** 209.) Could not be obtained. (Friedheim.)
$3H_2O$, $5As_2O_5$, $8V_2O_5+24H_2O$. (Gibbs.) Could not be obtained. (Friedheim.)

Arseniovanadates.

According to Friedheim (Z. anorg. 1892, **2.** 319) the arseniovanadates are double arsenates of VO_2 and NH_4.

Ammonium arseniovanadate, $(NH_4)_2O$, As_2O_5 $2V_2O_5$, $+5H_2O$.

Efflorescent in dry air; sl. sol. in cold, decomp. by hot H_2O. Composition is ammonium divanadium arsenate $=(VO_2)_2(NH_4)AsO_4+2\frac{1}{2}H_2O$. (Friedheim, B. **23.** 2600.)
Sl. sol. in cold H_2O. Somewhat more easily sol. in hot H_2O with separation of V_2O_5. (Schmitz-Dumont, Dissert. **1891.**)
$2(NH_4)_2O$, $3As_2O_5$ $2V_2O_5$, $+4H_2O$. Cannot be crystallized from H_2O. Composition is $(NH_4)_2HAsO_4+2(VO_2)_2H_2AsO_4$. (Friedheim.)
Decomp. under H_2O to $(NH_4)_2O$, $2V_2O_5$. $As_2O_5+5H_2O$. (Schmitz-Dumont, *l.c.*)
$5(NH_4)_2O$, $4As_2O_5$, $2V_2O_5+18H_2O$. Sol. in H_2O. (Ditte, C. R. **102.** 1019.) Does not exist. (Friedheim, B. **23.** 2605.)

Calcium arseniovanadate, $2CaO, 3As_2O_5, 2V_2O_5+21H_2O=CaHAsO_4+2(VO_2)H_2AsO_4+8H_2O$.

Can be crystallized in presence of vanadic acid without decomp. (Friedheim.)
Efflorescent. Sol. in H_2O. (Schmitz-Dumont, *l.c.*)

Cobalt arseniovanadate, $CoO, As_2O_5, V_2O_5+9H_2O=Co(VO_2)_2H_2(AsO_4)_2+8H_2O$.

Sol. in H_2O. (Friedheim.)

Copper arseniovanadate, $CuO, As_2O_5, V_2O_5+4H_2O=Cu(VO_2)_2H_2(AsO_4)_2+3H_2O$.

Sol. in H_2O. (Friedheim.)

Magnesium arseniovanadate, $MgO, As_2O_5, V_2O_5+10H_2O=(VO_2)_2MgH_2(AsO_4)_2+9H_2O$.

Sol. in H_2O. (Friedheim.)
Moderately sol. in H_2O. Solution decomp. on standing. (Schmitz-Dumont, *l.c.*)
$2MgO, 3As_2O_5 2V_2O_5,+23H_2O=MgHAsO_4+2(VO_2)H_2AsO_4+9H_2O$. Sol. in H_2O. (Friedheim.)
Sol. in H_2O but solution decomp. on evaporation. (Schmitz-Dumont, *l.c.*)

Potassium arseniovanadate, $K_2O, As_2O_5, 2V_2O_5+5H_2O=(VO_2)_2KAsO_4+2\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)
Sl. sol. in cold H_2O. Partially decomp. on heating. (Schmitz-Dumont.)

Strontium arseniovanadate, $2SrO, 3As_2O_5, 2V_2O_5+20H_2O=SrHAsO_4+2(VO_2)_2H_2AsO_4+7\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)
$+21H_2O$. Easily sol. in H_2O. (Schmitz-Dumont.)

Zinc arseniovanadate, $ZnO, As_2O_5, V_2O_5+6\frac{1}{2}H_2O=Zn(VO_2)_2H_2(AsO_4)_2+5\frac{1}{2}H_2O$.

Sol. in H_2O. (Friedheim.)
$2ZnO, 3As_2O_5, 2V_2O_5+5H_2O$, and $+18H_2O=ZnHAsO_4+2(VO_2)_2H_2AsO_4$, and $+6\frac{1}{2}H_2O$. Sol. in H_2O. (Friedheim.)

Arseniovanadicotungstic acid.

Ammonium arseniovanadicotungstate, $17(NH_4)_2O,2As_2O_5,14\frac{1}{2}V_2O_3,29WO_3+98H_2O$.

Sl. sol. in cold H_2O. Readily sol. in boiling H_2O. Insol. in alcohol, ether, benzene, CS_2, $CHCl_3$, acetone, nitrobenzene, aniline and acetic anhydride. (Rogers, J. Am. Chem. Soc. 1903, **25.** 307.)

Arseniovanadicovanadic acid.

Ammonium arseniovanadicovanadate, $5(NH_4)_2O, 12As_2O_5, 12VO_2, 6V_2O_5+7H_2O$.

Sl. sol. in cold, sol. in hot H_2O, from which crystallizes—
$4(NH_4)_2O, 9As_2O_5, 9VO_2, 8V_2O_5+11H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

Arseniovanadicovanadiotungstic acid.

Ammonium arseniovanadicovanadiotungstate, $17(NH_4)_2O,2As_2O_5,7V_2O_5,4V_2O_3,32WO_3+73H_2O$.

Sl. sol. in cold, readily sol. in boiling H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 310.)

Arseniovanadiotungstic acid.

Ammonium arseniovanadiotungstate, $18(NH_4)_2O, 2As_2O_5, 13V_2O_5, 39WO_3+88H_2O$.

Sol. in H_2O. Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, **25.** 306.)

Arseniuretted hydrogen, AsH_3.

See **Arsenic hydride.**

Arsenochromic acid.

Potassium arsenochromate, $K_4Cr_2As_2O_{16}+12H_2O$.

Sol. in moderately conc. mineral acids. (Tarugi, C. C. **1897,** II. 724.)
$K_7Cr_3As_5O_{22}+24H_2O$. Ppt. Sol. in dil. warm acids. (Tarugi.)

Potassium hydrogen arsenochromate, $K_4H_6Cr_3As_2O_{16}$.

(Tarugi, C. C. **1897,** II. 724.)

Arsenosoarseniotungstic acid.

Potassium arsenosoarseniotungstate, $10K_2O, 4As_2O_5, As_2O_3, 21WO_3+26H_2O$.

Precipitate. Sol. in a large amount of hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Arsenosomolybdic acid.

Ammonium arsenosomolybdate, $3(NH_4)_2O, 5As_2O_3, 12MoO_3+24H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Ammonium barium arsenosomolybdate, $3(NH_4)_2O, 2BaO, 5As_2O_3, 10MoO_3+50H_2O$.

Ppt. (Ephraim, Z. anorg. 1910, **66.** 57.)

Ammonium cupric arsenosomolybdate, $(NH_4)_2O, CuO, 2As_2O_3, 4MoO_3+2H_2O$, and $2(NH_4)_2O, CuO, 3As_2O_3, 6MoO_3+13H_2O$.

Ppts. (Ephraim, Z. anorg. 1910, **66.** 58.)

Barium arsenosomolybdate, $3BaO, 2As_2O_3, 8MoO_3+13H_2O$.

Very sl. sol. in H_2O. (Gibbs.)

Copper arsenosomolybdate, $2CuO, 3As_2O_3, 6MoO_3$.

Sol. in H_2O. (Gibbs.)

Manganese arsenosomolybdate, $2MnO, 3As_2O_3, 6MoO_3+6H_2O$, and $+15H_2O$.

Insol. in H_2O. (Gibbs.)

Potassium arsenosomolybdate, $3K_2O, As_2O_3, 5MoO_3+3H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **66.** 54.)

$3K_2O, As_2O_3, 8MoO_3+18H_2O$. Easily sol. in H_2O. (Ephraim.)

Sodium arsenosomolybdate, $Na_2O, As_2O_3, 2MoO_3+6H_2O$.

Easily sol. in H_2O. (Ephraim, Z. anorg. 1910, **66.** 56.)

$2Na_2O, As_2O_3, 4MoO_3+13H_2O$. Ppt. (Ephraim.)

Zinc arsenosomolybdate, $2ZnO, 3As_2O_3, 6MoO_3+6H_2O$.

Sol. in H_2O. (Gibbs.)

Arsenosophosphotungstic acid.

Potassium arsenosophosphotungstate, $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3+28H_2O$.

Moderately sol. in cold, very easily in hot H_2O. (Gibbs.)

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3+55H_2O$. Sol. in hot H_2O with decomp. (Gibbs.)

Potassium sodium arsenosophosphotungstate, $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3+15H_2O$.

(Gibbs, Am. Ch. J. **7.** 313.)

Arsenosotungstic acid.

Ammonium arsenosotungstate, $7(NH_4)_2O, 2As_2O_3, 18WO_3+18H_2O$.

Sol. in H_2O. (Gibbs.)

Barium arsenosotungstate, $4BaO, As_2O_3, 9WO_3+21H_2O$.

Precipitate. Nearly insol. in H_2O. (Gibbs.)

Sodium arsenosotungstate, $9Na_2O, 8As_2O_3, 16WO_3+55H_2O$.

Very sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Arsenyl bromide, AsOBr.

H_2O dissolves out As_2O_3; insol. in alcohol. (Sérullas.)

$+H_2O$. (Wallace, Phil. Mag. (4) **17.** 122.)

$As_8O_9Br_6=2AsBr_3, 3As_2O_3+12H_2O$.

Arsenyl bromide *with* MBr.

See **Arsenite bromide, M.**

Arsenyl chloride, AsOCl.

Sol. in H_2O with decomp.

$+H_2O$. (Wallace, Phil. Mag. (4) **16.** 358.)

As_3O_4Cl. (Wallace.)

Arsenyl chloride *with* MCl.

See **Arsenite chloride, M.**

Arsenyl potassium fluoride, $AsOF_3, KF+H_2O$.

(Marignac, A. **145.** 237.)

Arsenyl iodide, $As_8I_2O_{11}=2AsOI, 3As_2O_3+12H_2O$.

Decomp. by H_2O. (Wallace, Phil. Mag. (4) **17.** 122.)

Sl. sol. in cold H_2O, less sol. in alcohol. (Plisson, J. Pharm. **14.** 46.)

Arsenyl iodide *with* MI.

See **Arsenite iodide, M.**

Arsenyl sulphoiodide, $As_{13}I_9S_6O_9$.

Scarcely attacked by cold H_2O. Boiling H_2O extracts AsI_3. Decomp. by hot HNO_3 or H_2SO_4. Easily sol. in KOH, or NH_4OH+Aq. (Schneider, J. pr. (2) **36.** 513.)

Arsine.

See **Arsenic hydride.**

Atmospheric air.

See **Air, atmospheric.**

Auriamine, $Au(OH)_2NH_2$.

(Jacobsen, C. R. 1908, **146.** 1214.)

***Di*auriamine,** $Au_2(OH)_4NH$.

(Jacobsen, C. R. 1908, **146.** 1214.)

***Sesqui*auriamine,** NAu_3, NH_3.

Decomp. by H_2O into NAu_3. (Raschig, A. **235.** 341.)

Auric acid, HAu_2O_4.

Sol. in HBr, or HCl+Aq. (Krüss, B. **19.** 2546.)

Ammonium aurate.

See **Auroamidoimide.**

Barium aurate, $BaAu_2O_4+5H_2O$.

Sl. sol. in H_2O. (Weigand, Zeit. angew. Ch. 1905, **19.** 139.)

$+6H_2O$. Sl. sol. in H_2O. Sol. in dil. H_2SO_4 and in dil. HNO_3. Sol. in HCl. Decomp. by alcohol. (Meyer, C. R. 1907, **145.** 806.)

Calcium aurate (?).

Insol. in H_2O; sol. in $CaCl_2$+Aq. (Fremy, A. ch. (3) **31.** 485.)

$CaAu_2O_4+6H_2O$. As Ba salt. (Meyer, C. R. 1907, **145.** 806.)

Magnesium aurate (?).

Ppt. Insol. in H_2O; sol. in $MgCl_2$+Aq. (Pelletier.)

Potassium aurate, $KAuO_2+3H_2O$.

Very sol. in H_2O, and easily decomp. (Fremy, A. ch. (3) **31.** 483.)

Sol. in alcohol; the solution in alcohol does not decomp. below 50°. (Figuier, A. ch. (3) **11.** 364.)

Potassium aurate sulphite, $KAuO_2, 2K_2SO_3+5H_2O$.

Sol. in H_2O with decomp. Nearly insol. in alkaline solutions. (Fremy, A. ch. (3) **31.** 485.)

Sodium aurate, $Na_2Au_2O_4+2H_2O$.

Sol. in H_2O. Sol. in dil. H_2SO_4, dil. HNO_3, and HCl with decomp. Decomp. by alcohol. (Meyer, C. R. 1907, **145.** 806.)

Strontium aurate, $SrAu_2O_4+6H_2O$.

As Ba salt. (Meyer.)

Auriimide chloride, Au(NH)Cl.

(Raschig.)

Auriimide nitrate, $Au_2N_2H_2O$, $2HNO_3$, or AuN, $HNO_3+\frac{1}{2}H_2O$, or $Au_2O(NH)_2$, $2HNO_3$.

Not deliquescent. Decomp. by hot H_2O into $Au_2O(NH)_2$. (Schottländer, J. B. **1884.** 453.)

Auroamidoimide, $Au(HN)NH_2+3H_2O$.

(Fulminating gold.) Insol. in H_2O; not attacked by dil. acids; sol. in conc. acids, and in moderately dil. acids, when freshly precipitated. Insol. in alkalies or alcohol. Sol. in KCN+Aq.

*Tri*auroamine, Au_3N+5H_2O.

Not decomp. by boiling dil. acetic acid, HNO_3, or H_2SO_4. (Raschig, A. 1886, **235.** 349.)

Auricyanhydric acid, $HAu(CN)_4+1\frac{1}{2}H_2O$.

Easily sol. in H_2O, alcohol, or ether.

See also **Bromauricyanides.**
Chlorauricyanides.
Iodauricyanides.

Ammonium auricyanide, $NH_4Au(CN)_4$.

Easily sol. in H_2O or alcohol. Insol. in ether.

Cobaltous auricyanide, $Co[Au(CN)_4]_2+9H_2O$.

Sl. sol. in cold, easily in hot H_2O. Sl. sol. in alcohol. (Lindbom.)

Potassium auricyanide, $KAu(CN)_4+1\frac{1}{2}H_2O$.

Efflorescent. Sl. sol. in cold, easily in hot H_2O. Easily sol. in alcohol.

Silver auricyanide, $AgAuCN_4$.

Insol. in H_2O or HNO_3+Aq. Sol. in NH_4OH+Aq.

*Di*auro*di*amine nitrate.

See **Auriimide nitrate.**

Aurobromhydric acid.

See **Bromauric acid.**

Aurobromic acid.

See **Bromauric acid.**

Aurochlorhydric acid.

See **Chlorauric acid.**

Aurochloric acid.

See **Chlorauric acid.**

Aurocyanhydric acid.

Aurocyanides with MCN.

See **Cyanide, aurous with MCN.**

Azinosulphonic acid.

Ammonium azinosulphonate, $N_3SO_3NH_4$.

(Traube, B. 1914, **47.** 944.)

Barium azinosulphonate, $(N_3SO_3)_2Ba$.

(Traube, B. 1914, **47.** 944.)

Potassium azinosulphonate, N_3SO_3K.

Easily sol. in H_2O. Can be cryst. from boiling abs. alcohol. (Traube, B. 1914, **47.** 943.)

Sodium azinosulphonate, N_3SO_3Na.

(Traube, B. 1914, **47.** 944.)

Azoimide, HN_3.

Miscible with H_2O and alcohol. (Curtius and Radershausen, J. pr. (2) **43.** 207.)

Stable in aq. solution; decomp. slowly by dil. boiling HCl. (Curtius, J. pr. 1898, (2) **58.** 265.)

For salts of HN_3, see azoimide of metal under metal.

Azoimide, hydroxylamine, $N_3H,2NH_2OH$.

Sol. in H_2O. Gradually volatilizes at ord. temp. (Dennis, J. Am. Chem. Soc. 1907, **29.** 22.)

Azophosphoric acid.

See *Pyro*phosphamic acid.

*Deut*azophosphoric acid.

See *Pyro*phospho*di*amic acid.

Barium, Ba.

Decomp. by H_2O and abs. alcohol. (Guntz, C. R. 1901, **133.** 874.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Barium amalgam, $BaHg_{13}$.

Stable in contact with liquid amalgam up to 30°. Can be cryst. from Hg without decomp. if temp. does not exceed 30°. (Kerp, Z. anorg. 1900, **25.** 68.)

$BaHg_{12}$. Stable in contact with liquid amalgam from 30°–100°. Can be cryst. from Hg without decomp. at any temp. within these limits. (Kerp.)

Barium amide, $Ba(NH_2)_2$.

B.-pt. 280°. (Mentrel, C. C. **1903,** I. 276.)

Decomp. by H_2O. (Guntz and Mentrel, Bull. Soc. 1903, (3) **29.** 578.)

Barium potassium amide.

See **Potassium ammonobarate.**

Barium ammonia, $Ba(NH_3)_6$.

Takes fire in the air. Only sl. sol. in liquid NH_3. Violently decomp. by H_2O. (Mentrel, C. R. 1902, **135.** 740.)

Barium arsenide, Ba_3As_2.

Decomp. by H_2O. (Lebeau, C. R. 1899, **129.** 48.)

Barium azoimide, $Ba(N_3)_2$.

Very sl. hydroscopic; explosive.

12.5 pts. are sol. in 100 pts. H_2O at 0°
16.2 " " " " 100 " H_2O " 10.5°
16.7 " " " " 100 " H_2O " 15°
17.3 " " " " 100 " H_2O " 17°

0.0172 pts. are sol. in 100 pts. abs. alcohol at 16°.

Insol. in ether. (Curtius, J. pr. 1898, (2) **58.** 290.)

See also **Barium nitride.**

Barium boride, BaB_6

Sol. in fused oxidizing agents, not decomp. by H_2O; insol. in aq. acids; sl. sol. in conc. H_2SO_4, sol. in dil. and conc. HNO_3. (Moissan, C. R. 1897, **125,** 634.)

Barium ***sub*****bromide sodium bromide,** BaBr, NaBr.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium bromide, $BaBr_2$, and $+2H_2O$.

100 pts. H_2O dissolve—

at 0°	20°	40°	60°	80°	100°
98	104	114	123	135	149 pts. $BaBr_2$.

Sat. $BaBr_2$+Aq contains at:

—20°	—9°	+7°	16°	19°	40°	
45.7	46.5	48.5	48.8	49.3	50.9% $BaBr_2$	
71°	76°	77°	104°	145°	160°	175°
55.1	55.5	55.6	56.6	60.5	59.4	60.3% $BaBr_2$

(Étard, A. ch. 1894, (7) **2.** 540.)

Sp. gr. of $BaBr_2$+Aq at 19.5° containing:

5	10	15	20	25	30% $BaBr_2$
1.045	1.092	1.114	1.201	1.262	1.329

35	40	45	50	55% $BaBr_2$.
1.405	1.485	1.580	1.685	1.800

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

$BaBr_2$+Aq containing 7.74% $BaBr_2$ has sp. gr. 20°/20° = 1.0716.

$BaBr_2$+Aq containing 16.76% $BaBr_2$ has sp. gr. 20°/20° = 1.1674.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sat. $BaBr_2$+Aq boils at 113°. (Kremers, Pogg. **99.** 43.)

Solubility in BaI_2+Aq at t°.

t°	Sat. solution contains	
	% $BaBr_2$	% BaI_2
—16	4.7	57.9
—16	5.0	59.0
+60	5.5	66.0
135	9.3	67.3
135	9.0	67.2
170	11.0	67.4
210	14.9	67.7

(Étard, A. ch. 1894, (7) **3.** 287.)

Very sol. in absolute alcohol. (Hünefeld.)

100 pts. absolute methyl alcohol dissolve 50 pts. $BaBr_2$ at 22.5°.

100 pts. absolute ethyl alcohol dissolve 3 pts. $BaBr_2$ at 22.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sat. solution in 87% alcohol contains 6% $BaBr_2$. (Richards, Z. anorg. **3.** 455.)

100 pts. absolute methyl alcohol dissolve 45.8 pts. $BaBr_2+2H_2O$ at 15°.

100 pts. 93.5% methyl alcohol dissolve 27.3 pts. $BaBr_2+2H_2O$ at 15°.

100 pts. 50% methyl alcohol dissolve 4 pts. $BaBr_2+2H_2O$ at 15°. (de Bruyn, Z. phys. Ch. **10.** 787.)

100 g. $BaBr_2+CH_3OH$ contain 0.4 g. $BaBr_2$ at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

At 15°, 1 pt. by weight is sol. in:

36 pts. methyl alcohol, sp. gr. 0.709
207 " ethyl " " " 0.8035
652 " propyl " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

Nearly insol. in boiling amyl alcohol, 10 ccm. dissolving only an amt. equal to 1.3 mg BaO. (Browning, Sill. Am. J. **144.** 459.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Barium cadmium bromide, $BaBr_2$, $CdBr_2$+ $4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20.** 40.)

Barium rhodium bromide.

See **Bromorhodite, barium.**

Barium bromide ammonia, $BaBr_2,8NH_3$.

Decomp. by H_2O. (Joannis, C. R. 1905, **140.** 1244.)

Barium bromide hydrazine, $BaBr_2$, $2N_2H_4$.

Hydroscopic. Very sol. in H_2O. Insol. in alcohol. (Franzen, Z. anorg. 1908, **60.** 291.)

Barium bromofluoride, $BaBr_2,BaF_2$.

Insol. in and undecomp. by boiling alcohol. Sol. in HBr and in HNO_3. Decomp. by H_2O, hot H_2SO_4, dil. HCl, dil. HNO_3, or dil. acetic acid. (Defacqz, C. R. 1904, **138.** 199.)

Barium carbide, BaC_2.

Decomp. by H_2O. (Maquenne, C. R. **144.** 360.)

Sp. gr. 3.75. Easily decomp. by H_2O and dil. acids. (Moissan, Bull. Soc. 1894, (3) **11.** 1008.)

Barium carbonyl, $Ba(CO)_2$.

Sol. in H_2O. (Guntz and Mentrel, Bull. Soc. 1903, (3) **29.** 586.)

Barium ***sub*****chloride,** BaCl.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 751.)

Barium ***sub*****chloride sodium chloride,** BaCl, NaCl.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium chloride, $BaCl_2$, and $+2H_2O$.

Permanent in dry air.

100 pts. H_2O at t° dissolve (*a*) pts. $BaCl_2$ and (*b*) pts. $BaCl_2+2H_2O$.

t°	*a*	*b*	t°	*a*	*b*
15.64	34.86	43.50	74.89	59.94	65.51
49 31	43.84	55.63	105.48	59.58	77.89

(Gay-Lussac, A. ch. (2) **11.** 309.)

100 pts. H_2O at t° dissolve 32.62+0.2711t pts. $BaCl_2$. (Kopp.)

100 pts. H_2O dissolve pts. $BaCl_2+2H_2O$ at t°.

t°	Pts. $BaCl_2+2H_2O$	t°	Pts. $BaCl_2+2H_2O$
16.25	39.66	62.50	48.0
20 00	42.22	75.00	63.0
22 50	43.7	87.00	65.0
37.50	51.0	100	72.0
50 00	65 0	......	...

(Brandes.)

Sol. in 2.67 pts. H_2O at 18.75°. (Abl.)

1 pt. $BaCl_2$ is sol. in 2.86 pts. H_2O at 15.5°, and 1.67 pts. at boiling temp. (M. R. and P.)

100 pts. H_2O at 15.5° dissolve 20 pts. $BaCl_2$, and 43 pts. at 87.7°. (Ure's Dict.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	31.1	77.5	51.9
12 2	33.9	95.65	57.7
38.4	41 2	102.5	58.9
62.75	47.7	105	59.7

(Nordenskiold, Pogg. **136.** 316.)

100 pts. H_2O dissolve pts. $BaCl_2$ at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
9	33.2	50	43.7
30	38.1	58	45.9
37	40.0	..	....

(Gerardin, A. ch. (4) **5.** 143.)

1 pt. $BaCl_2+2H_2O$ is sol. in 2.18 pts. H_2O at 21.5°, and the solution has sp. gr. = 1.2878. (Schiff, A. **109.** 326.)

1 pt. anhydrous $BaCl_2$ is sol. in 2.86 pts. H_2O at 15°. (Gerlach.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$	t°	Pts. $BaCl_2$
0	30.9	36	39.7	71	49.7
1	31.2	37	40.0	72	50.0
2	31.5	38	40.2	73	50.3
3	31.7	39	40.5	74	50.6
4	31.9	40	40.7	75	50.9
5	32.2	41	41.0	76	51.2
6	32.4	42	41.3	77	51.5
7	32.6	43	41.6	78	51.8
8	32.8	44	41.9	79	52.1
9	33.1	45	42.2	80	52.4
10	33.3	46	42.5	81	52.7
11	33.5	47	42.7	82	53.0
12	33.8	48	43.0	83	53.3
13	34.0	49	43.3	84	53.6
14	34.2	50	43.6	85	54.0
15	34.5	51	43.9	86	54 3
16	34.7	52	44.2	87	54.6
17	35.0	53	44.4	88	55.0
18	35.2	54	44.7	89	55.3
19	35.5	55	45.0	90	55.6
20	35.7	56	45.3	91	55.9
21	36.0	57	45.6	92	56.2
22	36.2	58	45.9	93	56.6
23	36.5	59	46.2	94	56.9
24	36.7	60	46.4	95	57.2
25	37.0	61	46.7	96	57.6
26	37.2	62	47.0	97	57.9
27	37.5	63	47.3	98	58.2
28	37.7	64	47.6	99	58.5
29	38.0	65	47.9	100	58.8
30	38.2	66	48.2	101	59.2
31	38.5	67	48.5	102	59.5
32	38.7	68	48.8	103	59.8
33	39.0	69	49.1	104	60.2
34	39.2	70	49.4	104.1	60.3
35	39.5	..	....	...	....

(Mulder, calculated from his own and other observations. Scheik. Verhandel. **1864.** 45.)

The saturated solution contains—

60.3 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.1°. (Mulder.)

60.1 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.4°. (Legrand.)

61.8 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 104.5°. (Griffith.)

59.58 pts. $BaCl_2$ to 100 pts. H_2O, and boils at 105.48° (Gay-Lussac); at 106° (Kremers).

54.1 pts. $BaCl_2$ to 100 pts. H_2O, and forms crust at 104.4°; highest temperature observed, 104.9°. (Gerlach, Z. anal. **26.** 426.)

Sat. $BaCl_2$+Aq contains at:

100°	130°	144°	160°	180°	215°
36	37.3	37.5	38.9	40.7	43.1% $BaCl_2$

(Étard, A. ch. 1894, (7) **2.** 535.)

Aq. solution contains 27.6% $BaCl_2$ at 30°. (Shreinemakers, C. C. **1910,** **1.** 9.)

Solubility of $BaCl_2+2H_2O$ in H_2O equals 1.745 mol.-litre at 30°. (Masson, Chem. Soc. 1911, **99.** 1136.)

$BaCl_2$+Aq sat. at 8° has sp. gr. 1.27. (Anthon.)
$BaCl_2$+Aq sat. at 15° has sp. gr. 1.282. (Michel and Krafft.)
$BaCl_2$+Aq sat. at 18.1° has sp. gr. 1.285, and contains 44.31 pts. $BaCl_2+2H_2O$ to 100 pts. H_2O. (Karsten.)

Sp. gr. of $BaCl_2$+Aq at 19.5°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
8.88	1.0760	27.53	1.2245
18.24	1.1521	35.44	1.2837

(Kremers, Pogg. **99.** 444.)

Sp. gr. of $BaCl_2$+Aq at 15°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
1	1.00917	14	1.13778
2	1.01834	15	1.14846
3	1.02750	16	1.15999
4	1.03667	17	1.17152
5	1.04584	18	1.18305
6	1.05569	19	1.19458
7	1.06554	20	1.20681
8	1.07538	21	1.21892
9	1.08523	22	1.23173
10	1.09508	23	1.24455
11	1.10576	24	1.25736
12	1.11643	25	1.27017
13	1.12711	..	....

(Gerlach, Z. anal. **8.** 283.)

Sp. gr. of $BaCl_2$+Aq at 21.5°.

% $BaCl_2+2H_2O$	Sp. gr.	% $BaCl_2+2H_2O$	Sp. gr.
1	1.0073	16	1.1302
2	1.0147	17	1.1394
3	1.0222	18	1.1488
4	1.0298	19	1.1584
5	1.0374	20	1.1683
6	1.0452	21	1.1783
7	1.0530	22	1.1884
8	1.0610	23	1.1986
9	1.0692	24	1.2090
10	1.0776	25	1.2197
11	1.0861	26	1.2304
12	1.0947	27	1.2413
13	1.1034	28	1.2523
14	1.1122	29	1.2636
15	1.1211	30	1.2750

(Schiff, calculated by Gerlach, *l.c.*)

Sp. gr. of $BaCl_2$+Aq at 18°.

% $BaCl_2$	Sp. gr.	% $BaCl_2$	Sp. gr.
5	1.0445	20	1.2047
10	1.0939	24	1.2559
15	1.1473	..	......

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $BaCl_2$+Aq at 20°.

g. mols. $BaCl_2$ per l.	Sp. gr.
0.01	1.001878
0.025	1.00475
0.05	1.00929
0.075	1.01369
0.10	1.01766
0.25	1.0456
0.40	1.0726

(Jones and Pearce, Am. Ch. J. 1907, **38.** 701.)

$BaCl_2$+Aq containing 6.94% $BaCl_2$ has sp. gr. 20°/20° = 1.0640.

$BaCl_2$+Aq containing 11.38% $BaCl_2$ has sp. gr. 20°/20° = 1.1086.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sp. gr. of $BaCl_2$+Aq at 25°.

$BaCl_2$+Aq	Sp. gr.
1-normal	1.0884
½- "	1.0441
¼- "	1.0226
1/8- "	1.0114

(Wagner, Z. phys. Ch. 1890, **5.** 35.)

Sp. gr. of $BaCl_2$+Aq.

t°	Concentration of $BaCl_2$+Aq	Sp. gr.
25°	1 pt. $BaCl_2$ in 3.684 pts. H_2O	1.2194
22.8	1 " " " 52.597 " "	1.0145

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Temp. of Maximum Density.

Weight of $BaCl_2$ in 1000 grams H_2O	Temp. of maximum density	Molecular reduction of temp. of M. D.
0	3.982°	
6.73	3.207°	23.94
10.42	2.783°	23.88
20.83	1.572°	24.04
41.72	—0.843°	24.04

(De Coppet, C. R. 1897, **125.** 533.)

$BaCl_2$+Aq containing 10% $BaCl_2$ boils at 100.6°. (Gerlach.)

$BaCl_2$+Aq containing 20% $BaCl_2$ boils at 101.9°. (Gerlach.)

B.-pt. of $BaCl_2$+Aq containing pts. $BaCl_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 443); L = according to Legrand (A. ch. (2) **59.** 452).

B.-pt.	G	L
100.5°	6.4	11.0
101.0	12.7	19.6
101.5	19.0	26.2
102.0	25.3	32.5
102.5	31.6	38.6
103.0	37.7	44.5
103.5	43.7	50.3
104.0	49.5	56.0
104.4	....	60.1
104.5	55.2	....

Less sol. in H_2O containing HCl than in pure H_2O, and scarcely sol. in conc. HCl+Aq. (Berzelius.)

Solubility of $BaCl_2$ in HCl+Aq at 0°. $BaCl_2$ = no. ½ mols. (in milligrammes) dissolved in 10 cc. of the liquid; HCl = no. mols. (in milligrammes) contained in the same quantity of liquid.

$BaCl_2$	HCl	Sum of mols.	Sp. gr.
29.45	0	29.45	1.250
27.8	1.1	28.9	1.242
26.075	2.8	28.875	1.228
23.4	5.0	28.4	1.210
14.0	14.36	28.36	1.143
10.2	18.775	28.975	1.118
6.67	22.75	29.42	1.099
2.74	32.0	34.74	1.079
0.29	50.5	50.79	1.088

(Engel, Bull. Soc. (2) **45.** 653.)

Sol. in about 8000 pts. conc. HCl+Aq.

Sol. in about 20,000 pts. conc. HCl+Aq through which HCl gas was passed.

Practically insol. in conc. HCl+Aq containing 1/6 vol. ether. (Mar, Sill. Am. J. **143.**

Solubility in HCl+Aq at 30°.

Composition of the solution		Solid phase
% by wt. HCl	% by wt. $BaCl_2$	
0	27.6	$BaCl_2$, $2H_2O$
5.94	12.97	"
11.55	3.85	"
18.11	0.46	"
32.35	0.00	"
37.34	0.00	$BaCl_2$, $2H_2O$+$BaCl_2$, H_2O
38.63	0.00	$BaCl_2$, H_2O

(Schreinemakers, Z. phys. Ch. 1909, **68.** 89.)

Much less sol. in HNO_3+Aq than in H_2O, because $Ba(NO_3)_2$ is nearly insol. therein. (Wurtz.)

$BaCl_2$ is sol. in about—

4.00 pts. H_2O.

5.00 pts. NH_4OH+Aq (conc.).

5.33 pts. NH_4OH+Aq (1 vol. conc.: 3 vols. H_2O).

5.33 pts. HCl+Aq (1 vol. conc.: 4 vols. H_2O).

8.00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial acid: 1 vol. H_2O).

6.00 pts. NH_4Cl+Aq (1 pt. NH_4Cl : 10 pts. H_2O).

6.00 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH+Aq neutralized by dil. $HC_2H_3O_2$+Aq.)

6.67 pts. $NaC_2H_3O_2$+Aq (commercial $HC_2H_3O_2$ neutralized by Na_2CO_3, and dil. with 4 vols. H_2O).

6.33 pts. $Cu(C_2H_3O_2)_2$+Aq. *See* Stolba (Z. anal. **2.** 390).

5.67 pts. grape sugar (1 pt. grape sugar: 10 pts. H_2O). (Pearson, Zeit. Chem. **1869.** 662.)

$BaCl_2$+NH_4Cl. Solubility of $BaCl_2$ in NH_4Cl+Aq at 30°.

Composition of the solution		Solid phase
% NH_4Cl	% $BaCl_2$	
0	27.6	$BaCl_2.2H_2O$
5.71	22.16	"
10.06	18.36	"
13.84	15.42	"
20.00	10.89	"
24.69	8.33	"
25.79	7.95	$BaCl_2.2H_2O$+NH_4Cl
26.06	7.99	"
27.47	3.56	NH_4Cl
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, **66.** 688.)

See also under **Ammonium chloride.**

$BaCl_2$+$Ba(OH)_2$. Solubility of $BaCl_2$ in BaO+Aq at 30°.

Composition of the solution		Solid phase
% by wt. BaO	% by wt. $BaCl_2$	
0	27.6	$BaCl_2$, $2H_2O$
1.78	27.42	"
1.79	27.31	$BaCl_2$, $2H_2O$+BaCl(OH), $2H_2O$
1.75	27.41	"
2.33	24.98	BaCl(OH), $2H_2O$
2.50	24.20	"
3.27	21.46	"
4.67	19.18	"
4.86	18.97	BaCl(OH), $2H_2O$+BaO, $9H_2O$
4.29	18.83	"
4.64	18.77	"
4.65	18.10	"
4.62	18.04	BaO, $9H_2O$
4.60	17.08	"
4.58	12.81	"
4.45	10.77	"
4.99	0	"

(Schreinemakers, Z. phys. Ch. 1909, **68.** 88.)

Sol. in $CuCl_2$,NH_4Cl+Aq at 30°. (Schreinemakers, Z. phys. Ch. 1909, **66.** 688.)

The solubility data for the system $BaCl_2$+$CuCl_2$+KCl+Aq have been determined at 40° and 60°. (Schreinemakers, C. C. **1915,** I. 933.)

$BaCl_2$+$HgCl_2$. Solubility of $BaCl_2$+$HgCl_2$ in H_2O.

t°	Gms. per 100 g. solution		Solid phase
	$BaCl_2$	$HgCl_2$	
10.4°	23.58	50.54	$BaCl_2$,$2H_2O$+$HgCl_2$
10.4	23.44	50.74	$BaCl_2$,$3HgCl_2$, $6H_2O$
10.4	22.58	51.23	$BaCl_2$,$3HgCl_2$, $6H_2O$
10.4	22.48	51.41	$BaCl_2$,$3HgCl_2$, $6H_2O$
10.4	22.10	51.66	$BaCl_2$,$3HgCl_2$, $6H_2O$
10.4	21.64	51.74	$BaCl_2$,$2H_2O$+$HgCl_2$
25.0	23.02	54.83	$BaCl_2$,$2H_2O$+$HgCl_2$

(Foote and Bristol, Am. Ch. J. **32.** 248.)

Solubility of $BaCl_2+HgCl_2$ in H_2O.

Temp. =30

% $HgCl_2$	% $BaCl_2$	Solid phase
0	27.77	$BaCl_2.2H_2O$
2.90	27.56	"
7.09	27.47	"
12.98	26.99	"
22.61	26.89	"
34.57	26.69	"
46.50	25.22	"
55.16	23.46	$HgCl_2+BaCl_2.2H_2O$
55.32	23.08	"
55.19	22.98	"
48.97	17.87	$HgCl_2$
41.30	14.26	"
27.62	8.41	"
14.19	2.65	"
7.67	0	"

Temp. =0°

% $HgCl_2$	% $BaCl_2$	Solid phase
0	23.70	$BaCl_2.2H_2O$
14.25	24.0	"
36.20	24.89	"
46.12	24.07	$BaCl_2, 3HgCl_2.6H_2O+$
46.05	24.03	" $BaCl_2.2H_2O$
46.07	24.05	"
46.59	23.28	$BaCl_2, 3HgCl_2.6H_2O$
47.78	21.05	"
48.43	20.64	$BaCl_2, 3HgCl_2.6H_2O+HgCl_2$
48.49	20.71	"
44.33	18.50	$HgCl_2$
29.0	11.59	"
16.36	6.11	"
3.95	0	"
Temp. =40°		
56.57	22.98	$BaCl_2.2H_2O+HgCl_2$

(Schreinemakers, Ch. Weekbl. 1911, **7.** 202.)

$BaCl_2+KCl$. Sol. in sat. $KCl+Aq$, at first without pptn. The KCl is pptd. after a time until a state of equilibrium is reached.

100 pts. H_2O at 16.6° dissolve 33.8–27.2 pts. KCl and 18.2–34.9 pts. $BaCl_2$. (Kopp, A. **34.** 267.)

100 g. sat. solution of $BaCl_2+KCl$ contain 13.83 g. $BaCl_2$ and 18.97 g. KCl at 25°. (Foote, Am. Ch. J. **32.** 253.)

$BaCl_2+Ba(NO_3)_2$. $BaCl_2$ is sol. in sat. $Ba(NO_3)_2+Aq$.

Solubility of $BaCl_2+Ba(NO_3)_2$ in H_2O. Both salts present in solid phase.

t°	Gms. per 100 gms. solution		t°	Gms. per 100 gms. solution	
	$BaCl_2$	$Ba(NO_3)_2$		$BaCl_2$	$Ba(NO_3)_2$
0	22.5	4.3	100	31	14
20	24.5	6.0	140	32	20
40	26.5	7.5	180	33	26
60	28.5	9.5	210	32	32

(Etard, A. Ch. (7) **2.** 535.)

Very slowly sol. in sat. $NaNO_3+Aq$ with separation of $Ba(NO_3)_2$.

Rapidly sol. in sat. KNO_3+Aq, forming $Ba(NO_3)_2$, which separates out. (Karsten.)

$BaCl_2+NaCl$. $BaCl_2$ is sol. in $NaCl+Aq$ at first without separation of NaCl, which, however, finally separates.

100 pts. H_2O dissolve, when both salts are in excess—

	1	2	3	4	5	6
NaCl . . .	35.9	4.1	..	40.4	35.3	....
$BaCl_2$ . . .	...	34.5	35.0	....	19.4	60.3
		38.6			54.7	

1, 2, and 3 are at 17°. (Kopp, A. **34.** 268.)
4, 5, and 6 are at b.-pt. (Mulder.)

Solubility of $BaCl_2+NaCl$.

100 pts. H_2O dissolve pts. $BaCl_2$ and NaCl at t°.

t°	Pts. $BaCl_2$	Pts. NaCl	t°	Pts. $BaCl_2$	Pts. NaCl
10	4.1	33.9	60	9.7	33.5
20	4.1	33.8	70	11.7	33.6
30	5.0	33.7	80	13.9	33.6
40	6.3	33.6	90	15.9	33.6
50	7.9	33.5	100	17.9	33.6

(Precht and Wittgen, B. **14.** 1667.)

Solubility of $BaCl_2+NaCl$ in $HCl+Aq$ at 30°.

Solid phase, NaCl			Solid phase, $BaCl_2+2H_2O$		
Sp. gr. of sat. solution	G. mol. litre		Sp. gr. of sat. solution	G. mol.-litre	
	HCl	NaCl		HCl	$BaCl_2$
1.2018	0.0000	5.400	1.3056	0.0000	1.745
1.1906	0.4575	4.932	1.2651	0.4709	1.468
1.1801	0.969	4.386	1.2147	1.107	1.122
1.1633	1.786	3.589	1.1789	1.622	0.861
1.1512	2.412	2.978	1.1419	2.234	0.592
1.1427	3.052	2.463	1.1068	3.041	0.307
1.1289	4.152	1.628	1.0880	3.953	0.124
1.1188	5.950	0.630	1.0895	3.059	0.020
1.1258	7.205	0.268	1.1024	6.234	0.00
			1.1609	10.25	0.00

(Masson, Chem. Soc. 1911, **99.** 1136.)

Solubility of $BaCl_2+NaCl$ in $HCl+Aq$ at 30°.

%HCl	%NaCl	%$BaCl_2$	Solid phase
0	23.85	3.8	NaCl, $BaCl_2.2H_2O$
4.84	18.07	2.27	"
12.02	9.55	0.82	"
17.20	4.65	0.29	"
23.16	1.54	0.00	"
28.66	0.47	0.00	"
36.51	0.12	0.00	$NaCl+BaCl_2.H_2O$

(Schreinemakers, Arch. Néer. Sc. ex. nat. (2) **15.** 91.)

Insol in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Solubility in alcohol: 100 pts. alcohol of given sp. gr. dissolve pts. of the anhydrous, and crystallized salt.

Sp. gr.	Pts. $BaCl_2$	Pts. $BaCl_2+2H_2O$
0.900	1.00	1.56
0.848	0.29	0.43
0.834	0.185	0.32
0.817	0.09	0.06

(Kirwan.)

Insol. in abs. alcohol, or below 19° in alcohol of over 91%. Dil. alcohol dissolves less $BaCl_2$ than corresponds to the amount of H_2O present. (Gerardin, A. ch. (4) **5.** 142.)

Solubility in 100 pts. alcohol at t°. D = sp. gr. of alcohol; S = solubility.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
t°	s	t°	s	t°	s	t°	s
14	29.1	14	25.0	11	19.6	15	15.6
25	32.0	32	29.1	15	20.4	23	17.0
32	33.5	39	30.9	20	21.7	33	19.1
47	37.4	50	33.2	35	24.6	50	22.0
60	39.8	63	37.6	45	26.8	..	....

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8429	
t°	s	t°	s	t°	s	t°	s
13	10	12	6.5	12	0.1	12	0.00
24	11.4	23	7.2	30	4.3	19	0.00
34	12.9	31	8.3	47	4.9	25	0.04
39	13.8	37	9.0	..	...	50	0.28
50	15.2	47	10.1	..	...	67	0.377

(Gerardin, A. ch. (4) **5.** 142.)

Solubility in dil. alcohol of x% by weight at 15°.

% alcohol	0	10	20	30	40	60	80
Pts. $BaCl_2, 2H_2O$	30.25	23.7	18.0	12.8	9.3	3.4	0.5

(Schiff, A. **118.** 365.)

Sol. in 6885–8108 pts. 99.3% alcohol at 14.5°, and in 1857 pts. at ebullition. (Fresenius.)

Solubility of $BaCl_2$ in alcohol+Aq.

t°	% alcohol	% $BaCl_2$	Solid phase
30°	0	27.95	$BaCl_2.2H_2O$
"	32.67	10.63	"
"	50.16	5.68	"
"	66.72	2.23	"
"	92.53	0.05	"
"	94.83	0.07	$BaCl_2.2H_2O+BaCl_2.H_2O$
"	94.75	0.05	"
"	94.60	0.07	"
"	97.14	.....	$BaCl_2.H_2O$
"	98.17	0.08	$BaCl_2.H_2O+BaCl_2$
"	99.41	.....	$BaCl_2$
60°	0	31.57	$BaCl_2.2H_2O$
"	16.68	20.16	"
"	34.10	13.21	"
"	66.02	2.82	"
"	88.55	0.25	"
"	90.11	0.09	$BaCl_2.2H_2O+BaCl_2.H_2O$
"	90.39	.....	"
"	93.95	.....	$BaCl_2.H_2O$

(Schreinemakers and Massink, Chem. Weekbl. 1910, **7.** 213.)

100 pts. absolute methyl alcohol dissolve 2.18 pts. $BaCl_2$ at 15.5°, and 7.3 pts. $BaCl_2$, $2H_2O$ at 6°. (de Bruyn, Z. phys. Ch. **10.** 783.)

At 15° C. 1 pt. by weight is sol. in:—

78 pts. methyl alcohol of sp. gr. 0.790
7,000 " ethyl " " " " 0.8035
100,000 " propyl " " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

Absolutely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. **144.** 459.)

Absolutely insol. in acetic ether. (Cann, C. R. **102.** 363.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

100 pts. by weight of glycerine dissolve 10 pts. $BaCl_2$ at 15.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.) (Eidmann, C. C. **1899,** II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in anhydrous pyridine, 97% pyridine+Aq. and 95% pyridine+Aq. Sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

$+H_2O$. Solution of monohydrate sat. at 6° contains 31.57% $BaCl_2$. (Schreinemakers, Chem. Weekbl. 1910, **7.** 213.)

2.5 grams of the monohydrate are sol. in 100 cc. of methyl alcohol at 14°. (Kirschner, Z. phys. Ch. 1911, **76.** 176.)

Exact solubility in methyl alcohol cannot be determined as $BaCl_2+H_2O$ separates out from a sat. solution of the dihydrate. (Kirschner, Z. phys. ch. 1911, **76.** 177.)

Barium cadmium chloride, $BaCl_2,CdCl_2+4H_2O$.

Easily sol. in H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	100 pts. solution contain pts.			100 g. of solution contain g. salt	100 g. H_2O dissolve g. salt	100 mols. H_2O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.5	15.19	14.71	11.98	41.88	72.06	3.32
32.9	16.18	16.09	12.40	44.59	80.73	3.72
41.4	16.95	16 81	13.05	46.87	88.01	4.06
53.4	18.21	18.13	13.95	50.30	101.21	4.66
62.0	18.81	18.74	14.73	52.28	109.56	5.05
97.8	22.48	22.00	17.57	62.05	163.50	7.53
108.3	23.51	22.79	18.53	64.83	184.33	8.49
109.2	23.69	29.95	18.67	65.31	188.27	8.67

(Rimbach, B. 1897, **30.** 3083.)

$BaCl_2.2CdCl_2+5H_2O$. Quite difficultly sol. in H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	100 pts. by wt. of solution contain pts. by wt.			100 g. of solution contain g. salt	100 g. H_2O dissolve g. salt	100 mols. H_2O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.6	16.89	11.00	17.71	45.60	83.82	2.63
41.3	18.15	11.77	19.22	49.14	96.62	3.03
53.9	18.78	12.41	19.85	51.04	104.25	3.27
62.2	19.66	12.83	20.59	53.08	113.13	3.55
69.5	20.18	13 09	21.20	54.47	119.64	3.76
107.2	23.31	14.87	24.11	62.29	165.18	5.19
107.2	23.16	14.93	24.39	62.48	166 53	5 23

(Rimbach, B. 1897, **30.** 3083.)

Barium mercuric chloride, basic, $BaCl_2$, $HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium mercuric chloride, $BaCl_2$, $2HgCl_2+2H_2O$.

Efflorescent in dry air; sol. in H_2O. (v. Bonsdorff, Pogg. **17.** 130.)

The salt $BaCl_2$, $2HgCl_2+2H_2O$ described by Bonsdorff does not form under the conditions which he gives. (Foote, Am. Ch. J. 1904, **32.** 251.)

$BaCl_2,3HgCl_2+6H_2O$. Solubility determinations with mixtures of $BaCl_2$ and $HgCl_2$ show that these chlorides do not form a double salt at 25°, but that a transition temp. exists at about 17.2° below which the salt $BaCl_2$, $3HgCl_2+6H_2O$ forms. (Foote, Am. Ch. J. 1904, **32.** 251.)

$+8H_2O$. Less sol. in H_2O than the Sr and Mg double salts. (Swan, Am. Ch. J. 1898, **20.** 633.)

Barium rhodium chloride, $3BaCl_2$, Rh_2Cl_6.

See **Chlororhodite, barium.**

Barium stannous chloride, $BaCl_2$, $SnCl_2+4H_2O$.

Sol. in H_2O. (Poggiale, C. R. **20.** 1183.)

Barium stannic chloride.

See **Chlorostannate, barium.**

Barium uranium chloride, $BaCl_2,UCl_4$.

Decomp. by H_2O. (Aloy, Bull. Soc. 1899, (3) **21.** 265.)

Barium zinc chloride, $BaCl_2$, $ZnCl_2+4H_2O$.

Deliquescent, and sol. in H_2O. (Warner, C. N. **27.** 271.)

Pptd. from warm solution only. (Ephraim, Z. anorg. 1910, **67.** 381.)

$+2\frac{1}{2}H_2O$. Pptd. from cold solution. (Ephraim.)

Barium chloride hydrazine, $BaCl_2$, $2N_2H_4$.

Hydroscopic. (Franzen, Z. anorg. 1908, **60.** 290.)

Barium chloride hydroxylamine, $BaCl_2$, $2NH_2OH$.

Very sol. in H_2O. (Crismer, Bull. Soc. (3) **3.** 118.)

Barium chloride sulphuric anhydride, $BaCl_2$, $2SO_3$.

Decomp. by H_2O. (Schultz-Sellack, B. **4.** 113.)

Barium chlorofluoride, $BaClF$.

Difficultly sol. in H_2O, but much more sol. than BaF_2. Decomp. by H_2O, so that when washed on filter, the filtrate contains more $BaCl_2$ than BaF_2. (Berzelius, Pogg. **1.** 19.)

Insol. in and undecomp. by boiling alcohol; sol. in conc. HCl and HNO_3. Decomp. by hot H_2O, hot H_2SO_4, dil. acetic acid, dil. HCl or dil. HNO_3. (Defacqz, C. R. 1904, **138.** 198.)

Barium cyanamide, $BaCN_2$.

Decomp. by H_2O. (Frank, C. C. **1902, II.** 774.)

Barium *sub***fluoride sodium fluoride,** BaF, NaF.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium fluoride, BaF_2.

Scarcely sol. in H_2O (Berzelius); less sol. in H_2O than CaF_2.

1 liter H_2O dissolves 1630 mg. BaF_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1605 mg. are contained in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Insol. in molten $MnCl_2$, $MnBr_2$, MnI_2, $MnCl_2+BaCl_2$, $MnBr_2+BaBr_2$ and MnI_2+BaI_2. (Defacqz, A. ch. 1904, (8) **1.** 350.)

Easily sol. in HCl, HNO_3, or HF+Aq. (Gay-Lussac and Thénard.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in an aqueous solution of sodium citrate. (Spiller.)

Barium tin (stannic) fluoride.

See **Fluostannate, barium.**

Barium tellurium fluoride, BaF_2, $2TeF_4$.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Barium titanium fluoride.

See **Fluotitanate, barium.**

Barium titanyl fluoride, TiO_2F_2, BaF_2.

See **Fluoxypertitanate** *and* **fluoxytitanate, barium.**

Barium uranyl fluoride.

See **Fluoxyuranate, barium.**

Barium vanadyl fluoride.

See **Fluoxyvanadate, barium.**

Barium zirconium fluoride, $3BaF_2$, $2ZrF_4+2H_2O$.

Insoluble precipitate. (Marignac.)

See also **Fluozirconate, barium.**

Barium fluoiodide, BaF_2, BaI_2.

Decomp. by H_2O, dil. HCl, dil. HNO_3 or hot H_2SO_4. Sol. in HI and HNO_3. Insol. in and undecomp. by boiling alcohol. Decomp. by dil. acetic acid. (Defacqz, C. R. 1904, **138.** 199.)

Barium hydride, BaH.

Decomp. by H_2O or HCl+Aq. (Winkler, B. **24.** 1979.)

Decomp. by H_2O. (Guntz, C. R. 1901, **132.** 964.)

Barium hydrosulphide, BaS_2H_2.

Easily sol. in H_2O. Insol. in alcohol.

$+4H_2O$. Sol. in H_2O, and the solution dissolves S. (Veley, Chem. Soc. **49.** 369.)

Barium hydroxide, BaO_2H_2.

100 pts. cold H_2O dissolve 5 pts. BaO_2H_2.
" boiling " 50 "
(Davy.)

100 pts. H_2O at 20° dissolve 3.45 pts. BaO.
(Bineau, C. R. **41.** 509.)

100 pts. H_2O at 13° dissolve 2.86 pts. BaO.
" " 47° " 13.3 "
" " 70° " 17.9 "
(Osann.)

100 pts. H_2O dissolve pts. BaO at t°.

t°	Pts. BaO	t°	Pts. BaO	t°	Pts. BaO
0	1.5	30	5.0	60	18.76
5	1.75	35	6.17	65	24.67
10	2.22	40	7.36	70	31.9
15	2.89	45	9.12	75	56.85
20	3.48	50	11.75	80	90.77
25	4 19	55	14.71	..	.....

(Rosenthiel and Rühlmann, J. B. **1870.** 314.)

100 pts. H_2O dissolve at 25° 55.08 millimols. $\frac{BaO_2H_2}{2}$. (Herz and Knoch, Z. anorg. **1904, 41.** 315.)

Sp. gr. of BaO_2H_2+Aq.

% BaO	Sp. gr.	% BaO	Sp. gr.
30	1 6	1.8	1.02
19	1 3	0.9	1.01
2 6	1 03	...	....

(Dalton.)

Sp. gr. of BaO_2H_2+Aq at 18° containing 1.25% BaO_2H_2=1.0120; containing 2.5%=1.0253. (Kohlrausch, W. Ann. 1879, **6.** 41.)

Sp. gr. of BaO_2H_2+Aq at 80°.

Sp. gr.	% BaO_2H_2 by volume	% BaO_2H_2 by weight	Sp. gr.	% BaO_2H_2 by volume	% BaO_2H_2 by weight
1.514	58.22	38.45	1.219	24.53	20.12
1.500	56.31	37.54	1.200	23.00	19.17
1.479	54.14	36.60	1.195	22.15	18.53
1.458	49.38	33.87	1.174	19.83	16.89
1.450	48.90	33.72	1.152	17.78	15.43
1.413	45.99	32.55	1.129	16.01	14.18
1.400	45.00	32.14	1.125	15.80	14.04
1.390	44.22	31.81	1.114	14.56	13.07
1.375	42.40	30.84	1.100	13.06	11.87
1.368	41.45	30.30	1.076	10.58	9.83
1.350	38.60	28.59	1.062	9.16	8.62
1.338	37.30	27.88	1.049	7.55	7.20
1.312	35.02	26.69	1.040	6.51	6.26
1.301	34.02	26.13	1.031	5.18	5.02
1.278	31.48	24.67	1.022	4.78	4.67
1.249	28.14	22.52	1.015	3.90	3.84
1.236	26.41	21.36	1.009	3.37	3.34

(Haff, C. N. 1902, **86.** 284.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

More sol. in NaCl+Aq, KNO_3+Aq, or $NaNO_3$+Aq than in H_2O. (Karsten.)

Not precipitated by alcohol.

Sol. with combination in absolute alcohol and anhydrous methyl alcohol. Insol. in ether.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Solubility in acetone+Aq at 25°.

A = cc. acetone in 100 cc. acetone+Aq.

$\frac{BaO_2H_2}{2}$ = millimols. BaO_2H_2 in 100 cc. of the solution.

S = sp. gr. of the solution.

A	$\frac{BaO_2H_2}{2}$	S
0	55.08	1.04790
10	31.84	1.01677
20	17.79	0.99268
30	9.10	0.97630
40	4.75	0.95605
50	1.54	0.93980
60	0.48	0.91790
70	0.08	0.89562

(Herz, Z. anorg. 1904, **41.** 321.)

BaO_2H_2 is sol. in an aqueous solution of cane sugar (Hunton, Phil. Mag. (3) **11.** 156); also in an aqueous sol. of mannite (Favre, A. ch. (3) **11.** 76); sorbine (Pelouze); hot solution of quercite, separating on cooling (Dessaignes).

$+3H_2O$. Decomp. by H_2O free from carbonic acid. Sl. sol. in alcohol and ether. (Bauer, Z. anorg. 1905, **47,** 416.)

Solubility in H_2O the same as that of the comp. with $8H_2O$. Insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, **17.** 341.)

Nearly insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, **16.** 349.)

$+8H_2O$. Sol. in 20 pts. cold, and 3 pts. boiling H_2O (Graham); 17.5 pts. H_2O at 15.5°, and in all proportions of hot H_2O. (Hope.) Sol. in 19 pts. H_2O at 15°, and 2 pts. at 100°. (Wittstein.)

If $BaO_2H_2+8H_2O$ is heated it dissolves in the crystal H_2O and the solution has the following bpts.

%BaO	49.05	50.05	52.43	53.72
B.-pt.	103°	104°	105°	106°
%BaO	55.35	57.49	58.74	61.44
B.-pt.	107°	108°	108.5°	109°

$BaO_2H_2+3H_2O$ separates at 109°. (Bauer, Zeit. angew. Ch. 1903, **17.** 345.)

B.-pt. of $BaO_2H_2.8H_2O$+Aq at 732 mm.

Bpt.	Time	%BaO
78° (mpt.)	0	48.45
78	4′	48.45
103	6′ 30″	49.05
104	6′ 45″	50.05
105	7′ 30″	52.43
106	9′ 25″	53.72
107	10′ 45″	55.35
108	12′	57.49
108.5	—	58.74
109	13′	61.44
109	17′ 40″	63.65
108	17′ 50″	66.53
105	18′	67.51
100	18′ 45″	68.17

(Bauer, Z. anorg. 1905, **47.** 407.)

Solubility in $Ba(NO_3)_2$+Aq at 25°.

Solution sat. with respect to both $Ba(NO_3)_2$ and BaO_2H_2, $8H_2O$.

Sp. gr. 25°/25°	g. BaO as $Ba(OH)_2$ in 100 g. H_2O	g. $Ba(NO_3)_2$ in 100 g. H_2O
1.1448	5.02	11.48
1.1371	4.93	10.21
1.1288	4.83	8.66
1.1220	4.72	7.55
1.1133	4.72	7.01
1.1062	4.65	6.82
1.1044	4.61	6.55
1.1010	4.64	6.08
1.0975	4.60	5.66
1.0949	4.55	5.46
1.0937	4.54	5.32
1.0885	4.52	4.44
1.0864	4.53	4.41
1.0840	4.52	4.04
1.0790	4.48	3.47
1.0774	4.46	3.14
1.0731	4.40	2.79
1.0711	4.42	2.53
1.0651	4.35	1.88
1.0626	....	....
1.0640	4.35	1.45
1.0538	4.29	0.43
1.0512	4.29	0

(Parsons and Corson, J. Am. Chem. Soc. 1910, **32.** 1385.)

Solubility of $Ba(OH)_2+8H_2O$ (solid phase) in MCl+Aq (mol. per litre of solution) at 25°.

Solution of	(Cl′)	(OH′)
LiCl	0	0.555
"	0.75	0.745
"	1.42	0.937
"	2.30	1.336
KCl	0.86	0.645
"	1.75	0.660
"	3.40	0.676
NaCl	0	0.555
"	0.73	0.630
"	1.43	0.699
"	2.82	0.806
RbCl	1.25	0.648

(Herz, Z. anorg. 1910, **67.** 366.)

Solubility of BaO in NaOH+Aq at 30°.

% Na_2O	%BaO	Solid phase
0	4.99	$BaO.9H_2O$
4.78	1.29	"
6.43	0.89	"
9.63	0.57	"
11.62	0.53	"
17.87	0.47	"
23.28	1.06	"
24.63	1.87	$BaO.9H_2O+BaO.4H_2O$
26.14	1.84	$BaO.4H_2O$
27.72	1.75	"
28.43	1.58	"
29.24	1.34	$BaO.4H_2O+BaO.2H_2O$
32.12	0.82	$BaO.2H_2O$
34.72	0.59	"
41.09	0.57	$BaO.2H_2O+NaOH.H_2O$
42	0	$NaOH.H_2O$

(Schreinemakers, Z. phys. Ch. 1909, **68.** 84.)

50% alcohol dissolves less than 0.5% of its wt. of $BaO_2H_2+8H_2O$. (Beckmann, J. pr. 1883, (2) **27.** 138.)

Barium *sub*iodide sodium iodide, BaI, NaI.

Decomp. by H_2O. (Guntz, C. R. 1903, **136.** 750.)

Barium iodide, BaI_2.

Not deliquescent. Very sol. in H_2O and alcohol. 100 pts. of anhydrous salt dissolve:

at	0°	19.5°	30°	40°	60°	90°	106°
in	59	48	44	43	41	37	35 pts. H_2O.

(Kremers, Pogg. **103.** 66.)

Sp. gr. of BaI_2+Aq containing:

5	10	15	20	25	30% BaI_2
1.045	1.091	1.143	1.201	1.265	1.333
35	40	45	50	55	60% BaI_2.
1.412	1.495	1.596	1.704	1.825	1.970

(Kremers, Pogg. **111.** 63, calculated by Gerlach, Z. anal. **8.** 279.)

Easily sol. in alcohol. (Henry.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)
$+2H_2O$. At 15° C., 1 pt. by weight in sol. in:

22 pts. methyl alcohol sp. gr. 0.790
93 " " " " " 0.8035
307 " " " " " 0.8085

(Rohland, Z. anorg. 1897, **15.** 413.)

$+7H_2O$. (Thomson, B. **10.** 1343.)

The composition of the hydrates formed by BaI_2 at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by BaI_2 and of the conductivity and sp. gr. of BaI_2+Aq. (Jones, Am. Ch. J. 1905, **34.** 306.)

Barium iodide, basic, *Ba(OH)I$+9H_2O$.
See **Barium oxyiodide.**

Barium bismuth iodide, BaI_2, $2BiI_3+18H_2O$.
Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Barium cadmium iodide, BaI_2, CdI_2+5H_2O.
Deliquescent. (Croft.)

Barium mercuric iodide, BaI_2, $2HgI_2$.
Decomp. by much H_2O. (Boullay.)
BaI_2, HgI_2. Sol. in H_2O. (Boullay.)
Sp. gr. of sat. solution = 3.575–3.588. (Rohrbach, W. Ann. **20.** 169.)
$+5H_2O$. (Duboin, C. R. 1906, **143.** 314.)
$2BaI_2$, $3HgI_2+16H_2O$. (Duboin, C. R. 1906, **142.** 888.)
BaI_2, $5HgI_2+8H_2O$. As the corresponding Ca salt. (Duboin, C. R. 1906, **142.** 888.)
$3BaI_2$, $5HgI_2+21H_2O$. Very deliquescent. (Duboin, C. R. 1906, **142.** 889.)

Barium stannous iodide.
Very sol. in H_2O. (Boullay.)

Barium zinc iodide, BaI_2, $2ZnI_2$.
Deliquescent, and sol. in H_2O. (Rammelsberg.)
$+4H_2O$. Very hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 385.)

Barium nitride, Ba_3N_2.
Decomp. H_2O violently, not alcohol. (Maquenne, A. ch. (6) **29.** 219.)
BaN_6.
See **Barium azoimide.**

Barium oxide, BaO.
Sol. in H_2O with evolution of heat.
Easily sol. in dil. HNO_3, or HCl+Aq.
Solubility in NaOH+Aq. *See* **Barium hydroxide.**
Solubility in Na_2O, HCl, $+H_2O$ at 30°. (Schreinemakers, Z. phys. Ch. 1909, **68.** 98.)
Solubility in Na_2O, NaCl, $BaCl_2$+Aq at 30°. (Schreinemakers.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
Sol. with combination in absolute alcohol and anhydrous wood-spirit. Insol. in ether.
Easily sol. in absolute methyl alcohol.
1 l. absolute ethyl alcohol sat. with BaO at 9° contains 213.8 g. BaO. (Berthelot, Bull. Soc. **8.** 389.)
Sol. in methyl alcohol. (Neuberg and Neimann, Biochem. Z. 1906, **1.** 173.)
Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
See also **Barium hydroxide.**

Barium *per*oxide, BaO_2.
Insol. in H_2O; decomp. by boiling H_2O.

Sol. in acids with formation of hydrogen dioxide.

Forms hydrate with $8H_2O$; also $10H_2O$ (Berthelot, A. ch. (5) **21.** 157); also a compound BaO_2, H_2O_2, which is very unstable, sl. sol. in cold H_2O, and insol. in alcohol or ether. (Schöne, A. **192.** 257.)

$+8H_2O$. 100 cc. pure H_2O dissolve 0.168 g. BaO_2+8H_2O; if H_2O contains 0.3 g. $Ba(OH)_2+8H_2O$, only 0.102 g. BaO_2+8H_2O are dissolved; if 0.6 g. $Ba(OH)_2+8H_2O$ only 0.019 g. BaO_2+8H_2O are dissolved. (Schöne, A. 1878, **192.** 266.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37.** 4329.)

Barium oxybromide, $Ba(OH)Br+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **27.** 132.)

$BaBr_2,BaO+5H_2O$. Sl. sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1340.)

Barium oxychloride, $Ba(OH)Cl+2H_2O$.

Decomp. by H_2O. (Beckmann, J. pr. (2) **26.** 388, 474.)

Barium mercury oxychloride, $BaCl_2$, $HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Barium oxyiodide, $Ba(OH)I+9H_2O$.

Decomp. by H_2O and alcohol. (Beckmann, B. **14.** 2154.)

$BaI_2,BaO+9H_2O$. Sl. sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1340.)

Barium oxysulphides, $Ba_7O_4S_3+58H_2O$, $Ba_2OS+10H_2O$, $Ba_4OS_3+28H_2O$.

Very unstable; decomp. by recrystallization into BaS_2H_2 and BaO_2H_2.

Barium phosphide, BaP_2.

Decomp. by H_2O. (Dumas, A. ch. **32.** 364.)

Ba_3P_2. Crystallized. Sol. in dil. acids; insol. in conc. acids; decomp. by H_2O. Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, **129.** 765.)

Barium selenide, BaSe.

Sol. in H_2O with decomp.

Sl. sol. in H_2O. (Favre, C. R. **102.** 1469.)

Barium silicide, Ba_2Si.

(Jüngst, C. C. **1905, I.** 195.)

$BaSi_2$. Slowly decomp. by H_2O, not by NH_4OH+Aq. Rapidly decomp. by conc. NaOH. Sol. in HNO_3, H_2SO_4 and H_3PO_4 with evolution of spontaneously inflammable gas. Sol. in HF and HCl. Sol. in acetic acid without evolution of gas. (Moissan, Traité ch. min. **1904,** III. 680.)

Decomp. rapidly in both hot and cold H_2O. (Bradley, C. N. 1900, **82.** 150.)

Barium sulphide, BaS.

Sol. in H_2O with decomp.

Crystallized. Decomp. by H_2O.

Attacked by cold conc. HNO_3. (Mourlot, A. ch. 1899, (7) **17.** 521.)

Cryst. modification is less readily acted on by air and other reagents than the amorphous modification; sol. in fuse oxidizing agents. (Mourlot, C. R. 1898, **126.** 645.)

$+H_2O$. (Neuberg and Neimann, Biochem. Z. 1906, **1.** 174.)

$+6H_2O$. Slowly sol. in boiling H_2O, with decomp.; insol. in, but decomp. by boiling alcohol. (Schöne.)

Barium sulphide, $Ba_4S_7+25H_2O$ (?).

Sol. in H_2O. (Schöne, Pogg. **112.** 215.)

Barium ***tri*****sulphide,** BaS_3.

Sol. in large amount of boiling H_2O. (Schöne, Pogg. **112.** 215.)

Barium ***tetra*****sulphide,** BaS_4+H_2O.

Easily sol. in H_2O, especially if hot; sol. in 2.42 pts. H_2O at 15°; insol. in CS_2 or alcohol. (Schöne, Pogg. **112.** 224.)

$+2H_2O$. (Veley, Chem. Soc. **49.** 369.)

Barium ***penta*****sulphide,** BaS_5.

Known only in solution.

Barium mercuric sulphide, BaS, $HgS+5H_2O$.

Sol. in H_2O. (Wagner, J. pr. **98.** 23.)

Barium nickel sulphide, BaS, 4NiS.

Sol. in warm conc. HCl. (Bellucci, C. A. **1909,** 293.)

Barium stannic sulphide.

See **Sulphostannate, barium.**

Barium uranyl sulphide, 6BaS, UO_2S+xH_2O (?).

Decomp. by HCl+Aq. (Remelé, Pogg. **124.** 159.)

Baryta.

See **Barium oxide,** BaO.

Beryllium, Be.

For beryllium and its salts, see **Glucinum** and the corresponding salts.

Bismuth, Bi.

Not attacked by H_2O. Very slowly attacked by HCl+Aq (Troost). Very sl. sol. in conc. HCl+Aq (Schützenberger, Willm). Not attacked by dil. HCl+Aq (Naquet and Hanriot). Very slowly attacked by cold HCl +Aq (Godeffroy). According to very careful experiments pure Bi is absolutely unattacked by hot or cold, dil. or conc. HCl+Aq except in presence of oxygen. (Ditte and Metzner, A. ch. (6) **29.** 397.)

Not attacked by dil. H_2SO_4+Aq. Decomp.

by hot conc. H_2SO_4. Easily sol. in dil. or conc. HNO_3+Aq, or aqua regia.
Not attacked by pure HNO_3+Aq of 1.52 to 1.42 sp. gr. at 20°; violently attacked by a more dil. acid, but the acid becomes concentrated thereby. Conc. HNO_3+Aq attacks only by heating or adding NO_2. (Millon, A. ch. (3) **6.** 95.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
½ ccm. oleic acid dissolves 0.0091 g. Bi in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Bismuth arsenide, Bi_3As_4.
(Descamp, C. R. **86.** 1065.)

Bismuth *di*bromide, Bi_2Br_4.
Not known in a pure state. (Weber, Pogg. **107.** 599.)

Bismuth *tri*bromide, $BiBr_3$.
Very deliquescent. Decomp. by H_2O. Sol. in alcohol or ether.
Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

Bismuth hydrogen bromide, $BiBr_3$, $2HBr+4H_2O$.
Deliquescent.
Decomp. in the air. (Aloy, Bull. Soc. 1906, (3) **35.** 398.)

Bismuth cæsium bromide, $2BiBr_3$, $3CsBr$.
Ppt. Insol. in HBr.
Sol. in HCl and in HNO_3. (Hutchins, J. Am. Chem. Soc. 1907, **29.** 33.)

Bismuth potassium bromide, $BiBr_3$,$2KBr$.
Decomp. by H_2O. (Aloy, Bull. Soc. 1906, (3) **35.** 398.)

Bismuth bromide ammonia, $BiBr_3$, $3NH_3$.
Sol. in HCl+Aq.
$BiBr_3$, $2NH_3$ (?).
$2BiBr_3$, $5NH_3$. Not deliquescent; not decomp. by H_2O; easily sol. in dil. acids. (Muir, Chem. Soc. **29.** 144.)

Bismuth bromide potassium chloride,
$K_2BiCl_3Br_2+1\frac{1}{2}H_2O$.
Decomp. by H_2O. (Atkinson, Chem. Soc. **43.** 289.)

Bismuth *di*chloride, Bi_2Cl_4.
Very deliquescent. Decomp. by H_2O, dil. acids, or conc. NH_4Cl+Aq. (Weber, Pogg. **107.** 596.)

Bismuth *tri*chloride, $BiCl_3$.
Deliquescent. Decomp. by H_2O. Sol. in dil. HCl+Aq, and alcohol. Not decomp. by H_2O in presence of citrates. (Spiller.)
0.08 g. sol. in 100 ccm. liquid H_2S. (Antony, C. C. **1905,** I. 1692.)
Moderately sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
1 g. $BiCl_3$ is sol. in 5.59 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.9194. (Naumann, B. 1904, **37.** 4331.)
Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)
Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
1 pt. is sol. in 60.36 pts. ethyl acetate at 18°. Sp. gr at 18°/40° = 0.9106. (Naumann, B. 1910, **43.** 320.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth chloride, Bi_3Cl_8 (?).
Decomp. by H_2O. (Dehérain, C. R. **54.** 724.)

Bismuth hydrogen chloride, $2BiCl_3$, $HCl+3H_2O$.
Not deliquescent. Decomp. by H_2O. (Engel, C. R. **106.** 1797.)
$BiCl_3$, 2HCl. (Jacquelain, A. ch. (2) **62.** 363.)

Bismuth cæsium chloride, $BiCl_3$, 3CsCl.
Decomp. by H_2O. Sl. sol. in cold dil. HCl+Aq, but easily sol. on warming. (Brigham, Am. Ch. J. **14.** 181.)
$2BiCl_3$, 3CsCl. As above. (Brigham.)
$BiCl_3$, 6CsCl. Easily sol. in H_2O and dil. HCl+Aq. (Godeffroy, B. **8.** 9.)
Does not exist. (Brigham.)

Bismuth hydrazine chloride, $BiCl_3$, $3N_2H_4HCl$.
Sol. in acids, from which it is pptd. by H_2O. (Ferratini, C. A. **1912.** 1613.)

Bismuth nitrosyl chloride, $BiCl_3$, NOCl.
Very deliquescent. Decomp. by H_2O. (Sudborough, Chem. Soc. **59.** 662.)

Bismuth potassium chloride, $BiCl_3$, $KCl+H_2O$.
Decomp. by H_2O. Cannot be recryst. except from conc. $BiCl_3$+HCl. Decomp. by HCl+Aq into $BiCl_3$, $2KCl+2H_2O$. (Brigham, Am. Ch. J. **14.** 167.)
$BiCl_3$, 2KCl. Decomp. by H_2O. (Arppe, Pogg. **64.** 37.)
Deliquescent.
Sol. in H_2O with decomp. into the oxychloride when excess H_2O is used. (Aloy, Bull. Soc. 1906, (3) **35.** 397.)
$+2H_2O$. Decomp. by H_2O. (Jacquelain, J. pr. **14.** 1.)
Sol. in moderately conc. HCl+Aq.
$BiCl_3$, 3KCl. Decomp. by H_2O. (Arppe.)
Does not exist. (Brigham.)

Bismuth rubidium chloride, $BiCl_3$, $RbCl+H_2O$.

Decomp. by H_2O; sol. in dil. HCl+Aq, from which $BiCl_3$, 3RbCl crystallizes. (Brigham, Am. Ch. J. **14.** 174.)

$BiCl_3$, 3RbCl. Decomp. by H_2O; sol. in dil. HCl+Aq without decomp. (Brigham.)

$BiCl_3$, 6RbCl. Decomp. by H_2O; sol. in HCl+Aq (Godeffroy, B. **8.** 9); does not exist. (Brigham.)

$10BiCl_3$, 23RbCl (?). As above. (Brigham.)

Bismuth sodium chloride, $BiCl_3$, $2NaCl+H_2O$.

$+3H_2O$. Decomp. by H_2O. (Arppe, Pogg. **64.** 237.)

$BiCl_3$, 3NaCl.

Bismuth thallous chloride, $BiCl_3$, 3TlCl.

Ppt. (Ephraim, Z. anorg. 1909, **61.** 254.)

$BiCl_3$, 6TlCl. Ppt. (Ephraim.)

Bismuth chloride ammonia, $2BiCl_3$, NH_3.

Stable. (Dehérain, C. R. **54.** 724.)

$BiCl_3$, $2NH_3$. (D.)

$BiCl_3$, $3NH_3$. (D.)

Bismuth chloride nitric oxide, $BiCl_3$, NO.

Very hygroscopic. (Thomas, C. R. 1895, **121.** 129.)

Bismuth chloride nitrogen *per*oxide, $BiCl_3$, NO_2.

Decomp. by moist air, but stable in dry air. (Thomas, C. R. 1896, **122.** 612.)

Bismuth chloride selenide.

See **Bismuth selenochloride.**

Bismuth *tri*fluoride, BiF_3.

Insol. in H_2O or alcohol. (Gott and Muir, Chem. Soc. **53.** 138.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Bismuth hydrogen fluoride, BiF_3, 3HF.

Deliquescent. Decomp. by boiling H_2O. (Muir, Chem. Soc. **39.** 21.)

Bismuth gold, Au_3Bi.

Insol. in equal pts. of HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 71.)

Bismuthous hydroxide, $Bi(OH)_3$.

Sol. in strong acids. Insol. in solutions of alkalies, alkali carbonates, $(NH_4)_2CO_3$, or NH_4NO_3; or of amyl amine (Wurtz). When recently pptd. is sol. in NH_4Cl+Aq, but insol. in NH_4NO_3+Aq (Brett, **1837**). Not pptd. in presence of Na citrates (Spiller).

Solubility of freshly pptd. $Bi(OH)_3$ in NaOH+Aq.

g. NaOH per l.	g. Bi dissolved per l. at 20°	g. Bi dissolved per l. at 100°
400	0.16	1.70
320	0.11	1.20
240	0.11	....
200	0.10	0.5
160	0.08	0.5
120	0.07	....
80	0.04	0.35
40	trace	0.2
20	0	0.15

(Moser, Z. anorg. 1909, **61.** 386.)

Solubility of freshly pptd. $Bi(OH)_3$ in KOH+Aq.

KOH per l. g.	g. Bi dissolved per l. at 20°	g. Bi dissolved per l. at 100°
560	0.14	1.65
448	0.11	1.20
336	0.11	....
280	0.10	0.5
224	0.08	0.5
168	0.06	...
112	0.03	0.3
56	trace	0.2
28	0	0.15

(Moser, Z. anorg. 1909, **61.** 386.)

Bi_2O_3, $2H_2O$.

Bi_2O_3, H_2O. (Muir, Chem. Soc. **32.** 131.)

See also **Bismuth *tri*oxide.**

Bismuth *tetra*hydroxide, Bi_2O_4, H_2O.

Bi_2O_4, $2H_2O$. (Wernicke, Pogg. **141.** 109.)

Bismuthic hydroxide (Bismuthic acid), Bi_2O_5, H_2O.

Insol. in H_2O; easily decomp. by acids. (Fremy, A. ch. (3) **12.** 495.) Decomp. by H_2SO_4; not attacked by SO_2+Aq; neither dissolved nor decomp. by dil. HNO_3+Aq, but slowly converted into an allotropic modification (?). Partially decomp. by conc. HNO_3. Slowly but wholly dissolved by hot conc. HNO_3. Sl. sol. in conc. KOH+Aq. (Arppe.)

Sol. in about 100 pts. boiling KOH+Aq, so conc. that it solidifies on removing the lamp. (Muir, Chem. Soc. **51.** 77.)

Bi_2O_5, $2H_2O$. (Bödeker, A. **123.** 61.)

Does not exist. (Hoffmann and Geuther.)

Bismuth iodide, BiI_3.

Not attacked by cold H_2O, but by boiling, BiOI is formed. 100 pts. absolute alcohol dissolve 3½ pts. salt at 20°. (Gott and Muir, Chem. Soc. **57.** 138.)

Sol. in HNO_3, and HI+Aq, from which it is repptd. by H_2O or alcohol. Sol. in KI+Aq or KOH+Aq. (Rammelsberg.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

100 g. absolute alcohol dissolve 3.5 g. BiI_3 at 20°. (Gott and Muir, Chem. Soc. **57.** 138.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

100 pts. methylene iodide dissolve 0.15 pt. BiI_3 at 12°, and very little more at higher temperatures. (Retgers, Z. anorg. **3.** 343.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth hydrogen iodide, BiI_3, $HI+4H_2O$.

(Arppe, Pogg. **44.** 248.)

Bismuth cæsium iodide, $3CsI,2BiI_3$.

Very sl. sol. in H_2O. (Wells, Am. J. Sci. 1897, (4) **3.** 464.)

Bismuth calcium iodide, $2BiI_3$, CaI_2+18H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth magnesium iodide, $2BiI_3$, MgI_2+12H_2O.

Deliquescent; decomp. by H_2O. (Linau, Pogg. **111.** 240.)

Bismuth potassium iodide, BiI_3, $4KI$.

Ppt. (Arppe, Pogg. **44.** 237.)

BiI_3, $3KI$. (Astre, C. R. **110.** 1137.)

BiI_3, $2KI$. Sol. in acetic ether. (Astre.)

$+4H_2O$. Sol. in small amt. H_2O without pptn., but decomp. by much H_2O.

BiI_3, $2KI$, HI. (Arppe.)

$2BiI_3$, $3KI+2H_2O$. (Astre.)

$BiI_3,KI+H_2O$. Decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, KI. Sol. in acetic ether. (Astre.)

Bismuth sodium iodide, BiI_3, $NaI+H_2O$.

Deliquescent; decomp. by H_2O. (Nicklès, C. R. **51.** 1097.)

$2BiI_3$, $3NaI+12H_2O$. As above. (Linau, Pogg. **111.** 240.)

Bismuth zinc iodide, $2BiI_3$, ZnI_2+12H_2O.

Very deliquescent. (Linau, Pogg. **111.** 240.)

Bismuth iodide ammonia, BiI_3, $3NH_3$.

Decomp. by H_2O. (Rammelsberg.)

Bismuth iodide zinc bromide.

Sol. in H_2O. (Linau, Pogg. **111.** 240.)

Bismuth nitride.

Explosive. (Fischer, B. 1910, **43.** 1471.)

BiN. Ppt. Decomp. by H_2O or dil. acids. (Franklin, J. Am. Chem. Soc. 1905, **27.** 847.)

Bismuth *dioxide,* Bi_2O_2.

Sol. in conc. HNO_3+Aq. Decomp. by strong acids, and boiling $KOH+Aq$.

Decomp. by H_2O. (Tanatar, Z. anorg. 1901, **27.** 438.)

Bismuth *trioxide,* Bi_2O_3.

Insol. in H_2O. Sol. in conc. acids.

Solubility of Bi_2O_3 in HNO_3+Aq at 20°.

In 100 g. of the liquid phase		Solid phase
g. Bi_2O_3	g. N_2O_5	
0.321	0.963	$Bi_2O_3.N_2O_5.2H_2O$
0.337	0.982	"
3.54	4.68	"
6.37	7.17	"
13.67	12.50	"
14.85	13.31	"
18.74	15.90	$Bi_2O_3.N_2O_5.H_2O$
23.50	19.21	"
23.50	19.29	"
27.15	20.96	"
28.11	21.64	"
29.50	22.53	"
30.19	22.90	"
31.48	23.70	"
32.93	24.83	$Bi_2O_3.N_2O_5.H_2O+$
32.80	24.86	$Bi_2O_3.3N_2O_5.10H_2O$.
32.67	24.70	$Bi_2O_3.3N_2O_5.10H_2O$.
32.59	24.60	"
32.24	24.68	"
30.74	25.13	"
29.83	25.30	"
24.16	28.25	"
16.62	35.40	"
12.17	43.37	"
11.66	46.62	"
11.19	49.38	"
11.19	50.20	"
15.20	54.66	"
20.76	53.75	"
27.85	51.02	$Bi_2O_3.3N_2O_5.10H_2O+$ $Bi_2O_3.3N_2O_5.3H_2O$.
8.58	68.28	$Bi_2O_3.3N_2O_5.3H_2O$.
4.05	74.90	"

(Rutten, Z. anorg. 1902, **30.** 386.)

Solubility of Bi_2O_3 in HNO_3+Aq at t°.

t°	% Bi_2O_3	% N_2O_5	Solid phase
9°	20.8	17.1	$Bi_2O_3.N_2O_5.H_2O$
	24.02	19.1	"
	31.09	23.8	$Bi_2O_3.N_2O_5.H_2O+$
	31.2	23.9	$Bi_2O_3.3N_2O_5.10H_2O$
30°	34.2	26.5	"
	28.2	29.6	$Bi_2O_3.3N_2O_5.10H_2O$
	16.1	47.7	"
65°	5.55	7.44	$Bi_2O_3.N_2O_5.H_2O$
	27.62	22.46	"
	40.80	31.60	$Bi_2O_3.N_2O_5.H_2O+Bi_2O_3.3N_2O_5.10H_2O$
	37.82	35.80	$Bi_2O_3.3N_2O_5.10H_2O$
	35.73	47.02	$Bi_2O_3.3N_2O_5.10H_2O+$ $Bi_2O_3.3N_2O_5.3H_2O$
	4.59	77.90	$Bi_2O_3.3N_2O_5.3H_2O$

(Rutten.)

Solubility of Bi_2O_3 in HNO_3+Aq at t°.

t°	%Bi_2O_3	%N_2O_5	Solid phase
72°	37.23	47.76	$Bi_2O_3.3N_2O_5.4H_2O$
75°	36.74	47.91	"
80°	39.75	45.16	"
9°	31.2	23.9	$Bi_2O_3.3N_2O_5.10H_2O$+ $Bi_2O_3.N_2O_5.H_2O$
20°	32.8	24.8	
30°	34.2	26.4	"
50°	36.9	28.9	"
64°	40.6	31.1	"
65°	40.8	31.6	"
75.5°	45.4	34.6	"
72°	45.9	35.6	"
11.5°	25.36	52.57	$Bi_2O_3.3N_2O_5.10H_2O$+ $Bi_2O_3.3N_2O_5.3H_2O$
20°	27.85	51.02	"
50°	32.22	49.29	"
65°	35.73	47.02	"

(Rutten.)

Solubility in NaOH+Aq at 25°.

Conc. of NaOH Mol/l.	g. Bi_2O_3 in 100 cc. of solution. Mean result.
1.0	0.0013±0.0002
2.0	0.0026±0.0002
3.0	0.0049±0.0005

(Knox, Chem. Soc. 1909, **95.** 1767.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Min. *Bismite.* Easily sol. in HNO_3+Aq.

See also **Bismuthous hydroxide.**

Bismuth *tetr*oxide, Bi_2O_4.

Sol. in conc. HCl+Aq, with evolution of Cl; in oxygen acids with evolution of O. Less easily sol. in conc. H_2SO_4 than in HNO_3, or HCl+Aq.

Bismuth oxide, Bi_4O_9 (?).

(Hoffmann and Geuther.)

Bismuth *pent*oxide, Bi_2O_5.

Sol. in dil. acids. Combines with H_2O to form bismuthic hydroxide, which see. (Hasebroek, B. **20.** 213.)

Bismuth oxybromide, etc.

See **Bismuthyl bromide,** etc.

Bismuth palladium, $PdBi_2$.

Insol. in equal pts. HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 70.)

Bismuth platinum, $PtBi_2$.

Insol. equal pts. HNO_3 and tartaric acids. (Roessler, Z. anorg. 1895, **9.** 69.)

Bismuth phosphide, BiP.

(Cavazzi.)

Bismuth *tri*selenide, Bi_2Se_3.

Insol. in H_2O, alkalies, or alkali sulphides +Aq; sl. attacked by HCl+Aq; oxidized by HNO_3+Aq. (Schneider, Pogg. **94.** 628.)

Min. *Frenzelite.*

Bismuth potassium selenide.

See **Selenobismuthite, potassium.**

Bismuth selenochloride, BiSeCl.

Not attacked by H_2O; very sl. sol. in HCl+Aq; easily and completely sol. with decomp. in HNO_3+Aq. (Schneider.)

Bismuth *di*sulphide, $Bi_2S_2+2H_2O$ (?).

Insol. in H_2O. Decomp. by HCl+Aq.

Bismuth *tri*sulphide, Bi_2S_3.

Insol. in H_2O.

1 l. H_2O dissolves 0.35 x 10^{-6} moles Bi_2S_3 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Easily sol. in moderately dil. HNO_3+Aq, and conc. HCl+Aq, with separation of S. Insol. in alkalies, alkali sulphides, $Na_2S_2O_3$, or KCN+Aq; insol. in NH_4Cl, or NH_4NO_3+Aq (Brett). Insol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

Insol. in alkali hydroxides or alkali hydrosulphides.

Insol. in $2N-(NH_4)_2S$+Aq.

0.0090 g. Bi_2S_3 is sol. in 100 cc. $N-Na_2S_2$+Aq at 25°. (Knox, Chem. Soc. 1909, **95.** 1764.)

Somewhat sol. in Na_2S+Aq. 75 cc. of Na_2S+Aq (sp. gr. 1.06) dissolve an amt. of Bi_2S_3 corresponding to 0.031 g. Bi_2O_3. (Stillman, J. Am. Chem. Soc. 1896, **18.** 683.)

Solubility in Na_2S+NaOH+Aq at 25°.

Conc. of Na_2S Mol./l.	Conc. of NaOH Mol./l.	g. Bi_2S_3 in 100 cc. of solution
0.5	1.0	0.0185
1.0	1.0	0.0838

(Knox, Chem. Soc. 1909, **95.** 1763.)

Bismuth sulphide pptd. from acid solution is not dissolved by subsequent treatment with K_2S+Aq. (Stone, J. Am. Chem. Soc. 1896, **18.** 1091.)

Sol. in K_2S+Aq. (Ditte, C. R. 1895, **120.** 187.)

Solubility in K_2S+KOH+Aq at 25°.

Conc. of K_2S Mol./l.	Conc. of KOH Mol./l.	g. Bi_2S_3 in 100 cc. of solution
0.5	1.0	0.0240
1.0	1.0	0.1230
1.25	1.25	0.2354

(Knox, Chem. Soc. 1909, **95.** 1763.)

Solubility in alkali sulphides+Aq at 25°.

Alkali sulphide	Conc. of alkali sulphide Mol./l.	g. Bi_2S_3 in 100 cc. of solution
Na_2S	0.5	0.0040
	1.0	0.0238
	1.5	0.1023
K_2S	0.5	0.0042
	1.0	0.0337
	1.25	0.0639

(Knox, Chem. Soc. 1909, **95.** 1762.)

Decomp. by $FeCl_3$+Aq. (Cammerer, C. C. **1891,** II. 525.)
Insol. in KCN+Aq. (Hoffmann, A. 1884, **223.** 134.)
Min. *Bismuthinite.* Easily sol. in HNO_3+Aq.

Bismuth cuprous sulphide, Bi_2S_3, Cu_2S.
Insol. in H_2O. Sol. with decomp. in HNO_3+Aq. (Schneider, J. pr. (2) **40.** 564.)
Min. *Emplectonite.*

Bismuth potassium sulphide, Bi_2S_3, K_2S.
(Schneider, Pogg. **136.** 460.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Bi_2S_3,$4K_2S+4H_2O$. Decomp. by H_2O. Very sol. in K_2S+Aq. Efflorescent in dry air. (Ditte, C. R. 1895, **120.** 186.)
See also **Sulphobismuthite, potassium.**

Bismuth silver sulphide, Bi_2S_3, Ag_2S.
Insol. in cold HCl, or HNO_3. Sol. in warm HNO_3 with separation of S, in boiling HCl with separation of H_2S.
Min. *Plenargyrite, Matildite.*
(Schneider, J. pr. 1890, (2) **41.** 414.)

Bismuth sodium sulphide, Bi_2S_3, Na_2S.
(Schneider.)

Bismuth sulphide telluride, Bi_2S_3, $2Bi_2Te_3$.
Min. *Tetradymite.* Sol. in HNO_3 with separation of S.
Bi_2S_2, $2Bi_2Te$.
Min. *Joseite.* As above.

Bismuth sulphobromide, $BiSBr_2$.
(Muir and Eagles, Chem. Soc. 1895, **67.** 91.)

Bismuth sulphochloride, BiSCl.
Insol. in H_2O or dil. HCl+Aq. Sol. in conc. HCl, or HNO_3+Aq. Decomp. by alkalies+Aq. (Schneider, Pogg. **93.** 464.)

Bismuth sulphoiodide, BiSI.
Not attacked by boiling H_2O, and dil. acids. Decomp. by hot conc. HCl+Aq, and HNO_3+Aq. KOH+Aq dissolves out I_2. (Schneider, Pogg. **110.** 114.)

Bismuth telluride, Bi_2Te_3.
Min. *Tetradymite.* Sol. in HNO_3+Aq.
See also **Bismuth sulphide telluride.**

Bismuthic acid, $HBiO_3$.
See **Bismuthic hydroxide.**

Potassium bismuthate, $KBiO_3$.
Sol. in H_2O. (Arppe.)
$KH(BiO_3)_2$. Insol. in H_2O.
Not decomp. by boiling H_2O. (André, C. R. **113.** 860.)
No salts of $HBiO_3$ can exist. (Muir and Carnegie, Chem. Soc. **51.** 77.)

Bismuthicotungstic acid.

Ammonium bismuthicotungstate, $3(NH_4)_2O$, $2Bi_2O_3$, $11WO_3+10H_2O$.
A yellow oil which dries to a yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1232.)

Potassium bismuthicotungstate, $3K_2O$, $2Bi_2O_3$,$11WO_3+15H_2O$.
A yellow oil which dried to a pale yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1233.)

Strontium bismuthicotungstate, 3SrO, $2Bi_2O_3$,$11WO_3+11H_2O$.
A yellow wax, insol. in pure H_2O, but sol. in H_2O containing a few drops HNO_3. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1233.)

Bismuthyl bromide, BiOBr.
Insol. in H_2O; sol. in moderately conc. HBr+Aq.
Insol. in H_2O. (Herz, Z. anorg. 1903, **36.** 348.)
$Bi_8O_9Br_6$. Insol. in H_2O; easily sol. in conc. HCl, or HNO_3+Aq; less sol. in dil. HNO_3+Aq.
$Bi_{11}O_{13}Br_7$. As the preceding comp. (Muir.)

Bismuthyl chloride, BiOCl.
Insol. in H_2O or dil. acids. Sol. in conc. HCl, or HNO_3+Aq.
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
$+H_2O$. (Heintz, Pogg. **63.** 55.)
$+3H_2O$. (Phillips, Br. Arch. (1) **39.** **41.**)
$Bi_7O_9Cl_3$. (Arppe.)
BiO_2Cl_3. Insol. in H_2O; sol. in hot HCl, or HNO_3+Aq. (Muir.)

Bismuthyl fluoride, BiOF.
Insol. in H_2O; sol. in HCl, HBr, or HI+Aq. (Gott and Muir, Chem. Soc. **33.** 139.)
BiOF, 2HF. Insol. in H_2O.

Bismuthyl iodide, BiOI.

Not decomp. by H_2O or alkaline solutions. Sol. in HCl+Aq. Decomp. by HNO_3+Aq. (Schneider, J. pr. **79.** 424.)

Insol. in KCl, or KI+Aq.

$3BiOI,7Bi_2O_3$. Sol. in dil. HCl; decomp. by HNO_3; insol. in boiling H_2O and alkali. (Blyth, C. N. 1896, **74.** 200.)

$BiI_3, 5Bi_2O_3$. Ppt. Sl. sol. in $HC_2H_3O_2$+Aq. Not decomp. by H_2O. (Fletcher and Cooper, Pharm. J. (3) **13.** 254.)

$4BiI_3, 5Bi_2O_3$. Easily sol. in HCl+Aq. Decomp. by HNO_3+Aq. Sl. attacked by H_2SO_4; somewhat sol. in $H_2C_4H_4O_6$, and $KHC_4H_4O_6$+Aq.

Sol. in $(NH_4)_2S$, and KOH+Aq. (Storer's Dict.)

Bismuthyl sulphide, Bi_6O_3S.

(Hermann, J. pr. **75.** 452.)

Bi_2O_2S. Insol. in H_2O. (Scherpenberg, C. C. **1889,** II. 641.)

Bi_4O_3S.

Min. *Karelinite.*

Boracic acid.

See **Boric acid.**

Borax.

See *Tetra***borate, sodium.**

Boric acid, *anhydrous*, B_2O_3.

See **Boron** *tri***oxide.**

*Meta*boric acid, HBO_2.

Sol. in H_2O.

Sl. sol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

*Ortho*boric acid, H_3BO_3.

Sol. in 33 pts. H_2O at 10°.
" 25 " " 20°.
" 3 " " 100°.
(Berzelius.)

Sol. in 20 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O at 100° dissolve 2 pts. (Ure's Dict.)

1 pt. crystallized acid dissolves in—

25.66 pts. H_2O	at 19°.
14.88 "	" 25°.
12.66 "	" 37.5°.
10.16 "	" 50°.
6.12 "	" 62.5°.
4.73 "	" 75°.
3.55 "	" 87.5°.
2.97 "	" 100°.

Or, 100 pts. H_2O dissolve at—

19°	3.9 pts. H_3BO_3.
25°	6.8 " "
37.5°	7.8 " "
50°	9.8 " "
62.5°	16.0 " "
75°	21.0 " "
87.5°	28.0 " "
100°	34.0 " "

Or, sat. aqueous solution contains at—

19°	3.75% H_3BO_3.
25°	6.27 " "
37.5°	7.32 " "
50°	8.96 " "
62.5°	14.04 " "
75°	17.44 " "
87.5°	21.95 " "
100°	25.17 " "

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves at—

0°	19.47 g. H_3BO_3.
12°	29.20 " "
20°	39.92 " "
40°	69.91 " "
62°	114.16 " "
80°	168.15 " "
102°	291.16 " "

(Ditte, C. R. **85.** 1069.)

1 l. H_2O dissolves 0.901 mol. H_3BO_3 at 25°. (Herz, Z. anorg. 1910, **66.** 359.)

1 l. H_2O dissolves 0.898 mol. H_3BO_3 at 25°. Sp. gr. of the solution = 1.0168. (Müller, Z. phys. Ch. 1907, **57.** 529.)

1 l. H_2O dissolves 0.887 mol. H_3BO_3 at 25° and 1.025 mol. at 30°. (Ageno and Valla, Ist. Ven. (VIII) **14.** II, 331.)

Solubility in H_2O at t°.

t°	g. H_3BO_3 in 100 g. of the solution
0	2.59
12.2	3.69
21	4.90
31	6.44
40	8.02
50	10.35
60	12.90
69.5	15.58
80	19.11
90	23.30
99.5	28 10
108	36.7
115	45.0
120	52.4

(Nasini and Ageno, Z. phys. Ch. 1909, **69.** 483.)

Solubility curve for orthoboric acid in H_2O at various temp. up to 120°. (Nasini and Ageno, Gazz. ch. it. 1911, **41.** (1) 131.

Sp. gr. of H_3BO_3+Aq sat. at 8° = 1.014. (Anthon, A. **24.** 241.)

Sp. gr. of H_3BO_3+Aq sat. at 15° = 1.0248. (Stolba, J. pr. **90.** 457.)

Sp. gr. of H_3BO_3+Aq at 15°.

% H_3BO_3	Sp. gr.	% H_3BO_3	Sp. gr.
1	1.0034	4	1.0147
2	1.0069	Sat. sol.	1.015
3	1.0106	. . .	. . . .

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of H_3BO_3+Aq at 18°.

% H_3BO_3	0.776	1.92	2.88	3.612
Sp. gr.	1.0029	1.0073	1.0109	1.0131

(Bock, W. Ann. 1887, **30.** 638.)

Volatile with steam.

More sol. in dil. HCl+Aq than in H_2O. Sol. in warm conc. H_2SO_4, HCl, or HNO_3+Aq.

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
...	9.01
7.0	7.69
13.7	6.66

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility of H_3BO_3 in HCl+Aq at 16°.

Normality of HCl	Normality of H_3BO_3
0.	0.907
0.130	0.895
0.260	0.870
0.390	0.842
1.30	0.645
2.16	0.542
4.32	0.308
6.00	0.338
7.08	0.327
8.74	0.327
9.51	0.338

(Herz, Z. anorg. 1902, **33.** 354.)

Solubility in HF+Aq at 26°.

(1) Titer of HF	(2) Titer after saturation with H_3BO_3 at 26°	(3) Titer after addition of mannitol	(3)−(2) equals free boric acid
3.21n.	1.61	2.36	0.75
2.80n.	1.25(1.40?)	2.21	0.96(0.81?)

The values 0.75 and 0.81 represent the solubility of H_3BO_3 in the concentrations of fluorboric acid resulting from the original concentration of HF+Aq.

(Abegg, Z. anorg. 1903, **35.** 145.)

Solubility of H_3BO_3 in acids+Aq at 26°.

Acid	Normality of the acid	Normality of H_3BO_3
H_2SO_4	0.548	0.746
	2.74	0.518
	5.48	0.312
	8.75	0.092
HNO_3	0.241	0.818
	1.206	0.676
	1.607	0.593
	2.411	0.567
	5.96	0.268
	7.38	0.238

(Herz, Z. anorg. 1903, **34.** 205.)

Solubility in KOH+Aq.
See **Borates, potassium.**

Solubility in NaOH+Aq.
See **Borates, sodium.**

Solubility in LiCl+Aq at 25°.

Millimols LiCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
7.1	8.13
10.3	7.65
22.3	6.42
37.2	5.02

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility in KCl+Aq at 25°.

Millimols KCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
1.9	9.20
7.9	9.44
15.6	9.80
30.6	10.75

(Herz.)

Solubility in RbCl+Aq at 25°.

Millimols RbCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
...	9.01
14.0	9.66
25.3	10.60

(Herz.)

Solubility in NaCl+Aq at 25°.

Millimols NaCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
8.2	8.49
15.2	8.25
29.4	8.20

(Herz.)

Solubility in H_2O is increased by presence of KCl, KNO_3, K_2SO_4, $NaNO_3$ and Na_2SO_4.

In general the solubility in H_2O is increased by the presence of both electrolytes and non-electrolytes. (Bogdan, C. C. **1903,** II. 2.)

Sol. in borax+Aq. (McLauchlan, Z. anorg. 1903, **37.** 371.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Unattacked and undissolved by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1362.)

Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff.) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

1 l. H_2O sat. with amyl alcohol dissolves 0.8952 mol. H_3BO_3 at 25°. (Auerbach, Z. anorg. 1903, **37.** 357.)

Bismuthyl iodide, BiOI.

Not decomp. by H_2O or alkaline solutions. Sol. in HCl+Aq. Decomp. by HNO_3+Aq. (Schneider, J. pr. **79.** 424.)

Insol. in KCl, or KI+Aq.

$3BiOI,7Bi_2O_3$. Sol. in dil. HCl; decomp. by HNO_3; insol. in boiling H_2O and alkali. (Blyth, C. N. 1896, **74.** 200.)

$BiI_3, 5Bi_2O_3$. Ppt. Sl. sol. in $HC_2H_3O_2$+Aq. Not decomp. by H_2O. (Fletcher and Cooper, Pharm. J. (3) **13.** 254.)

$4BiI_3, 5Bi_2O_3$. Easily sol. in HCl+Aq. Decomp. by HNO_3+Aq. Sl. attacked by H_2SO_4; somewhat sol. in $H_2C_4H_4O_6$, and $KHC_4H_4O_6$+Aq.

Sol. in $(NH_4)_2S$, and KOH+Aq. (Storer's Dict.)

Bismuthyl sulphide, Bi_6O_3S.

(Hermann, J. pr. **75.** 452.)

Bi_2O_3S. Insol. in H_2O. (Scherpenberg, C. C. **1889,** II. 641.)

Bi_4O_3S.

Min. *Karelinite.*

Boracic acid.

See **Boric acid.**

Borax.

*See Tetra***borate, sodium.**

Boric acid, *anhydrous*, B_2O_3.

See **Boron** *tri***oxide.**

*Meta***boric acid,** HBO_2.

Sol. in H_2O.

Sl. sol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

*Ortho***boric acid,** H_3BO_3.

Sol. in 33 pts. H_2O at 10°.
" 25 " " 20°.
" 3 " " 100°.
(Berzelius.)

Sol. in 20 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O at 100° dissolve 2 pts. (Ure's Dict.)

1 pt. crystallized acid dissolves in—

25.66 pts. H_2O at	19°.
14.88 " "	25°.
12.66 " "	37.5°.
10.16 " "	50°.
6.12 " "	62.5°.
4.73 " "	75°.
3.55 " "	87.5°.
2.97 " "	100°.

Or, 100 pts. H_2O dissolve at—

19°	3.9 pts. H_3BO_3.
25°	6.8 " "
37.5°	7.8 " "
50°	9.8 " "
62 5°	16.0 " "
75°	21.0 " "
87.5°	28.0 " "
100°	34.0 " "

Or, sat. aqueous solution contains at—

19°	3.75% H_3BO_3.
25°	6.27 " "
37.5°	7.32 " "
50°	8.96 " "
62.5°	14.04 " "
75°	17.44 " "
87.5°	21.95 " "
100°	25.17 " "

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves at—

0°	19.47 g. H_3BO_3.
12°	29.20 " "
20°	39.92 " "
40°	69.91 " "
62°	114.16 " "
80°	168.15 " "
102°	291.16 " "

(Ditte, C. R. **85.** 1069.)

1 l. H_2O dissolves 0.901 mol. H_3BO_3 at 25°. (Herz, Z. anorg. 1910, **66.** 359.)

1 l. H_2O dissolves 0.898 mol. H_3BO_3 at 25°. Sp. gr. of the solution=1.0168. (Müller, Z. phys. Ch. 1907, **57.** 529.)

1 l. H_2O dissolves 0.887 mol. H_3BO_3 at 25° and 1.025 mol. at 30°. (Ageno and Valla, Ist. Ven. (VIII) **14.** II, 331.)

Solubility in H_2O at t°.

t°	g. H_3BO_3 in 100 g. of the solution
0	2.59
12.2	3.69
21	4.90
31	6.44
40	8.02
50	10.35
60	12.90
69.5	15.58
80	19 11
90	23.30
99.5	28.10
108	36.7
115	45.0
120	52.4

(Nasini and Ageno, Z. phys. Ch. 1909, **69.** 483.)

Solubility curve for orthoboric acid in H_2O at various temp. up to 120°. (Nasini and Ageno, Gazz. ch. it. 1911, **41.** (1) 131.

Sp. gr. of H_3BO_3+Aq sat. at 8° = 1.014. (Anthon, A. **24.** 241.)

Sp. gr. of H_3BO_3+Aq sat. at 15° = 1.0218. (Stolba, J. pr. **90.** 457.)

Sp. gr. of H_3BO_3+Aq at 15°.

% H_3BO_3	Sp. gr.	% H_3BO_3	Sp. gr.
1	1.0034	4	1.0147
2	1.0069	Sat. sol.	1.015
3	1.0106	...	....

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of H_3BO_3+Aq at 18°.

% H_3BO_3	0.776	1.92	2.88	3.612
Sp. gr.	1.0029	1.0073	1.0109	1.0131

(Bock, W. Ann. 1887, **30.** 638.)

Volatile with steam.

More sol. in dil. HCl+Aq than in H_2O. Sol. in warm conc. H_2SO_4, HCl, or HNO_3+Aq.

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
...	9.01
7.0	7.69
13.7	6.66

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility of H_3BO_3 in HCl+Aq at 16°.

Normality of HCl	Normality of H_3BO_3
0.	0.907
0.130	0.895
0.260	0.870
0.390	0.842
1.30	0.645
2.16	0.542
4.32	0.308
6.00	0.338
7.08	0.327
8.74	0.327
9.51	0.338

(Herz, Z. anorg. 1902, **33.** 354.)

Solubility in HF+Aq at 26°.

(1) Titer of HF	(2) Titer after saturation with H_3BO_3 at 26°	(3) Titer after addition of mannitol	(3)−(2) equals free boric acid
3.21n.	1.61	2.36	0.75
2.80n.	1.25(1.40?)	2.21	0.96(0.81?)

The values 0.75 and 0.81 represent the solubility of H_3BO_3 in the concentrations of fluorboric acid resulting from the original concentration of HF+Aq.

(Abegg, Z. anorg. 1903, **35.** 145.)

Solubility of H_3BO_3 in acids+Aq at 26°.

Acid	Normality of the acid	Normality of H_3BO_3
H_2SO_4	0.548	0.746
	2.74	0.518
	5.48	0.312
	8.75	0.092
HNO_3	0.241	0.818
	1.206	0.676
	1.607	0.593
	2.411	0.567
	5.96	0.268
	7.38	0.238

(Herz, Z. anorg. 1903, **34.** 205.)

Solubility in KOH+Aq.
See **Borates, potassium.**
Solubility in NaOH+Aq.
See **Borates, sodium.**

Solubility in LiCl+Aq at 25°.

Millimols LiCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
7.1	8.13
10.3	7.65
22.3	6.42
37.2	5.02

(Herz, Z. anorg. 1910, **66.** 359.)

Solubility in KCl+Aq at 25°.

Millimols KCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
1.9	9.20
7.9	9.44
15.6	9.80
30.6	10.75

(Herz.)

Solubility in RbCl+Aq at 25°.

Millimols RbCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
14.0	9.66
25.3	10.60

(Herz.)

Solubility in NaCl+Aq at 25°.

Millimols NaCl in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
....	9.01
8.2	8.49
15.2	8.25
29.4	8.20

(Herz.)

Solubility in H_2O is increased by presence of KCl, KNO_3, K_2SO_4, $NaNO_3$ and Na_2SO_4.

In general the solubility in H_2O is increased by the presence of both electrolytes and non-electrolytes. (Bogdan, C. C. **1903,** II. 2.)

Sol. in borax+Aq. (McLauchlan, Z. anorg. 1903, **37.** 371.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Unattacked and undissolved by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1362.)

Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff.) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

1 l. H_2O sat. with amyl alcohol dissolves 0.8952 mol. H_3BO_3 at 25°. (Auerbach, Z. anorg. 1903, **37.** 357.)

Solubility of H_3BO_3 in amyl alcohol+Aq at t°.
M = millimols H_3BO_3 in 1 l. of H_2O.
A = millimols H_3BO_3 in 1 l. of alcohol.

t°	M	A
15°	607.2	176.4
	589.3	177.4
	589.0	177.1
	586.0	173.4
	427.4	127.6
	425.8	127.0
	289.1	84.9
	894.0	264.0
	372.0	110.0
	371.8	110.8
25°	301.2	85.7
	180.8	54.0
	49.15	15.45
	51.04	15.45
	26.02	8.05
35°	146.3	44.27

(Müller, Z. phys. Ch. 1907, **57.** 514.)

Sp. gr. of amyl alcohol+Aq sat. with H_3BO_3.

g. water in 1 l. of alcohol + Aq	d25°/4°
32.481	0.82229
35.465	0.82324
37.339	0.82321
42.479	0.82392
45.175	0.82447
45.636	0.82456
47.883	0.82454
51.461	0.82527
52.043	0.82585
59.270	0.82699
63.179	0.82739
64.254	0.82779
66.403	0.82701
66.624	0.82670
68.253	0.82856
69.211	0.82884
75.610	0.82999(?)

(Müller.)

Solubility of H_3BO_3 in amyl alcohol and NaCl+Aq at 25°.

Water phase		Amyl alcohol phase			
NaCl normality	mol. H_3BO_3	Sp. gr. 25°/4°	1 l. contains mol. H_2O	mol. amyl alcohol	mol. H_3BO_3
0.00	0.880	0.8296	4.10	8.39	0.2640
0.945	0.866	0.8277	3.55	8.49	0.2638
1.490	0.850	0.8268	3.27	8.54	0.2689
1.865	0.844	0.8259	3.03	8.56	0.2724
2.355	0.833	0.8254	2.86	8.59	0.2850
2.845	0.827	0.8247	2.62	8.62	0.2877
3.06	0.810	0.8241	2.39	8.66	0.2891
3.48	0.810	0.8240	2.32	8.69	0.3006
3.57	0.807	0.8236	2.15	8.70	0.3066
4.01	0.801	0.8233	1.99	8.72	0.3162
4.28	0.798	0.8229	1.78	8.75	0.3210

(Müller)

Solubility in hydroxy-compounds+Aq at 25°.

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Lactic acid	2.321	1.07	1.0252	1.0444
	6.819	1.61	1.0722	1.0986
	18.77	1.86	1.1405	1.1635
	36.33	2.08	1.2023	1.2254
Glycerine	24.64	1.208	1.1574	1.1707
	46.75	2.132	....	1.2260
	67.71	2.96	1.2370	1.2526
	90.58	3.78	1.2531	1.2710

Solubility in hydroxy-compounds, etc.—*Continued*

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Mannitol	0.790	1.007	....	1.0425
	0.810	1.015	1.0244	1.0433
	0.945	1.029	1.0288	....
	1.585	1.136	1.0475	....
Dulcitol	0.065	0.8876	0.9995	1.0686
	0.130	0.9078	1.0018	1.0212
	0.260	0.9360	1.0060	1.0260

(Müller.)

Solubility of H_3BO_3 in alcohols+Aq at 25°.
M = Mol. of alcohol in 100 mol. of alcohol+Aq.
H_3BO_3 = Mol. of H_3BO_3 in 1 l. of the solution.
d_1 = Sp. gr. of alcohol+Aq.
d_2 = Sp. gr. of alcohol+Aq sat. with H_3BO_3.

Alcohol added	M	H_3BO_3	d_1	d_2
Methyl alcohol	11.74	0.895		
	28.64	1.012		
	36.02	1.098		
	43.95	1.161		
	52.31	1.307		
	100	2.900	0.7924	0.8904
Ethyl alcohol	8.996	0.829		
	22.28	0.800		
	44.46	0.729		
	55.62	0.700		
	79.89	0.893		
	88.10	1.105		
	99.26	1.527	0.7860	0.8353
n-Propyl alcohol	23.66	0.6437	0.9043	0.9193
	53.63	0.4569	0.8231	0.8570
	83.65	0.5776	0.8133	0.8466
	100	0.961	0.8010	0.8297
i-Butyl alcohol	0.70	0.884	0.9923	1.0124
	2.15	0.857	0.9853	0.0038
	2.18	0.857	0.9855	0.0046
	71.4	0.323	0.8173	0.8351
	77.1	0.347	0.8133	0.8220
	85.6	0.4212	0.8081	0.8195
	100	0.6927	0.7984	0.8172
i-Amyl alcohol	0.448	0.883	0.9943	1.0132
	0.520	0.880	0.9936	1.0125
	0.525[1]	0.880	0.9931	1.0123
	67.26[2]	0.2584	0.8232	0.829
	75.54	0.2722	0.8183	0.8253
	83.40	0.3190	0.8142	0.8223
	100	0.5703	0.8068	0.8220

[1] Water sat. with alcohol.
[2] Alcohol sat. with water.

(Müller.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Solubility in acetone+Aq at 20°.
A = ccm. acetone in 100 ccm. acetone+Aq.
H_3BO_3 = millimols H_3BO_3 in 100 ccm. of the solution.

A	H_3BO_3
0	79.15
20	81.71
30	83.35
40	82.74
50	81.61
60	76.40
70	67.62
80	55.05
100	8.06

(Herz, Z. anorg. 1904, **41.** 319.)

100 g. pure anhydrous ether dissolve 0.00775 g. H_3BO_3.
100 g. ether sat. with H_2O dissolve 0.2391 g. H_3BO_3.
(J. A. Rose, Dissert. **1902.**)

Sol. in 10 pts. glycerine. (Hager.)

100 pts. glycerine (sp. gr. 1.26 at 15.5°) dissolve pts. H_3BO_3 at t°.

t°	Pts. H_3BO_3	t°	Pts. H_3BO_3	t°	Pts. H_3BO_3
0	20	40	38	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56	. .	. .

(Hooper, Ph. J. Trans. (3) **13.** 258.)

Solubility of H_3BO_3 in glycerine+Aq at 25°.
G = g. glycerine in 100 g. glycerine+Aq.
H_3BO_3 = Millimols H_3BO_3 in 100 cc. of the solution.

G	H_3BO_3	Sp. gr.
0	90.1	1.0170
7.15	90.1	1.0379
20.44	90.6	1.0629
31.55	92.9	1.0897
40.95	97.0	1.1130
48.7	103.0	1.1328
69.2	140.2	1.1871
100	390.3	1.2719

(Herz, Z. anorg. 1905, **45.** 268.)

Solubility of H_3BO_3 in organic acids+Aq at 26°.

Acid	Normality of the acid	Normality of H_3BO_3
Acetic	0.570	0.887
	2.85	0.538
	5.70	0.268

Solubility of H_3BO_3, etc.—*Continued.*

Acid	Normality of the acid	Normality of H_3BO_3
Tartaric	0.955	0.890
	1.909	0.923
	2.51	0.962
	3.316	1.07

(Herz, Z. anorg. 1903, **34.** 206.)

The solubility of H_3BO_3 in H_2O is increased by the presence of racemic acid.

Millimols racemic acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
6.3	9.86
12.6	10.46
24.7	11 65

(Herz, Z. anorg. 1911, **70.** 71.)

Solubility of H_3BO_3 in H_2O is increased by the presence of tartaric acid.

Millimols tartaric acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
7.5	10.00
15	10.70
30	12.07

(Herz, Z. anorg. 1911, **70.** 71.)

Solubility in oxalic acid+Aq at 25°.

Millimols oxalic acid in 10 ccm. of the solution	Millimols H_3BO_3 in 10 ccm. of the sat. solution
. .	9.01
2.97	9.95
5.95	10.80
13.77	11.98

(Herz, Z. anorg. 1910, **66.** 93.)

Solubility in H_2O is increased by the presence of urea, acetone or propyl alcohol. (Bogdan, C. C. **1903,** II. 2.)
Readily sol. in hot glacial acetic acid. (Holt Chem. Soc. 1911, **100** (2). 720.)
Sol. in 250 pts. benzene. (Hager.)

Solubility of H_3BO_3 in mannite+Aq at t°.

Solid phase, H_3BO_3

t°	Mg.-mols. in 1 l. Mannite	Mg.-mols. in 1 l. H_3BO_3	t°	Mg-mols in 1 l. Mannite	Mg-mols in 1 l. H_3BO_3
25°	0	0.887	30°	0	1.025
"	0.1	0.951	"	0.1	1.056
"	0.3	1.015	"	0.2	1.086
"	0.4	1.039	"	0.3	1.118
"	0.5	1.071	"	0.4	1.157
"	0.6	1.102	"	0.5	0.193
"	0.7	1.142	"	0.6	1.219
"	0.8	1.173	"	0.7	1.258
"	1.043	1.244			
"	1.409	1.404			
"	1.781	1.521			

Solid phase, mannite		
t°	Mg. mols. in 1 l.	
	Mannite	H_3BO_3
25°	1.075	0
"	1.1424	0.2646
"	1.259	0.463
"	1.265	0.559
"	1.354	0.794
"	1.409	0.927
"	1.536	1.243
"	1.781	1.521

(Ageno and Valla, Ist. Ven. (VIII) **14.** 331.)

Distribution between H_2O and amyl alcohol at 25°.

w = concentration of H_3BO_3 in H_2O layer expressed in millimols.

a = concentration of H_3BO_3 in alcohol layer expressed in millimols.

w	a
265.8	76.6
196.5	59.5
159.6	47.5
126	37.1
87.9	33.2
75.2	22.7
64.6	19.76

(Abegg, Z. anorg. 1903, **35.** 130.)

Partition of H_3BO_3 between water and mixtures of amyl alcohol and CS_2.

W = Millimols H_3BO_3 in 10 ccm. of the aqueous layer.

G = Millimols H_3BO_3 in 10 ccm. of the amyl alcohol—CS_2 layer.

Composition of the solvent mixture	G	W	W/G
75% by vol. amyl alcohol+25% by vol. CS_2	0.145	0.624	4.31
	0.275	1.198	4.36
	0.429	1.844	4.30
	0.589	2.565	4.45
50% by vol. amyl alcohol+ 50% by vol. CS_2	0.145	0.756	5.47
	0.259	1.353	5.21
	0.364	1.946	5.34
	0.555	2.889	5.22
25% by vol. amyl alcohol+ 75% by vol. CS_2	0.085	0.699	8.24
	0.175	1.467	8.40
	0.264	2.165	8.12
	0.384	3.129	8.14

(Herz, Z. Elektrochem. 1910, **16.** 870.)

Distribution between HF+Aq and amyl alcohol at 25°.

c = HF concentration (millimols).

a = H_3BO_3 concentration in alcohol layer (expressed in millimols).

w = H_3BO_3 concentration in water layer (expressed in millimols).

c	a	w
500	14.3	71.2
"	19.2	99.2
"	25.3	144.2
"	114.3	979.0
250	30.1	144.5
"	37.0	194.8
"	56.8	321.5
"	108.0	652.0
125	39.0	170.5
"	47.2	214.0
"	52.8	240.5
"	96.0	442.0
62.5	30.4	111.2
"	39.4	151.8
"	65 (68?)	272.8
"	90.0	362.2

(Abegg, Z. anorg. 1903, **35.** 131.)

See also **Boron** ***tri*****oxide.**

Pyro**boric (*****tetra*****boric) acid,** $H_2B_4O_7$.

Sol. in H_2O.

Sp. gr. of solutions of boric acid, calculated as $H_2B_4O_7$, containing—

6.3	1.27	1.91	2.54% $H_2B_4O_7$
1.0034	1.0069	1.0106	1.0147 sp. gr.

Sat. solution at 15° has sp. gr. 1.015. (Gerlach, Z. anal. **28.** 473.)

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

Borates.

No borate is quite insol. in H_2O; the alkali borates are very sol. The less sol. borates are easily decomp. by H_2O; the easily sol. salts are also decomp., but less quickly. The less sol. borates are easily sol. in H_3BO_3, HNO_3, etc. They are more sol. in H_2O containing tartaric acid or potassium tartrate than in pure H_2O. (Souberain.) The normal borates of the alkaline-earths are sol. to no inconsiderable extent in H_2O, and more readily in hot, than in cold H_2O. (Berzelius, Pogg. **34.** 568.)

All borates are insol., or sl. sol. in alcohol.

Aluminum borate, $2Al_2O_3$, B_2O_3.

Min. *Jeremciewite.*

$+3H_2O$. Ppt. (Rose, Pogg. **91.** 452.)

$3Al_2O_3$, B_2O_3. *Crystallized.* Insol. in HNO_3+Aq. (Ebelmen, A. ch. (3) **33.** 62.)

$3Al_2O_3$, $2B_2O_3+7H_2O$. Ppt. (Rose, *l. c.*)

Ammonium borate.

The system $(NH_4)_2O$,B_2O_3,H_2O at 60° has

been studied by Sborgi. (Real. Ac. Linc. 1915 (5) **24.** I, 1225.)

$2(NH_4)_2O,4B_2O_3+5H_2O$. (Sborgi.)

Ammonium *di*borate.

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium *tetra*borate, $(NH_4)_2B_4O_7+4H_2O$, or perhaps $NH_4H(BO_2)_2+1\frac{1}{2}H_2O$.

Sol. in 12 pts. cold H_2O; decomp. by heat. (Rammelsberg, Pogg. **90.** 21.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+H_2O$. (Arfvedson.)

Ammonium *octo*borate, $(NH_4)_2B_8O_{13}+6H_2O$.

Sol. in 8 pts. cold, decomp. by boiling H_2O. (Rammelsberg, Pogg. **90.** 21.)

$+4H_2O$.

Min. *Lardellerite.* Sol. in H_2O with decomp.

Ammonium *deka*borate, $(NH_4)_2B_{10}O_{16}+6H_2O$.

Permanent. Sol. in H_2O. (Rammelsberg.)

$+8H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Ammonium *dodeka*borate, $(NH_4)_2B_{12}O_{19}+9H_2O$.

Sol. in hot H_2O. (Bechi, Sill. Am. J. (2) **17.** 129.)

Ammonium *per*borate, NH_4BO_3.

See **Perborate, ammonium.**

Ammonium calcium borate, $(NH_4)_8CaB_4O_{11} = CaB_4O_7+4(NH_4)_2O$.

(Ditte, C. R. **96.** 1663.)

Ammonium magnesium borate.

Sol in H_2O, decomp. by boiling. (Rammelsberg, Pogg. **49.** 451.)

Ammonium zinc borate, $4(NH_4)_2B_4O_7, Zn(BO_2)_2+5H_2O$.

(Ditte, C. R. **96.** 1663.)

Barium borate, $Ba(BO_2)_2$.

Ppt. (Ouvrard, C. R. 1906, **142.** 283.)

$+2H_2O$. (Atterberg.)

$+4H_2O$. (Benedikt, B. **7.** 703.)

Sol. in	3,300	pts.	45% alcohol.
"	7,800	"	50 "
"	25,000	"	60 "
"	55,000	"	75 "

(Berg, Z. anal. **16.** 25.)

$+10H_2O$. Sl. sol. in cold, more readily in hot H_2O, especially in presence of ammonium salts. (Berzelius, Pogg. **34.** 568.) Sol. in sodium citrate+Aq. (Spiller.) Insol. in wood spirit. (Ebelmen.)

$2BaO,B_2O_3$. Decomp. by H_2O forming $BaO, B_2O_3+4H_2O$. (Ouvrard, C. R. 1906, **142.** 283.)

$3BaO, B_2O_3$. Easily sol. in mineral acids. Sl. attacked by dil. acetic acid. (Ouvrard, C. R. 1901, **132.** 258.)

BaB_4O_7. Slowly sol. in warm dilute HNO_3 +Aq. (Ditte, C. R. **77.** 892.)

$+5H_2O$. Sol. in 100 pts. cold, and more freely in hot H_2O. When freshly pptd. sol. in cold NH_4Cl+Aq (Wackenroder, A. **41.** 315); NH_4NO_3+Aq (Brett, Phil. Mag. (3) **10.** 96); and $BaCl_2$+Aq (Rose).

$BaB_6O_{10}+13H_2O$. (Laurent, A. ch. (2) **67.** 215.)

$Ba_2B_2O_5$. (Bloxam, Chem. Soc. **14.** 143.)

$5BaO, 2B_2O_3$.

$Ba_3B_{10}O_{18}+6H_2O$. Sol. in 100 pts. cold H_2O. Easily sol. in ammonium nitrate, or chloride, or barium chloride+Aq. (Rose, Pogg. **87.** 1.)

$Ba_2B_6O_{11}$. Easily sol. in warm dilute acids.

$+6H_2O$.

$+7H_2O$.

$+15H_2O$. (Laurent, A. ch. (2) **67.** 215.)

Barium borate bromide, $3BaO, 5B_2O_3, BaBr_2$.

(Ouvrard, C. R. 1906, **142.** 283.)

Barium borate chloride, $3BaO,5B_2O_3,BaCl_2$.

Unaffected by H_2O. Sol. in acids. (Ouvrard, C. R. 1906, **142.** 283.)

Bismuth borate, $BiBO_3+2H_2O$.

Ppt. Sl. sol. in H_2O. Decomp. by H_2S. Not decomp. by KOH+Aq. (Vanino, J. pr. 1906, (2) **74.** 152.)

Cadmium borate, $Cd_3(BO_3)_2$.

Insol. in H_2O, easily sol. in dil. acids. (Ouvrard, C. R. 1900, **130.** 174.)

$Cd(BO_2)_2$. Difficultly sol. in H_2O (Stromeyer); insol. in H_2O, sol. in HCl+Aq (Odling); easily sol. in warm NH_4Cl+Aq (Rose).

(Guertler, Z. anorg. 1904, **40.** 242.)

$3CdO, 2B_2O_3+3H_2O$. Ppt. Sl. sol. in H_2O. (Rose, Pogg. **88.** 299.)

$CdO, 2B_2O_3+2H_2O$. (Ditte, A. ch. 1883, (5) **30.** 255.)

$CdO, 4B_2O_3+10H_2O$. Sol. in H_2O; decomp. on heating. (Ditte, A. ch. 1883, (5) **30.** 255.)

Cadmium borate bromide, $6CdO, 8B_2O_3, CdBr_2$.

Insol. in H_2O and fuming HCl or HBr+Aq. (Rousseau and Allaire, C. R. 1894, **119.** 72.)

Cadmium borate chloride, $6CdO, 8B_2O_3, CdCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1256.)

Cadmium borate iodide, $6CdO, 8B_2O_3,CdI_2$.

(Allaire, C. R. 1898, **127.** 557.)

Cæsium borate, $Cs_2B_6O_{10}$.

Very sol. in H_2O, less in alcohol. (Reischle, Z. anorg. **4.** 116.)

Calcium borate, $Ca(BO_2)_2$.

Sl. sol. in H_2O; insol. in alkali chlorides, or boiling conc. acetic acid+Aq; sol. in cold or hot solutions of ammonium salts, especially ammonium nitrate, in $CaCl_2$+Aq, and also easily sol. in dilute mineral acids at 50°. (Ditte, C. R. **80.** 490, 561.)

$+2H_2O$.

$+4H_2O$; two modifications of which one is very unstable. (van't Hoff and Meyerhoffer, A. 1906, **351.** 101.)

$+6H_2O$. When warmed in H_2O it goes over into $CaB_2O_4+4H_2O$. (van't Hoff and Meyerhoffer.)

Sol. in H_2O without decomp.; 1 l. solution contains 2 g. salt. (Ditte, C. R. **96.** 1663.)

CaB_4O_7. Decomp. by H_2O. (Blount, C. N. **54.** 208.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+3H_2O$. (Ditte, C. R. **96.** 1663.)

$+4H_2O$. Min. *Bechilite.*

$+6H_2O$. Min. *Borocalcite.* Sol. in acids.

CaB_6O_{10}, $+4H_2O$.

$+8H_2O$. Unstable. On standing in the solution in which it is formed it changes into $CaB_6O_{10}+4H_2O$.

$+12H_2O$. Unstable. Goes over into $CaB_6O_{10}+8H_2O$. (van't Hoff and Meyerhoffer, A. 1906, **351.** 104.)

$CaB_8O_{13}+12H_2O$. (Ditte, C. R. **96.** 1663.)

$2CaO, B_2O_3$. Insol. in H_2O, sol. in dil. acids. (Ouvrard, C. R. 1905, **141.** 353.)

$Ca_2B_6O_{11}$. (Ditte, C. R. **77.** 785.)

$+3H_2O$. Min. *Pandermite, Priceite. See* $4CaO, 5B_2O_3+9H_2O$.

$+5H_2O$. Min. *Colemanite.*

If all the Ca is in form of colemanite, the solution contains in 100 g., 4.8 g. H_3BO_3 and 0.1 g. CaO. (van't Hoff, B. A. B. **1907,** 653.)

$+7H_2O$.

$+9H_2O$. (van't Hoff and Meyerhoffer, A. 1906, **351.** 101.)

$3CaO, B_2O_3$. Easily sol. in dil. acids. (Ouvrard, C. R. 1901, **132.** 258.)

$3CaO, 5B_2O_3+9H_2O$. (van't Hoff, B. A. B. **1906,** II. 568.)

$4CaO, 5B_2O_3+9H_2O$. True composition of Pandermite. (van't Hoff, B. A. B. **1906,** II. 572.)

Calcium iron (ferrous) borate silicate, $Ca_2FeB_2Si_2O_{10}$.

Min. *Homilite.* Easily sol. in HCl+Aq.

Calcium magnesium borate, $CaO, MgO, 3B_2O_3+6H_2O$.

Min. *Hydroboracite.* Somewhat sol. in H_2O. Easily sol. in warm HCl+Aq or HNO_3 +Aq.

$3CaO, 3MgO, 4B_2O_3$. (Ditte, C. R. **77.** 894.)

Calcium sodium borate, $2CaO, Na_2O, 5B_2O_3+8H_2O$.

(van't Hoff, B. A. B. **1907,** 303.

$Ca_3B_{10}O_{18}$, $Na_3B_5O_9$+15, or $24H_2O$.

Min. *Natroborocalcite, Ulexite.* Decomp. by boiling with H_2O. Sol. in acids.

$Ca_2Na_4B_{12}O_{22}+15H_2O$. Min. *Franklandite.* Sl. sol. in H_2O; easily sol. in HCl, and HNO_3+Aq.

Calcium borate bromide, $3CaO, 3B_2O_3, CaBr_2$.

Sl. attacked by H_2O. Very sol. in dilute acetic acid. (Ouvrard, C. R. 1905, **141. 1023.**)

$3CaO, 5B_2O_3, CaBr_2$. Hardly attacked by cold H_2O or very dil. acetic acid. Sol. in strong acids, even when dilute. (Ouvrard, C. R. 1905, **141.** 1023.)

Calcium borate chloride, $Ca_3B_2O_6, CaCl_2$.

Decomp. quickly by moist air or H_2O, slowly by absolute alcohol. (Chatelier, C. R. **99.** 276.)

$3CaO, 3B_2O_3, CaCl_2$. (Ouvrard, C. R. 1905, **141.** 353.)

$3CaO, 5B_2O_3, CaCl_2$. Sl. attacked by cold H_2O and dil. acetic acid+Aq. Strong acids dissolve even when very dilute. (Ouvrard, C. R. 1905, **141.** 352.)

Calcium borate silicate, $2CaO, B_2O_3, 2SiO_2+H_2O$.

Min. *Datolite.* Sol. in HCl+Aq with separation of gelatinous silica.

$+2H_2O$. Min. *Botryolite.*

CaO, B_2O_3, SiO_2. Min. *Danburite.* Very sl. attacked by HCl+Aq before ignition.

Chromous borate.

Precipitate. Sol. in free acids; insol. in borax+Aq. (Moberg.)

Chromic borate, $7Cr_2O_3, 4B_2O_3$.

Insol. in H_2O; sol. in excess of borax+Aq. (Hebberling, C. C. **1870.** 122.)

Chromic magnesium borate, $3Cr_2O_3, 6MgO, 2B_2O_3$.

Not attacked by acids. (Ebelmen, A. ch. (3) **33.** 52.)

$2Cr_2O_3, 9MgO, 3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Cobaltous borate, $3CoO, 2B_2O_3+4H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **88.** 299.)

$3CoO, B_2O_3$. (Mallard, C. R. **105.** 1260.)

$2CoO, B_2O_3$. (Ouvrard, C. R. 1900, **130.** 337.)

Cobaltous borate bromide, $6CoO, 8B_2O_3, CoBr_2$.

(Rousseau and Allaire, C. R. 1894, **119. 73.**)

Cobaltous borate chloride, $6CoO, 8B_2O_3, CoCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1257.)

Cobaltous borate iodide, $6CoO, 8B_2O_3, CoI_2$.

(Allaire, C. R. 1898, **127.** 557.)

Cuprous borate, $3Cu_2O, 2B_2O_3$.

(Guertler, Z. anorg. 1904, **38. 459.**)

Cupric borate.

Composition depends on temperature and concentration of solutions. Boiling H_2O dissolves out all the boric acid. Sol. in acids; slowly sol. in hot conc. NH_4Cl+Aq.

$Cu(BO_2)_2$. Insol. in cold dil. acids, even HF. Slowly sol. in hot conc. HCl. Not attacked by alkalies or alkali carbonates+Aq. (Guertler, Z. anorg. 1904, **38.** 456.)

Insol. in methyl acetate. (Naumann, B. **1909, 42.** 3790.)

Cupric borate ammonia, CuB_4O_7, $4NH_3$+$6H_2O$.

Efflorescent. Can be recrystallized from a little NH_4OH+Aq. (Pasternack, A. **151.** 227.)

Didymium borate, $DiBO_3$.

Insol. in H_2O acidulated with HCl+Aq. (Cleve, Bull. Soc. (2) **43.** 363.)

$Di_2(B_4O_7)_3$. Insol. in H_2O; sol. in acids. (Frerichs and Smith, A. **191.** 355.)

Glucinum borate, basic, $5GlO$, B_2O_3.

Insol. in H_2O; sol. in acids. (Krüss and Moraht, B. **23.** 735.)

Iron (ferrous) borate.

Ppt. H_2O dissolves out all the boric acid. (Tünnerman.)

Iron (ferric) borate, $Fe_2(BO_2)_6$+$3H_2O$.

Ppt. Insol. in H_2O.

Min. *Lagonite.* Sol. in acids.

$2Fe_2O_3$, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

$6Fe_2O_3$, B_2O_3+$6H_2O$. Ppt. (Rose, Pogg. **89.** 473.)

$9Fe_2O_3$, B_2O_3+$9H_2O$. Ppt. (Rose.)

Iron (ferric) magnesium borate, $3Fe_2O_3$, $6MgO$, $2B_2O_3$.

Insol. in H_2O. Sol. in conc. HCl+Aq. (Ebelmen, A. ch. (3) **33.** 53.)

$2Fe_2O_3$, $9MgO$, $3B_2O_3$. (Mallard, C. R. **105.** 1260.)

Iron (ferroferric) magnesium borate, $3MgO$, FeO, Fe_2O_3, B_2O_3.

Min. *Ludwigite.* Slowly sol. in HCl+Aq, when finely powdered.

Iron (ferrous) borate bromide, $6FeO$, $8B_2O_3$, $FeBr_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1445.)

Iron (ferrous) borate chloride, $6FeO$, $8B_2O_3$, $FeCl_2$.

Slowly sol. in hot HNO_3+Aq. (Rousseau and Allaire, C. R. **116.** 1195.)

Lanthanum borate, $2La_2O_3$, B_2O_3.

(Nordenskjöld, Pogg. **114.** 618.)

$La_2(B_4O_7)_3$. Ppt. (Smith.)

Formula is $La_2B_6O_{15}$+xH_2O. (Cleve, B. **11.** 910.)

Lead borate, basic,

$2PbO$, B_2O_3+$2H_2O$. Ppt.

$4PbO$, $3B_2O_3$+$4H_2O$. Ppt.

+$5H_2O$. Ppt.

$6PbO$, $5B_2O_3$+$6H_2O$. Ppt.

$8PbO$, $3B_2O_3$+$8H_2O$. Ppt.

$9PbO$, $5B_2O_3$+$9H_2O$. Ppt. (Rose, Pogg. **87.** 470.)

Lead borate, $Pb(BO_2)_2$+H_2O.

Insol. in H_2O. Easily sol. in dil. HNO_3, or boiling $HC_2H_3O_2$+Aq. Decomp. by H_2SO_4, HCl, also by boiling KOH, or NaOH+Aq. Insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Sol. in NH_4Cl+Aq; sol. in sat. NaCl+Aq.

$2PbO$, $3B_2O_3$+$4H_2O$. (Herapath.)

PbB_4O_7+$4H_2O$. Slightly sol. in pure H_2O, but insol. in solutions of Na salts as $Na_2B_4O_7$+Aq. (Soubeiran.)

Lead borate chloride, $Pb(BO_2)_2$, $PbCl_2$+H_2O.

Insol. in cold, very slowly decomp. by hot H_2O into its constituents. Easily sol. in dil. hot HNO_3+Aq; insol. in alcohol. (Herapath, Phil. Mag. (3) **34.** 375.)

Lead borate nitrate, $Pb(BO_2)_2$, $Pb(NO_3)_2$+H_2O.

Insol. in alcohol. (Herapath.)

Lithium borate, $LiBO_2$.

Solubility in H_2O.

100 g. H_2O dissolve g. $LiBO_2$ at t°.

t°	g. $LiBO_2$	t°	g. $LiBO_2$
0	0.7	30	4.9
10	1.4	40	11.12
20	2.6	45	20.

(Le Chatelier, C. R. 1897, **124.** 1094.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

+$8H_2O$. (Le Chatelier, Bull. Soc. 1899, (3) **21.** 35.)

+$16H_2O$. Effloresces in the air; slowly sol. in cold H_2O, rapidly in hot H_2O. (Le Chatelier, C. R. 1897, **124.** 1092.)

$Li_2H_4(BO_3)_2$+$14H_2O$. (Reischle, Z. anorg. **4.** 166.)

$Li_2B_4O_7$. Deliquescent; easily sol. in H_2O. (Arfvedson, A. ch. **10.** 82.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

+$5H_2O$. Insol. in alcohol. (Filsinger, Arch. Ph. (3) **8.** 198.)

$Li_2O, 3B_2O_3+6H_2O$. Very sol. in H_2O; insol. in alcohol. (Filsinger.)

$Li_2O, 4B_2O_3$. Insol. in H_2O. (Le Chatelier, Bull. Soc. 1899, (3) **21.** 35.)

$+10H_2O$. Sol. in H_2O; insol. in alcohol. (Filsinger.)

"Acid lithium borate" is less sol. than the tetraborate. (Gmelin.)

$Li_2O, 5B_2O_3+10H_2O$. (Dukelski, C. A. **1908.** 1089.

Magnesium borate, $Mg(BO_2)_2$.

(Ditte, C. R. **77.** 893.)

$+3H_2O$. Min. *Pinnoite.*

$+4H_2O$. (Laurent, A. ch. (2) **67.** 215.)

$+8H_2O$. Insol. in cold or hot H_2O; easily sol. in HCl+Aq. Decomp. by conc. HCl +Aq into H_3BO_3 and $MgCl_2$. (Wöhler.)

$MgB_4O_7+8H_2O$. (Popp, A. Suppl. **8.** 1.)

$MgO, 3B_2O_3+8H_2O$. Very slowly sol. in H_2O. (Rose, A. **84.** 221.)

Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **49.** 445.)

$2MgO, B_2O_3$. Insol. in H_2O, but sol. in Na_2CO_3+Aq. (Guertler, Z. anorg. 1904, **40.** 236.)

$+H_2O$. Very sl. sol. in $^1/_{10}$ N HCl+Aq. (van't Hoff, B. A. B. **1907,** 658.)

Min. *Ascharite.*

$3MgO, B_2O_3$. Insol. in H_2O; easily sol. in acids. (Ebelmen, A. **80.** 208.)

Very sl. sol. in cold, but somewhat decomp. by boiling H_2O. (Rammelsberg.)

$+9H_2O$. Somewhat sol. in cold H_2O. (Wöhler, Pogg. **28.** 525.)

$3MgO, 2B_2O_3$. Sol. in warm H_2SO_4 or HNO_3+Aq. (Ditte, C. R. **77.** 893.)

$MgO, 6B_2O_3+18H_2O = Mg(BO_2)_2, 10HBO_2 +13H_2O$. (Rammelsberg, Pogg. **49.** 445.)

$3MgO, 4B_2O_3$. Sol. in hot dil. acids; insol. in acetic acid. (Ditte, C. R. **77.** 893.)

$5MgO, 2B_2O_3+1\frac{1}{2}$, and $3H_2O$. Min. *Szaibelyite.* Difficultly sol. in HCl+Aq.

$9MgO, B_2O_3$. (Mallard, C. R. **105.** 260.)

Magnesium manganous borate, $3Mg_2B_2O_5, 4Mn_2B_2O_5+7H_2O$.

Min. *Sussexite.* Sol. in HCl+Aq.

Magnesium potassium borate, $KMg_2B_{11}O_{19}+ 9H_2O$.

Min. *Kaliborite.* Insol. in H_2O. (Feit, Ch. Z. 1889, **13.** 1188.)

$2MgO, 2K_2O, 11B_2O_3+20H_2O$. (van't Hoff and Lichtenstein, B. A. B. **1904,** 936.)

Magnesium sodium borate, $Mg_2B_6O_{11}, Na_2B_4O_7+30H_2O$.

Efflorescent. About as sol. in cold H_2O as borax; solution separates out a Mg borate on warming, which redissolves on cooling. Decomp. by boiling H_2O. (Rammelsberg.)

Magnesium strontium borate, $3MgO, 3SrO, 4B_2O_3$.

Easily sol. in dil. acids. (Ditte, C. R. **77.** 895.)

Magnesium borate bromide, $2Mg_3B_8O_{15}, MgBr_2$ or $6MgO, 8B_2O_3, MgBr_2$.

(Rousseau and Allaire, C. R. **1894,** 119, 71.)

Magnesium borate chloride, $2Mg_3B_8O_{15}, MgCl_2$.

Min. *Boracite.* Insol. in H_2O; slowly sol. in acids. (Kraut.)

Stassfurthite. Easily sol. in warm acids. (Bischof.)

Magnesium borate iodide, $6MgO, 8B_2O_3, MgI_2$.

(Allaire, C. R. 1898, **127.** 556.)

Magnesium borate phosphate, $Mg(BO_2)_2, 2MgHPO_4+7H_2O$.

Min. *Luneburgite.*

Magnesium borate sulphate, $2Mg_3B_4O_9, 3MgSO_4+12H_2O$.

Min. *Magnesium sulphoborite.*

Sol. in mineral acids when ground. (Naupert, B. 1893, **26.** 874.)

Manganous borate, MnB_4O_7 (?).

Insol. in H_2O (Berzelius); very sl. sol. in H_2O (Thomas, Am. Ch. J. **4.** 358); decomp. by warm, slowly by cold H_2O. Sol. in $MgSO_4$ +Aq (Berzelius).

$+3H_2O$. (Endemann and Paisley, Zeit. angew. Ch. 1903, **16.** 176.)

$+5H_2O$. Ppt. (Endemann and Paisley.)

Very hydroscopic. (Endemann, Am. Ch. J. 1903, **29.** 72.)

$3MnO, B_2O_3$. (Mallard, C. R. **105.** 1260.)

Not attacked by H_2O. Very sol. in acids. (Ouvrard, C. R. 1900, **130.** 336.)

$3MnO, 2B_2O_3$. (Mallard.)

$MnH_4(BO_3)_2$. Very sl. sol. in H_2O.

Solubility in 2% Na_2SO_4+Aq. At 18.5°, 0.77 g. $MnH_4(BO_3)_2$ are dissolved per litre; at 40°, 0.65 g.; at 60°, 0.36 g.; at 80°, 0.12 g.

Solubility in 2% NaCl+Aq. 1 l. solution dissolves 1.31 g. salt at 18.2°; 0.6 g. at 59°; and 0.29 g. at 80°.

Solubility in 2% $CaCl_2$+Aq. 1 l. $CaCl_2$+Aq dissolves 2.91 g. salt at 17.6°; 2.44 g. at 43.0°; 2.25 g. at 61°; and 1.35 g. at 80°. (Hartley and Ramage, Chem. Soc. **63.** 129.)

Manganous borate bromide, $6MnO, 8B_2O_3, MnBr_2$.

(Rousseau and Allaire, C. R. 1894, **119.** 73.)

Manganous borate chloride, $6MnO, 8B_2O_3, MnCl_2$.

(Rousseau and Allaire, C. R. 1894, **118.** 1257.)

Molybdenum borate, $MoO_2, 2B_2O_3$ (?).

Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Molybdenum borate, Mo_2O_3, B_2O_3.

Precipitate. Insol. in H_2O; sl. sol. in a solution of boric acid. (Berzelius.)

See **Boromolybdic Acid.**

Nickel borate, $Ni(BO_2)_2+2H_2O$.

Insol. in H_2O. Easily sol. in acids. Easily sol. in warm NH_4Cl+Aq. (Rose, Pogg. **88.** 299.)

$2NiO, B_2O_3+xH_2O$. Easily sol. in acids. (Rose.)

$3NiO, 2B_2O_3+5H_2O$. Easily sol. in acids. (Rose.)

$3NiO,B_2O_3$. Not attacked by H_2O; sol. in acids. (Ouvrard, C. R. 1900, **130.** 337.)

Nickel borate bromide, $6NiO, 8B_2O_3, NiBr_2$. (Rousseau, C. R. 1894, **119.** 73.)

Nickel borate chloride, $6NiO,8B_2O_3,NiCl_2$. (Rousseau, C. R. 1894, **118.** 1257.)

Potassium borates.

Solubility of B_2O_3 in K_2O+Aq at 30°.

Solution contains		Solid phase
% by wt. K_2O	% by wt. B_2O_3	
47.50	.....	KOH, $2H_2O$
46.45	0.72	"
46.36	0.91	K_2O, B_2O_3, $2.5H_2O$
40.51	1.25	"
36.82	1.80	"
36.72	1.85	"
32.74	3.51	"
29.63	6.98	"
26.89	12.12	"
24.84	17.63	"
23.30	18.19	K_2O, $2B_2O_3$, $4H_2O$
16.21	13.10	"
11 78	9.82	"
9.18	8.00	"
6.22	9.13	"
7.79	13.20	"
7.73	13.37	K_2O, $2B_2O_3$, $4H_2O$+ K_2O, $5B_2O_3$, $8H_2O$
7.81	13.28	"
7.67	13.19	"
7.71	13.21	K_2O, $5B_2O_3$, $8H_2O$
7.63	13.28	"
3.42	7.59	"
1.80	4.15	"
0.80	3.05	"
0.51	3.19	"
0.33	4.58	K_2O, $5B_2O_3$, $8H_2O$+ $B(OH)_3$
0.38	4.51	"
0.31	4.46	"
0.28	4.36	$B(OH)_3$
.....	3.54	"

At 30° only the three potassium borates K_2O, $B_2O_3+2.5H_2O$; K_2O, $2B_2O_3+4H_2O$ and K_2O, $5B_2O_3+8H_2O$ exist in stable form. (Dukelski, Z. anorg. 1906, **50.** 42.)

Potassium *meta*borate, KBO_2.

Sol. in small amount of H_2O. (Berzelius, Pogg. **34.** 568.)

$+1\frac{1}{4}H_2O$. Only stabile hydrate. (Dukelski, Z. anorg. 1906, **50.** 42.)

$+1\frac{1}{2}H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Potassium *tetra*borate, $K_2B_4O_7$.

Very sol. in H_2O.

$+4H_2O$. (Atterberg, Bull. Soc. (2) **22.** 350.)

Only stabile hydrate. (Dukelski, *l. c.*)

$+5H_2O$. Very sol. in H_2O; more sol. than $K_2B_6O_{10}$ or $K_2B_{12}O_{19}$.

$+6H_2O$. (Atterberg, *l. c.*)

Potassium *hexa*borate, $K_2B_6O_{10}+5$, and $8H_2O$.

Easily sol. in H_2O.

Does not exist. (Dukelski, *l. c.*)

Potassium *deka*borate, $K_2B_{10}O_{16}+8H_2O$.

Sol. in H_2O. (Rammelsberg.)

Only hydrate. (Dukelski.)

Potassium *dodeka*borate, $K_2B_{12}O_{19}+10H_2O$.

Sl. sol. in cold, very sol. in hot H_2O. (Laurent, A. ch. **67.** 215.)

$=K_2B_{10}O_{16}$. (Rammelsberg.)

Does not exist. (Dukelski.)

Potassium borate fluoride, KBO_2, KF.

Sol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

KBO_2, 2KF. Sol. in little, decomp. by much H_2O. Insol. in H_2O. (Schiff and Sestini, A. **228.** 72.)

Rubidium borate, $Rb_2B_4O_7$.

Anhydrous. (Reischle, Z. anorg. **4.** 166.)

$+6H_2O$. Not deliquescent or efflorescent. Sol. in H_2O. (Reissig, A. **127.** 33.)

Samarium borate, $SmBO_3$.

Insol. in H_2O; sol. in $HCl+Aq$. (Cleve, Bull. Soc. (2) **43.** 1670.)

Scandium borate, $ScBO_3$.

Sol. in dil. acids. (Crookes, Phil. Trans. 1910, **210.** A. 364.)

Silver borate, $AgBO_2$.

Sl. sol. in H_2O. By washing with H_2O the boric acid is dissolved out. (Rose, Pharm. Centralbl. **1853.** 205.)

Sol. with decomp. in $Na_2S_2O_3+Aq$ (Herschel); sol. in NH_4NO_3+Aq if pptd. cold.

1 l. H_2O dissolves ca. 6×10^{-2} gram-atoms at 25°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$3Ag_2O$, $4B_2O_3$. (Rose, *l. c.*)

Sodium borates.

Solubility of B_2O_3 in Na_2O+Aq at 30°.

Solution contains		Solid phase
% by wt. Na_2O	% by wt. B_2O_3	
42.00	.....	NaOH, H_2O
40.85	2.71	"
41.37	5.10	"
38.85	5.55	Na_2O, B_2O_3, $4H_2O$
34.44	3.73	"
29.39	2.51	"
28.61	2.38	"
27.78	2.44	"
26.13	2.75	"
25.08	2.98	"
23.00	3.82	"
16.61	13.69	"
21.58	4.63	Na_2O, B_2O_3, $4H_2O$+ Na_2O, B_2O_3, $8H_2O$
20.58	4.69	Na_2O, B_2O_3, $8H_2O$
18.31	4.97	"
15.32	6.21	"
13.25	8.18	"
12.39	9.12	"
8.85	10.49	Na_2O, $2B_2O_3$, $10H_2O$
5.81	6.94	"
4.00	4.76	"
1.88	2.41	"
1.38	5.16	"
1.84	7.36	"
2.02	7.79	"
2.40	9.48	"
4.08	17.20	Na_2O, $2B_2O_3$, $10H_2O$ +Na_2O, $5B_2O_3$, $10H_2O$
3.79	15.84	Na_2O, $5B_2O_3$, $10H_2O$
3.47	13.30	"
2.26	12.14	"
1.99	11.84	Na_2O, $5B_2O_3$, $10H_2O$ +$B(OH)_3$
1.86	11.78	$B(OH)_3$
1.81	11.18	"
0.64	6.11	"
...	3.54	"

At 30°, only the four sodium borates Na_2O, $B_2O_3+4H_2O$; Na_2O, $B_2O_3+8H_2O$; Na_2O, $2B_2O_3+10H_2O$; and Na_2O, $5B_2O_3+10H_2O$ exist as stable phases.

(Dukelski, Z. anorg. 1906, **50.** 46.)

Sodium *meta*borate, $NaBO_2$.

Anhydrous. Easily sol. in H_2O, with evolution of heat.

$+H_2O$. Easily sol. in H_2O. (Benedikt.)

$+2H_2O$. Easily sol. in H_2O. (Benedikt, B. **7.** 703.)

$+3H_2O$. Easily sol. in H_2O. (Berzelius.)

$+4H_2O$. Sl. efflorescent. Sol. in hot, less sol. in cold H_2O. Melts at 57° in its crystal H_2O. (Dukelski, Z. anorg. **50.** 42.)

$+4\frac{1}{2}H_2O$. (Atterberg, Z. anorg. 1906, **48.** 370.)

$+5\frac{1}{2}H_2O$. (Atterberg.)

$+8H_2O$. (Atterberg.)

$+4H_2O$ and $+8H_2O$ are the only hydrates formed. (Dukelski.)

System Na_2O, B_2O_3, H_2O at 60° investigated by Sborgi. (Real. Ac. Linc. 1915, (5) **24.** I, 443.)

Sodium *tetra*borate, $Na_2B_4O_7$ (*Borax*).

100 g. H_2O dissolve at:

5°	10°	21.5°	30°	37.5°
1.3	1.6	2.8	3.9	5.6 g. anhydrous salt.

45°	50°	54°	55°	56°	57°
8.1	10.5	13.3	14.2	15.0	16.0 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, **30.** 347.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in amyl alcohol in the presence of meta-arsenious acid and excess of H_3BO_3. (Auerbach, Z. anorg. 1903, **37.** 358.)

$+4H_2O$.

$+5H_2O$.

100 g. H_2O dissolve at:

65°	70°	80°	90°	100°
22.0	24.4	31.4	40.8	52.3 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, **30.** 347.)

$+6H_2O$. Grows opaque in the air. (Bechi, Sill. Am. J. (2) **17.** 129.)

$+10H_2O$. Only stabile hydrate. (Dukelski, Z. anorg. **50.** 30.) Efflorescent on surface in dry air. Not efflorescent when free from Na_2CO_3. (Sims.)

Sol. in 12 pts. cold, and 2 pts. hot H_2O. Sat. cold $Na_2B_4O_7$+Aq contains 9.23%, and sat. hot $Na_2B_4O_7$+Aq contains 33.33% $Na_2B_4O_7$. (Gmelin.)

Sol. in 20 pts. cold. and 6 pts. boiling H_2O. (Wallerius.)

Sol. in 15 pts. H_2O at 18.75°. (Abl.)

100 pts. H_2O at 15.5° dissolve 5 pts.; at 65°, 40 pts.; at 100°, 166 pts. $Na_2B_4O_7+10H_2O$. (Ure's Dictionary.)

100 pts. sat. $Na_2B_4O_7$+Aq at 105.5° contain 52.5 pts. $Na_2B_4O_7$, or 100 pts. H_6O dissolve 110.54 pts. $Na_2B_4O_7$, or 1 pt. $Na_2B_4O_7$ is sol. in 0.9047 pt. H_2O at 105.5°. (Griffith, Quar. J. Sci. **18.** 90.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7$ $+10H_2O$	t°	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7$ $+10H_2O$
0	1.49	2.83	60	18.09	40.43
10	2.42	4.65	70	24.22	57.85
20	4.05	7.88	80	31.17	76.19
30	6.00	11.90	90	40.14	116.66
40	8.79	17.90	100	55.16	201.43
50	12.93	27.41	...	...	....

(Poggiale, A. ch. (3) **8.** 46.)

100 pts. H_2O dissolve 1.4 pts. $Na_2B_4O_7$ at 0°, and 55.3 pts. at 100°. (Mulder.)

$Na_2B_4O_7$+Aq sat. at 15° has sp. gr. = 1.0199, and contains 3.926 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 471.)

$Na_2B_4O_7$+Aq sat. at 17° has sp. gr. = 1.0208. (Stolba, J. pr. **97.** 503.)

Sp. gr. of $Na_2B_4O_7$+Aq at 15°.

% $Na_2B_4O_7$	% $Na_2B_4O_7$ +10H_2O	Sp. gr.	% $Na_2B_4O_7$	% $Na_2B_4O_7$ +10H_2O	Sp. gr.
1	0.52	1.0049	4	2.11	1.0199
2	1.06	1.0099	5	2.64	1.0249
3	1.59	1.0149	6	3.17	1.0299

(Gerlach, Z. anal. **28.** 473.)

Sp. gr. of $Na_2B_4O_7$+Aq sat. at 15° = 1.032. (Gerlach.)

Sat. $Na_2B_4O_7$+Aq boils at 105.5°, and contains 110.5 pts. $Na_2B_4O_7$ to 100 pts. H_2O. (Griffith.)

Sat. $Na_2B_4O_7$+Aq forms a crust at 103°, and contains 60.14 pts. $Na_2B_4O_7$ to 100 pts. H_2O; highest temp. observed, 104.3°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Na_2B_4O_7$+Aq containing pts. $Na_2B_4O_7$ to 100 pts. H_2O.

B.-pt.	Pts. $Na_2B_4O_7$	B.-pt	Pts. $Na_2B_4O_7$
100.5°	8.64	103.0°	61.2
101.0	17.2	103.5	75.4
101.5	26.5	104.0	90.8
102.0	37.5	104.5	109.0
102.5	48.5	104.6	112.3

(Gerlach, Z. anal. **26.** 452.)

M.-pt. of $Na_2B_4O_7+10H_2O$ is 75.5°. (Tilden, Chem. Soc. **45.** 407.)

Insol. in alcohol.

100 g. alcohol (0.941 sp. gr.) dissolve 2.48 g. at 15.5° (U. S. P.).

Sol in alcoholic solution of $NaC_2H_3O_2$. (Stromeyer.)

Sol. in 14.7 pts. glycerine of 1.225 sp. gr. (Vogel.)

Sol. in 1 pt. glycerine. (Schultze, Arch. Pharm. (3) **6.** 149.)

100 g. glycerine dissolve 60.3 g. at 15.5° (U. S. P.)

Min. *Tincal.*

Sodium borate, $Na_2B_8O_{13}+10H_2O$.

Sol. in 5–6 pts. cold H_2O. (Bolley, A. **68.** 122.) Perhaps sodium hydrogen tetraborate $NaHB_4O_7+4\frac{1}{2}H_2O$.

$Na_2B_{10}O_{16}+10H_2O$. Decomp. by H_2O. (Atterberg, Z. anorg. **48.** 370.)

Stabile. (Dukelski, Z. anorg. **50.** 42.)

$+11H_2O$. (Laurent, C. R. **29.** 5.)

Sodium borate fluoride, $NaBO_2$, $3NaF+4H_2O$.

Sol. in H_2O.

Basarow (B. **7.** 112) considers this salt to be a mixture.

$Na_2B_4O_7$, $12NaF+22H_2O$. Can be separated into its constituents by H_2O. (Berzelius, Berz. J. B. **23.** 96.)

Strontium borate, $Sr(BO_2)_2$.

(Ditte, C. R. **77.** 788.)

Easily hydrated by H_2O forming SrO, B_2O_3 $+2H_2O$. Very sol. in dil. acetic acid. (Ouvrard, C. R. 1906, **142.** 282.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+2H_2O$. (Ouvrard, *l. c.*)

$+4H_2O$. (Ouvrard, *l. c.*)

$+5H_2O$. 1 l. H_2O dissolves 2.3 g. at 10°. (Ditte, A. ch. 1883 (5) **30.** 253.)

SrB_4O_7. Insol. in H_2O; sol. in dil. acids. (Guertler, Z. anorg, 1904, **40.** 243.)

$+4H_2O$. Sol. in 130 pts. boiling H_2O. 100 pts. H_2O at 100° dissolve 7.7 pts. (Ure's Dict.). Easily sol. in cold NH_4 salts+Aq; sol. in cold HNO_3+Aq.

$2SrO,B_2O_3$. Easily decomp. by H_2O forming B_2O_3, SrO, $4H_2O$. Very sol. in acids. (Ouvrard, C. R. 1906, **142.** 282.)

$3SrO$, B_2O_3. Less easily attacked by H_2O than Ca comp. Very sol. in mineral acids. Sl. attacked by dil. acetic acid. (Ouvrard, C. R. 1901, **132.** 258.)

SrB_6O_{10}. Very sl. sol. in H_2O; sol. in acids. (Laurent.)

$SrB_8O_{31}+7H_2O$. Ppt. (Laurent.)

$+12H_2O$. (Ditte.)

$Sr_3B_4O_9$. Sol. in cold mineral acids and acetic acid. (Ditte, C. R. **77.** 785.)

$2SrO$, $3B_2O_3$. Easily sol. in acids. (Ditte, *l. c.*)

Strontium borate bromide, $3SrO$, $5B_2O_3$, $SrBr_2$.

As the chloride. (Ouvrard, C. R. 1906, **142.** 283.)

Strontium borate chloride, $3SrO$, $5B_2O_3$, $SrCl_2$.

Sl. attacked by cold H_2O, not attacked by dilute acetic acid. (Ouvrard, C. R. 1906, **142.** 282.)

Thallous borate, $TlBO_2+\frac{1}{2}H_2O$.

Decomp. in the air. (Buchtala, J. pr. 1913, (2) **88.** 784.)

$Tl_2B_2O_7$. (Buchtala.)

$Tl_2B_4O_7$. Ppt. Sol. in boiling H_2O; insol. in cold dil. H_2SO_4+Aq. (Crookes.)

$+2H_2O$. (Buchtala, J. pr. 1913 (2) **88.** 774.)

$Tl_2B_6O_{10}+3H_2O$. (Buchtala.)

$Tl_2B_8O_{13}+4H_2O$. (Buchtala.)

$Tl_2B_{10}O_{16}+8H_2O$. (Buchtala.)

$Tl_2B_{12}O_{19}+7H_2O$. (Buchtala.)

Thorium borate (?).

Precipitate. Insol. in H_2O and H_3BO_3+Aq. (Berzelius.)

Tin (stannous) borate (?).

Ppt. (Wenzel.)

Divanadyl borate.
Insol. in H_2O; sol. in H_3BO_3+Aq. (Berzelius.)

Ytterbium borate, $YbBO_3$.
Insol. in conc. HCl; sol. in HF. (Cleve, Z. anorg. 1902, **32.** 148.)

Yttrium borate.
Precipitate. (Berlin, Pogg. **43.** 105.)

Zinc borate, $3ZnO, 2B_2O_3$.
(Mallard, C. R. **105.** 1260.)
Decomp. by H_2O; very sol. in dil. acids. (Ouvrard, C. R. 1900, **130.** 336.)
$ZnO, 2B_2O_3+4H_2O$. Sol. in H_2O with decomp. (Ditte, A. ch. 1883, (5) **30.** 256.)
$3ZnO, 4B_2O_3+H_2O$. Ppt. (Holdermann, Arch. Pharm. 1904, **242.** 567.)
$ZnO, 4B_2O_3+10H_2O$. (Ditte, A. ch. 1883, (5) **30.** 256.)
$9ZnO, 4B_2O_3+9H_2O$. Sl. sol. in H_3BO_3 +Aq. (Rose, Pogg. **88.** 299.)
$3ZnO, B_2O_3$. Insol. in mineral acids. (le Chatelier, C. R. **113.** 1034.)

Zinc borate ammonia, $ZnB_4O_7, 4NH_3+6H_2O$.
Easily sol. in NH_4OH, $HC_2H_3O_2$, H_2SO_4, HCl, and HNO_3+Aq. (Büchner, A. **151.** 234.)

Zinc borate bromide, $6ZnO, 8B_2O_3, ZnBr_2$.
(Rousseau and Allaire, C. R. **116.** 1446.)

Zinc borate chloride, $6ZnO,8B_2O_3,ZnCl_2$.
Insol. in HCl. (Rousseau, C. R. 1894, **118.** 1256.)

Zinc borate iodide, $6ZnO, 8B_2O_3, ZnI_2$.
(Allaire, C. R. 1898, **127.** 556.)

Zirconium borate, (?).
Insol. in H_2O.

Perboric acid.
See **Perboric Acid.**

Boric phosphoric acid.
See **Phosphoboric acid.**

Boric tungstic acid.
See **Borotungstic acid.**

Boric acid sulphur *tri*oxide.
See **Borosulphuric acid.**

Borimide, $B_2(NH)_3$.
Decomp. by H_2O; insol. in all indifferent solvents; sol. in liquid NH_3+S to form a dark blue solution. (Stock, B. 1901, **34.** 3044.)

Borimide hydrochloride, $B_2(NH)_3,3HCl$.
Decomp. by H_2O; insol. in all ordinary organic solvents. (Stock, B. 1901, **34.** 3045.)

Borofluorhydric acid, HBF_4.
See **Fluoboric acid.**

Borofluorides.
See **Fluoborides.**

Boromolybdic acid.
Sol. in H_2O. Decomp. by alcohol. (Berzelius.)

Boron, B.
(*a*) *Amorphous.* Somewhat sol. in pure H_2O, when not ignited. Salts and acids separate it out of aqueous solution. Upon evaporation of H_2O solution a crust is formed, which is only partially sol. in H_2O. (Berzelius, Pogg. **2.** 113.) Decomp. by hot H_2SO_4 and cold moderately conc. HNO_3+Aq. Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd., and is insol. in H_2O. (Berzelius.) Insol. in caustic alkalies+Aq; also in alcohol and ether.
Above boron was very impure. (Moissan, C. R. **114.** 392.)
Pure B is not attacked by acids, but has a strong reducing action on $KMnO_4$+Aq, $FeCl_3$ +Aq, etc. (Moissan, C. R. **114.** 617.)
Does not melt at 1500°. Readily sol. in conc. acids, as H_2SO_4, HNO_3, H_3PO_4; very sl. sol. in hydracids; decomp. H_2O at red heat. (Moissan, A. ch. 1895, (7) **6.** 313–14.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
(*b*) *Crystallized.* 1. Insol. in H_2O, HCl, or KOH+Aq. Very slightly and slowly attacked by boiling conc. H_2SO_4. Gradually sol. in hot conc. HNO_3. Formula is Al_2B_{24}. (Hampe, A. **183.** 75.)
2. Very slightly attacked by conc. HCl or H_2SO_4; slowly but completely sol. in conc. HNO_3; insol. in KOH+Aq. Formula is $C_2Al_3B_{48}$. (Hampe.)
$C_2Al_3B_{44}$. *Crystalline.* Insol. in a solution of CrO_3 in H_2SO_4. Insol. in hot conc. HCl and H_2SO_4. Sol. in hot conc. HNO_3. (Biltz, B. 1910, **43.** 303.)

Boron *tri*bromide, BBr_3.
Sol. in H_2O or alcohol with decomp. (Nicklès, C. R. **60.** 800.)

Boron phosphorus bromide, BBr_3, PBr_3.
Decomp. by H_2O.
Sol. in CS_2, and $CHCl_3$. Decomp. by alcohol, ether, etc. (Tarible, C. R. **116.** 1521.)
BBr_3, PBr_5. Sl. sol. in cold, easily in hot CS_2. (Tarible.)

Boron bromide ammonia, $BBr_3, 4NH_3$.
Decomp. by H_2O and alkalies. (Besson, C. R. **114.** 542.)

Boron bromide phosphine, BBr_3, PH_3.
Violently decomp. by H_2O. (Besson, C. R. **113.** 78.)

Boron bromide phosphorus *tri*chloride, $2BBr_3,PCl_3$.

Decomp. by H_2O. Sol. in BBr_3, PCl_3, CS_2, and $CHCl_3$. Insol. in petroleum ether. (Tarible, C. R. 1901, **132.** 84.)

Boron bromide phosphorus *penta*chloride, $2BBr_3,PCl_5$.

Sol. in BBr_3 and CS_2; decomp. by H_2O; insol. in light petroleum. (Tarible, C. R. 1901, **132.** 85.)

Boron bromide phosphorus *di*iodide, $2BBr_3$, P_2I_4.

Sol. in BBr_3, CS_2, $CHCl_3$; insol. in light petroleum; decomp. by H_2O. (Tarible, C. R. 1901, **132.** 205.)

Boron bromide phosphoryl chloride, BBr_3, $POCl_3$.

Very easily decomp. (Oddo and Tealdi, Gazz. ch. it. 1903, **33.** (2) 431.)

Boron bromoiodide, BBr_2I.

Decomp. violently by H_2O. (Besson, C. R. **112.** 100.)

$BBrI_2$. (Besson, C. R. **112.** 100.)

Boron bromosulphide, B_2S_3,BBr_3.

Decomp. by H_2O. (Stock, B. 1901, **34.** 3040.)

Boron carbide, B_6C.

Very stable; insol. in HF and in HNO_3; sol. in KOH at red heat. (Moissan, Bull. Soc. 1894, (3) **11.** 1101.)

Insol. in acids; sol. in fused alkali. (Moissan, C. R. 1894, **118.** 559.)

BC or B_2C_2. Insol. in all the usual solvents. (Müllhäuser, Z. anorg. **5.** 92.)

Boron *tri*chloride, BCl_3.

Rapidly absorbed by H_2O and alcohol with decomposition.

Boron nitrosyl chloride, BCl_3, NOCl.

Decomp. violently by H_2O. (Geuther, J. pr. (2) **8.** 854.)

Boron phosphoryl chloride, BCl_3, $POCl_3$.

Decomp. immediately by H_2O. (Gustavson, Zeit. Chem. **1870.** 521.)

Boron chloride ammonia, $2BCl_3$, $3NH_3$.

Decomp. by H_2O. (Berzelius, Pogg. **2.** 147.)

Boron chloride phosphine, BCl_3, PH_3.

Decomp. by H_2O. (Besson, C. R. **110.** 516.)

Boron chlorosulphide, B_2S_3,BCl_3.

Decomp. by H_2O. (Stock, B. 1901, **34.** 3040.)

Boron *tri*fluoride, BF_3.

H_2O absorbs 700 vols. BF_3 gas to form a liquid of 1.77 sp. gr. On boiling, 1/5 of the BF_3 is given off, and a residue boiling at 165–200°, with composition BF_3+2H_2O or HBO_2+3HF, is left. (J. Davy, A. ch. **86.** 178.)

1 ccm. H_2O absorbs at 0° and 762 mm. pressure 1.057 ccm. BF_3.

1 vol. conc. H_2SO_4 of 1.85 sp. gr. absorbs 50 vols. BF_3.

Absorbed by alcohol with decomp.

Cold oil of turpentine absorbs 6.8% of BF_3.

Boron fluoride ammonia, BF_3,NH_3, BF_3, $2NH_3$, and BF_3, $3NH_3$.

Decomp. by H_2O.

Boron fluoride cyanhydric acid, BF_3, HCN.

Very unstable. (Patein, C. R. **113.** 85.)

Boron fluoride phosphine, $2BF_3$, PH_3.

Very unstable at ordinary temp. Decomp. by H_2O. (Besson, C. R. **110.** 80.)

Boron hydride, BH_3.

Not obtained free from H. Sl. sol. in H_2O. (Jones, Chem. Soc. **35.** 41.)

See **Cyclo*tri*borene.**

B_4H_{10}. B.-pt. 16–17° at 760 mm.

Very unstable. Takes fire spontaneously in the air.

Decomp. by H_2O, dil. HCl, and oxidized by conc. HNO_3 with explosive violence.

Absorbed by NaOH+Aq.

Decomp. by alcohol. Sol. in dry benzene. (Stock, B. 1912, **45.** 3562.)

B_6H_{12}. B.-pt. 100° at atmospheric pressure. Decomp. by H_2O. With aqueous alkalies, hydrogen is evolved. (Stock, B. 1912, **45.** 3565.)

B_8H. Insol. in HCl. Sol. in aqua regia and Br_2+Aq. (Winkler, B. 1890, **23.** 778.)

$B_{10}H_{14}$. M.-pt. 99.5°; not attacked by cold or boiling H_2O. Sol. in dil. NaOH+Aq. Sol. in alcohol, ether, benzene, and CS_2. (Stock, B. 1913, **46.** 3360.)

Boron iodide, BI_3.

Very hygroscopic, and instantly decomp. by H_2O or alcohol. Very sol. in CS_2, CCl_4, C_6H_6; less sol. in PCl_3, $AsCl_3$, and a great many organic liquids. (Moissan, C. R. **112.** 717.)

Boron iodide ammonia, BI_3, $5NH_3$.

Decomp. by H_2O. (Besson, C. R. **114.** 542.)

Boron iodophosphide, BI_2P.

Very hygroscopic; decomp. by H_2O. Not attacked by cold conc. H_2SO_4, even if fuming, but on heating decomposition takes place. Very sl. sol. in CS_2. Insol. in benzene, PCl_3, or CCl_4. (Moissan, C. R. **113.** 624.)

BIP. Less hygroscopic than BI_2P, but otherwise the properties are similar. (Moissan.)

Boron nitride, BN.

Insol. in H_2O, conc. HNO_3, conc. HCl+Aq, or conc. solutions of alkalies.

Decomp. by hot conc. H_2SO_4 or HF. (Wöhler, A. **74.** 70.)

Boron *tri*oxide, B_2O_3.

Deliquescent. Sol. in H_2O with a large increase in temp. (Ditte, C. R. **85.** 1069.)

1 pt. dissolves—

at	18.75°	in 47.01 pts. H_2O.
"	25°	" 27.75 " "
"	37.5°	" 18.73 " "
"	50°	" 15.13 " "
"	62.5°	" 9.29 " "
"	75°	" 7.28 " "
"	87.5°	" 5.58 " "
"	100°	" 4.74 " "

Or 100 pts. H_2O dissolve—

at	18.75°	2.13 pts. B_2O_3.
"	25°	3.60 " "
"	37.5°	4.24 " "
"	50°	6.61 " "
"	62.5°	10.76 " "
"	75°	13.73 " "
"	87.5°	17.92 " "
"	100°	21.09 " "

(Brandes and Firnhaber, Arch. Pharm. **7.** 50.)

1 litre H_2O dissolves—

at	0°	11.00 g. B_2O_3.
"	12°	16.50 " "
"	20°	22.49 " "
"	40°	39.50 " "
"	62°	64.50 " "
"	80°	95.00 " "
"	102°	164.50 " "

(Ditte, C. R. **85.** 1069.)

Sat. H_2O solution boils at 100°. (Brandes and Firnhaber.)

Sat. H_2O solution boils at 103.3°. (Griffiths, Quar. J. Sci. **18.** 90.)

Sol. in acetic acid, hot conc. HCl+Aq, HNO_3, and H_2SO_4. From the three latter it separates on cooling or dilution with H_2O.

Solubility in Na_2O+Aq at 30.

See **Borates, sodium.**

Solubility in K_2O+Aq at 30°.

See **Borates, potassium.**

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, **100.** (2) 720.)

Insol. in alcohol. (Graham.)

Sol. in alcohol. (Berzelius, Ebelmen.)

Sol. in oils.

See also **Boric acid.**

Boron *tri*oxide potassium fluoride, B_2O_3, 2KF.

Gradually sol. in H_2O. Decomp. by much H_2O. Insol. in alcohol. (Schiff and Sestini, A. **228.** 82.)

Boron oxychloride, BOCl.

(Gustavson, Zeit. Chem. **1870.** 521.)

$BOCl_3$. Slowly decomp. by H_2O. (Councler, J. pr. (2) **18.** 399.)

Oxychlorides of either the above formulæ do not exist; the true formula for boron oxychloride is $B_8O_{11}Cl_2$. (Lorenz, A. **247.** 226.)

Boron phosphide, BP.

Insol. in H_2O. Sol. in conc. boiling alkalies + Aq with decomp. Decomp. by HNO_3+Aq. (Besson, C. R. **113.** 78.)

Insol. in PCl_3, $AsCl_3$, $SbCl_3$, CCl_4, and in fact in all known solvents.

Not attacked by boiling H_2O, conc. HCl, or HI+Aq. Sol. in conc. HNO_3 with decomp. on heating. Not attacked by cold H_2SO_4. (Moissan, C. R. **113.** 726.)

B_5P_3. Not attacked by boiling conc. HNO_3 +Aq. Insol. in all solvents. (Moissan.)

Boron phosphoiodide.

See **Boron iodophosphide.**

Boron selenide, B_2Se_3.

Violently decomp. by H_2O. (Sabatier, C. R. **112.** 1000.)

Boron *tri*sulphide, B_2S_3.

Decomp. with violence with H_2O. Combines with alcohol and ether. (Fremy, A. ch. (3) **38.** 312.)

Insol. in most solvents, but sl. sol. in PCl_3 without decomp.; more sol. in SCl_2, but does not crystallize from the solution. (Moissan, C. R. **115.** 203.)

Boron *tri*sulphide ammonia, B_2S_3,$6NH_3$.

Ppt. (Stock, B. 1901, **34.** 3042.)

Boron *penta*sulphide, B_2S_5.

Decomp. by H_2O and alcohol. (Moissan, C. R. **115.** 271.)

Borosulphuric acid, $BOHSO_4+SO_3$.

Decomp. by H_2O. (Schultz-Sellac, B. **4.** 12.)

$B(HSO_4)_3$. Very deliquescent. Easily sol. in fuming H_2SO_4. (D'Arcy, Chem. Soc. **55.** 155.)

$SO_2(O.BO)_2$. Hydroscopic. Deliquescent. Sol. in H_2O with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) **3.** 1121.)

$(SO_3)_2B_2O_3$. Hydroscopic. Deliquescent. Sol. in H_2O with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) **3.** 1121.)

Boro*nono*tungstic acid, $H_4B_2W_9O_{32}+22H_2O=9WO_3, B_2O_3, 2H_2O+22H_2O$.

Sol. in less than $^1/_9$ pt. H_2O, and as easily sol. in alcohol and ether. Sp. gr. of aqueous solution is somewhat under 3. (Klein, A. ch. (5) **28.** 370.)

Aluminum boro*nono*tungstate, $Al_4(B_2W_9O_{32})_3+65H_2O$.

Extremely sol. in H_2O. (Klein.)

Ammonium ——, $(NH_4)_4B_2W_9O_{32}+18H_2O$.

Quickly effloresces. (Klein.)

Barium borononotungstate, $Ba_2B_2W_9O_{32}+19H_2O$.

Sol. in 4 pts. cold, and less than ½ pt. hot H_2O. (Klein.)

Cadmium ——, $Cd_2B_2W_9O_{32}+18H_2O$.

Deliquescent.

100 pts. of salt dissolve in less than 8 pts. H_2O at 19°. Sp. gr. of solution is 3.28. (Klein.)

Sp. gr. of sat. solution at 15.6°/4° = 3.2887; at 16.2°/4° = 3.2868. (Kahlbaum, Z. anorg. 1902, **29.** 229.)

Calcium ——, $Ca_2B_2W_9O_{32}+15H_2O$.

Sol. in $^1/_{10}$ pt. H_2O. Solution has sp. gr. = 3.10. (Klein.)

Cerium ——, $Ce_4(B_2W_9O_{32})_3+57H_2O$.

Very sol. in H_2O; sp. gr. of solution is over 3.

Chromium ——, $Cr_4(B_2W_9O_{32})_3+74H_2O$.

Very sol. in H_2O; sp. gr. of solution is 2.80. (Klein.)

Cobalt ——, $Co_2B_2W_9O_{32}+18H_2O$.

Very sol. in H_2O; sp. gr. of solution sat. at 19° = 3.36. (Klein.)

100 pts. H_2O dissolve 306.8 pts. anhydrous salt at 16.2°; 288 pts. at 18.5°; 299.7 pts. at 19.6°; 286 pts. at 21.8°.

Sp. gr. of solution sat. at 19.2°/4° = 3.1369. (Kahlbaum, Z. anorg. 1902, **29.** 218.)

Copper ——, $Cu_2B_2W_9O_{32}+19H_2O$.

25 pts. H_2O dissolve 100 pts. salt. Sp. gr. of solution = 2.6. (Klein.)

Lead ——, $Pb_2B_2W_9O_{32}+11H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. (Klein.)

Lithium ——, (?).

Very sol. in H_2O. Sp. gr. of solution is about 3.

Magnesium ——, $Mg_2B_2W_9O_{32}+22H_2O$.

Very sol. in H_2O. (Klein.)

Manganous ——, $Mn_2B_2W_9O_{32}+17H_2O$.

100 pts. dissolve in 13 pts. H_2O. Sp. gr. of solution at 19° = 3.15. (Klein.)

Mercurous ——, $3Hg_2O$, B_2O_3, $9WO_3+14H_2O$ (?).

Precipitate.

Insol. in H_2O (Klein.)

Sol. in 20,000 pts. dil. cold, and 1000 pts. boiling HNO_3+Aq of 1.42 sp. gr.

Nickel ——, $Ni_2B_2W_9O_{32}+18H_2O$.

Very sol. in H_2O; sp. gr. of sat. solution at 19° = 3.32.

100 pts. H_2O dissolve 261.6 pts. at 21.2°.

Sp. gr. 15.75°/4° of solution = 2.2959. (Kahlbaum, Z. anorg. 1902, **29.** 218.)

Potassium borononotungstate, $K_4B_2W_9O_{32}+13H_2O$.

5 pts. salt dissolve in 8 pts. H_2O at 19° to form a solution of 1.38 sp. gr. The solution sat. at 100° has sp. gr. of over 2. (Klein.)

Silver ——, $Ag_4B_2W_9O_{32}+14H_2O$.

Very sl. sol. in H_2O.

Sodium ——, $Na_2H_2B_2W_9O_{32}+23H_2O$.

Very sol. in H_2O. Solution sat. at 19° contains 84 pts. salt to 16 pts. H_2O. (Klein.)

$Na_4B_2W_9O_{32}+12H_2O$. Sol. in less than $^1/_3$ pt. H_2O.

Thallium ——, $Tl_2B_2W_9O_{32}+5H_2O$.

Sl. sol. in hot H_2O and nearly insol. in cold H_2O. (Klein.)

Uranyl ——, $(UO_3)_3(B_2W_9O_{30})_2+30H_2O$.

Very sol. in H_2O. (Klein.)

Sp. gr. of solution = 3.1.

Zinc ——, $Zn_2B_2W_9O_{32}+2H_2O$.

Very sol. in H_2O. Sp. gr. of solution = 3.15. (Klein.)

Boro*deci*tungstic acid.

Barium boro*deci*tungstate, $Ba_2B_2W_{10}O_{35}+20H_2O$.

Sol. in H_2O. (Klein, C. R. **99.** 35.)

Boro*duodeci*tungstic acid, $H_8B_2W_{12}O_{43}$ = $4H_2O$, B_2O_3, 12 WO_3.

Known only in solution, which decomposes into boro*nono*tungstic acid and tungstic acid, when evaporated to a certain concentration. (Klein, C. R. **99.** 35.)

Barium potassium boro*duodeci*tungstate, $3BaO$, K_2O, B_2O_3, $12WO_3+28H_2O$.

Potassium ——, $K_8B_2W_{12}O_{43}+21H_2O$.

Sol. in H_2O. (Klein.)

$2K_2O$, $12WO_3$, $B_2O_3+18H_2O$. Sol. in H_2O. (Klein.)

Boro*quatuordeci*tungstic acid, $H_{12}B_2W_{14}O_{51}$ = $6H_2O$, B_2O_3, $14WO_3$.

Has not been obtained in the free state. (Klein, A. ch. (5) **28.** 353.)

Barium boro*quatuordeci*tungstate, $Ba_3B_2W_{14}O_{48}$ = $3BaO$, B_2O_3, $14WO_3+5H_2O$.

Sl. sol. in H_2O. (Klein.)

Barium sodium ——, $3\frac{1}{2}BaO$, $1\frac{1}{2}Na_2O$, $5H_2O$, B_2O_3, $14WO_3+29H_2O$.

Potassium ——, $3K_2O$, H_2O, B_2O_3, $14WO_3+22H_2O$.

Sol. in H_2O. (Klein.)

Silver ——, $Ag_6H_2B_2W_{14}O_{48}+7H_2O$.

Nearly insol. in cold H_2O. (Klein.)

Sodium ——, $Na_4H_8B_2W_{14}O_{51}+29H_2O$.

Sol. in H_2O (Klein.)

Sodium strontium boro*quatuordeci*tungstate, $3\frac{1}{2}SrO, 1\frac{1}{2}Na_2O, B_2O_3, 14WO_3+29H_2O$.

Decomp. by H_2O. (Klein.)

Boro*undeviginti*tungstic acid.

Barium boro*undeviginti*tungstate, $4BaO, B_2O_3, 19WO_3+30H_2O$.

Can be cryst. from H_2O. (Ebenhusen, Dissert. **1905.**)

Boro*quattuoretviginti*tungstic acid, $B_2O_3, 24WO_3+66H_2O$.

Deliquescent. Somewhat more sol. in H_2O than $B_2O_3, 28WO_3+62H_2O$. Also more stable. (Copaux, C. R. 1908, **147.** 975.)

Barium boro*quattuoretviginti*tungstate, $5BaO, B_2O_3, 24WO_3+54H_2O$.

100 pts. H_2O dissolve 50 pts. salt. (Copaux. A. ch. 1909, (8) **17.** 217.)

$6BaO, B_2O_3, 24WO_3+58H_2O$. (Copaux, *l. c.*)

Cadmium ——, $5CdO, B_2O_3, 24WO_3+51H_2O$.

Extremely sol. in H_2O. (Copaux, *l. c.*)

Calcium ——, $5CaO, B_2O_3, 24WO_3+44H_2O$.

Very sol. in H_2O. (Copaux, *l. c.*)

Lithium ——, $15Li_2O, B_2O_3, 24WO_3+38H_2O$. (Copaux, *l. c.*)

Magnesium ——, $5MgO, B_2O_3, 24WO_3+42H_2O$.

Very sol. in H_2O. (Copaux, *l. c.*)

Mercurous ——, $9Hg_2O, B_2O_3, 24WO_3+25H_2O$.

(Copaux, *l. c.*)

Potassium ——, $5K_2O, B_2O_3, 24WO_3+36H_2O$.

(Copaux, *l. c.*)

Sodium ——, $5Na_2O, B_2O_3, 24WO_3+5H_2O$.

As NH_4 salt. (Copaux, *l. c.*)

Boro*quinquetviginti*tungstic acid.

Potassium boro*quinquetviginti*tungstate, $5K_2O, B_2O_3, 25WO_3+34H_2O$. (Ebenhusen, Dissert. **1905.**)

Boro*duodetriginta*tungstic acid, $B_2O_3, 28WO_3+62H_2O$.

Decomp. in boiling aqueous solution. (Copaux, C. R. 1908, **147.** 975.)

Potassium boro*duodetriginta*tungstate, $6K_2O, B_2O_3, 28WO_3+42H_2O$.

Decomp. by boiling alkalies. (Copaux, A. ch. 1909 (8) **17.** 217.)

Borovanadic acid.

Sol. in H_2O. Easily decomp. (Guyard, Bull. Soc. (2) **25.** 354.)

***Meta*bromantimonic acid,** $HSbBr_6+3H_2O$.

Very hydroscopic. Loses Br_2 in the air. Decomp. by H_2O with separation of antimonic acid. (Weinland, B. 1903, **36.** 256.)

Ammonium *meta*bromantimonate, $NH_4SbBr_6+H_2O$.

Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Iron (ferric) *meta*bromantimonate, $Fe(SbBr_6)_3+14H_2O$.

Very hydroscopic. Decomp. by H_2O. (Weinland, *l. c.*)

Lithium *meta*bromantimonate, $LiSbBr_6+4H_2O$.

Very hydroscopic. Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Nickel *meta*bromantimonate, $Ni(SbBr_6)_2+12H_2O$.

Hydroscopic. Decomp. by H_2O. (Weinland, *l. c.*)

Potassium *meta*bromantimonate, $KSbBr_6+H_2O$.

Loses Br_2 in the air. Decomp. by H_2O. (Weinland, *l. c.*)

Bromarsenious acid.

See **Arsenyl bromide.**

Bromauric acid, $HAuBr_4+3H_2O$.

(Lengfeld, Am. Ch. J. 1901, **26.** 329.)

$+5H_2O$. Very sol. in H_2O. (Thomsen, J. pr. (2) **13.** 337.)

$+6H_2O$. Sol. in ether and $CHCl_3$ without decomp. (Lengfeld, Am. Ch. J. 1901, **26.** 329.)

Ammonium bromaurate, NH_4AuBr_4.

Ppt. (Gutbier, Z. anorg. 1914, **85.** 358.)

Barium bromaurate.

Not deliquescent. Sol. in H_2O. (v. Bonsdorff, Pogg. **17.** 261.)

Cæsium bromaurate, $CsAuBr_4$.

Sl. sol. in H_2O or alcohol. Insol. in ether. (Wells and Wheeler, Sill. Am. J. **144.** 157.)

Ppt. (Gutbier, Z. anorg. 1914, **85.** 360.)

Cerium bromaurate, $CeAuBr_6+8H_2O$.

Sol. in H_2O. (Jolin, Bull. Soc. (2) **21.** 533.)

Didymium bromaurate, $DiAuBr_6+9H_2O$.

Very deliquescent. Sol. in H_2O. (Cleve.)

Lanthanum bromaurate, $LaAuBr_6+9H_2O$.

Sol. in H_2O. (Cleve.)

Magnesium bromaurate.

Deliquescent in moist air. (v. Bonsdorff.)

Manganese bromaurate.

Deliquescent. (v. Bonsdorff.)

Potassium bromaurate, $KAuBr_4$.

Sl. sol. in H_2O. More sol. in cold alcohol than in H_2O. (v. Bonsdorff.)

$+2H_2O$. Sol. in 5.12 pts. H_2O at 15°, 1.56 pts. at 40°, and 0.48 pt. at 67°. Decomp. by ether. Sl. sol. in KBr+Aq. (Schottländer, A. **217.** 314.)

$+5H_2O$. Efflorescent. (v. Bonsdorff.)

Rubidium bromaurate, $RbAuBr_4$.

As cæsium bromaurate.

Ppt. (Gutbier, Z. anorg. 1914, **85.** 359.)

Samarium bromaurate, $SmAuBr_6+10H_2O$.

Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 165.)

Sodium bromaurate, $NaAuBr_4$.

Slowly sol. in H_2O. (v. Bonsdorff.)

Zinc bromaurate, $Zn(AuBr_4)_2$.

Very deliquescent. (v. Bonsdorff.)

Bromauricyanhdric acid.

Not known in free state.

Barium bromauricyanide, $Ba[Au(CN)_2Br_2]_2+10H_2O$.

Very sol. in hot or cold H_2O, also in alcohol. (Lindbom, Lund. Univ. Arsk. **12.** No. 6.)

Cadmium bromauricyanide, $Cd[Au(CN)_2Br_2]_2+6H_2O$.

Very sol. in hot or cold H_2O, but solution is unstable. (Lindbom.)

Calcium bromauricyanide, $Ca[Au(CN)_2Br_2]_2+10H_2O$.

Extremely sol. in H_2O and alcohol. (Lindbom.)

Cobalt bromauricyanide, $Co[Au(CN)_2Br_2]_2+9H_2O$.

Moderately sol. in H_2O. Less sol. than other bromauricyanides. (Lindbom.)

Potassium bromauricyanide, $KAu(CN)_2Br_2+3H_2O$.

Sol. in H_2O and alcohol.

Sodium bromauricyanide, $NaAu(CN)_2Br_2+2H_2O$.

Very sol. in H_2O or alcohol.

Strontium bromauricyanide, $Sr[Au(CN)_2Br_2]_2+xH_2O$.

Very sol. in H_2O or alcohol.

Zinc bromauricyanide, $Zn[Au(CN)_2Br_2]_2+8H_2O$.

Easily sol. in cold or hot H_2O.

Bromhydric acid, HBr.

Very sol. in H_2O.

The most concentrated HBr+Aq has a sp. gr. of 1.78, and contains 82.02% HBr. (Champion and Pellat, C. R. **70.** 620.) This, or a weak acid on heating, leaves a residue, which distils unchanged at 125–125.5° under 785 mm. pressure, and contains 48.17% HBr (Topsoë); at 126° under 758 mm. pressure, and contains 46.83% HBr (Bineau); and has sp. gr. = 1.486 at 20° (Bineau); sp. gr. = 1.48 at 20° (Champion and Pellat); sp. gr. = 1.49 at 20° (Topsoë).

According to Roscoe (A. **116.** 214) an acid of constant composition, obtained by boiling a stronger or a weaker acid, if distilled under 752–762 mm. pressure, contains 47.38–47.86% HBr, and boils at 126° at 760 mm. pressure; but the composition is dependent on the pressure, as, for example, under 1952 mm. pressure, the residue boils at 153°, and contains 46.3% HBr. (Roscoe.)

By conducting dry air through HBr+Aq an acid is obtained containing 51.65% HBr if at 16°, and 49.35% HBr if at 100° (Roscoe).

1 vol. H_2O dissolves 600 ± vols. HBr at 10°. (Berthelot, C. R. **76.** 679.)

1 pt. H_2O at t° and 760 mm. pressure dissolves pts. HBr.

t°	Pts. HBr	t°	Pts. HBr	t°	Pts. HBr
—25	2.550	—5	2.280	+50	1.715
—20	2.473	0	2.212	+75	1.505
—15	2.390	+10	2.103	+100	1.300
—10	2.335	+25	1.930	...	...

(Roozeboom, R. t. c. **4.** 107.)

Absorption by 1 pt. H_2O at t° and p pressure in mm.

t° = —25°.

p	Pts. HBr	p	Pts. HBr
760	2.550	100	2.056
300	2.263	1	1.755
140	2.120	0.5	1.10

t° = —20°.

p	Pts. HBr	p	Pts. HBr
760	2.473	130	2.056
375	2.267	20	1.850
180	2.119	...	...

t° = —15°.

p	Pts. HBr	p	Pts. HBr
760	2.390	175	2.056
470	2.266	102	1.980
250	2.119	...	...

t° = —11.3°.

p	Pts. HBr	p	Pts. HBr
760	2.350	310	2.118
570	2.265	216	2.055

t° = —5°.

p	Pts. HBr	p	Pts. HBr
760	2.280	430	2.117
730	2.264	298	2.055

t° = 0°.

p	Pts. HBr	p	Pts. HBr
760	2.212	380	2.054
540	2.116	5	1.085

(Roozeboom, R. t. c. **4.** 107.)

Sp. gr. of HBr+Aq.

Sp. gr.	% HBr	Temp.	Sp. gr.	% HBr	Temp.
1.055	7.67	14°	1.335	36.67	13°
1.075	10.19	14°	1.349	37.86	13°
1.089	11.94	14°	1.368	39.13	13°
1.097	12.96	14°	1.419	43.12	13°
1.118	15.37	14°	1.431	43.99	13°
1.131	16.92	14°	1.438	44.62	13°
1.164	20.65	14°	1.451	45.45	14°
1.200	24.35	13°	1.460	46.09	13°
1.232	27.62	13°	1.485	47.87	14°
1.253	29.68	13°	1.490	48.17	14°
1.302	33.84	13°	...	...	...

(Topsoë, B. **3.** 404.)

Sp. gr. of HBr+Aq at 14°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.007	18	1.140	35	1.314
2	1.014	19	1.149	36	1.326
3	1.021	20	1.158	37	1.338
4	1.028	21	1.167	38	1.351
5	1.035	22	1.176	39	1.363
6	1.043	23	1.186	40	1.376
7	1.050	24	1.196	41	1.389
8	1.058	25	1.206	42	1.403
9	1.065	26	1.215	43	1.417
10	1.073	27	1.225	44	1.431
11	1.081	28	1.235	45	1.445
12	1.089	29	1.246	46	1.459
13	1.097	30	1.257	47	1.473
14	1.106	31	1.268	48	1.487
15	1.114	32	1.279	49	1.502
16	1.122	33	1.290	..	...
17	1.131	34	1.302	..	...

(Topsoë, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HBr+Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
5	1.038	25	1.204	45	1.435
10	1.077	30	1.252	50	1.515
15	1.177	35	1.305	..	...
20	1.159	40	1.365	..	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. **23.** 242.)

Sp. gr. of HBr+Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.0082	18	1.145	35	1.314
2	1.0155	19	1.154	36	1.326
3	1.0230	20	1.163	37	1.338
4	1.0305	21	1.172	38	1.350
5	1.038	22	1.181	39	1.362
6	1.046	23	1.190	40	1.375
7	1.053	24	1.200	41	1.388
8	1.061	25	1.209	42	1.401
9	1.069	26	1.219	43	1.415
10	1.077	27	1.229	44	1.429
11	1.085	28	1.239	45	1.444
12	1.093	29	1.249	46	1.459
13	1.102	30	1.260	47	1.474
14	1.110	31	1.270	48	1.490
15	1.119	32	1.281	49	1.496
16	1.127	33	1.292	50	1.513
17	1.136	34	1.303	..	...

(Biel, C. C. **1882.** 148.)

Absorbed by alcohol with formation of C_2H_5Br.

The composition of the hydrates formed by HBr at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by HBr and of the conductivity and sp. gr. of HBr+Aq. (Jones, Am. Ch. J. 1905, **34.** 326.)

$+H_2O$. (Roozeboom, R. t. c. **5.** 363.)

$+2H_2O$. (Berthelot, A. ch. (5) **14.** 369.) (Pickering Chem. Soc.1894, **64** (2) 232.

Mpt. —11.2°. (Pickering, *l. c.*)

$+3H_2O$. Mpt. —48.0°. (Pickering.)

$+4H_2O$. Mpt. —55.8°. (Pickering.)

$+5H_2O$. (Pickering.)

Bromhydric cyanhydric acid, 3HBr, 2HCN.

Decomp. by H_2O and alcohol.

Insol. in ether. (Gautier, A. ch. (4) **17.** 141.)

Bromic acid, $HBrO_3$.

Known only in aqueous solution.

Solution evaporated on water bath decomposes when it contains 4.26% $HBrO_3$. In vacuo, an acid containing 50.59% $HBrO_3$ corresponding to formula $HBrO_3+7H_2O$ can be obtained.

Not decomp. by dil. HNO_3, or H_2SO_4+Aq. Conc. H_2SO_4 decomposes.

Alcohol and ether are quickly oxidized by $HBrO_3$.

Bromates.

Most of the bromates are very sol. in H_2O, a few are sl. sol., but none are insol., the least sol. being $AgBrO_3$ and $Hg_2(BrO_3)_2$.

Aluminum bromate, $Al(BrO_3)_3$.

Deliquescent. (Rammelsberg, Pogg. **55.** 63.)

$+9H_2O$. Mpt. 62.3°. Less hygroscopic

than $Al(ClO_3)_3$. (Dobrosserdow, C. C. **1907.** I, 1723.)

Ammonium bromate, NH_4BrO_3.

Decomposes spontaneously; sol. in H_2O. (Rammelsberg, Pogg. **52.** 85.)

Barium bromate, $Ba(BrO_3)_2$.

Solubility of $Ba(BrO_3)_2$ in H_2O. 100 g. sat. $Ba(BrO_3)_2$+Aq at t° contain g. anhydrous $Ba(BrO_3)_2$.

t°	grams $Ba(BrO_3)_2$	t°	Grams $Ba(BrO_3)_2$
Eutectic point			
—0.034°±0.002°	0.280	50°	1.72
0°	0.286	60°	2.271
+10°	0.439	70°	2.922
20°	0 652	80°	3.521
25°	0.788	90°	4.26
30°	0.95	98.7°	5.256
40°	1.31	*99.65°	5.39

*99.65° is bpt. at 740 mm. = 100.39° at 760 mm.

(Anschütz, Z. phys. Ch. 1906, **56.** 240.)

100 g. sat. $Ba(BrO_3)_2$+Aq contain 0.793 g. $Ba(BrO_3)_2$ at 25°. Sp. gr. of the solution at 25°/4° = 1.0038. (Harkins J. Am. Chem. Soc. 1911, **33.** 1815.)

Solubility of $Ba(BrO_3)_2$ in salts+Aq at 25°.
C = concentration of salt in salt+Aq in milliequivalents per l.
d_1 = Sp. gr. at 25°/4° of salt+Aq.
S = solubility of $Ba(BrO_3)_2$ in salt+Aq expressed in milliequivalents per l.
d_2 = sp. gr. at 25°/4° of $Ba(BrO_3)_2$+salt+Aq.

Salt	C	d_1	S	d_2
None			40.18	1.0038
KNO_3	25.018	0.9985	43.86	1 0059
	50.032	1.0030	47.03	1.0081
	99.970	1.0033	52.13	1 0120
$Ba(NO_3)_2$	25.018	1.0003	36.77	1.0059
	50.039	1.0025	34.74	1.0083
	99.97	1.0073	32.63	1.0132
	199.95	1.0183	30.95	1.0233
$KBrO_3$	24.988	1.0001	26.53	1.0046
	49.971	1.0031	17.37	1.0062
	99.85	1.0093	8.76	1.0109
$Mg(NO_3)_2$	100.0		52.57	1.0114

(Harkins, J. Am. Chem. Soc. 1911, **33.** 1815.)

+H_2O. Sol. in 130 pts. cold, and 24 pts. boiling H_2O. (Rammelsberg, Pogg. **52.** 81.)
Decomp. by H_2SO_4, or HCl+Aq.
Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth bromate.

Known only in solution, which decomp. on evaporation. (Rammelsberg, Pogg. **55.** 76.)

Cadmium bromate, $Cd(BrO_3)_2+H_2O$.

Sol. in 0.8 pt. cold H_2O. (Rammelsberg, Pogg. **55.** 74.)
+$2H_2O$. (Topsoë, J. B. **1872,** 164.)

Cadmium bromate ammonia, $Cd(BrO_3)_2$, $3NH_3$.

Decomp. by H_2O. (Rammelsberg, Pogg. **55.** 74.)
$Cd(BrO_3)_2$, $4NH_3$. Ppt. (Ephraim, B. 1915, **48.** 51.)

Calcium bromate, $Ca(BrO_3)_2+H_2O$.

Sol. in 1.1 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 98.)

Cerous bromate, $Ce(BrO_3)_3+9H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **55.** 63.)
Mpt. 49°; very sol. in H_2O with decomp. (James, J. Am. Chem. Soc. 1909, **31.** 914.)

Cobaltous bromate, $Co(BrO_3)_2+6H_2O$.

Sol. in 2.2 pts. cold H_2O; sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **55.** 71.)

Cupric bromate, basic, 6CuO, $Br_2O_5+10H_2O$.

Ppt. (Rammelsberg, Pogg. **55.** 78.)

Cupric bromate, $Cu(BrO_3)_2+6H_2O$.

Easily sol. in H_2O. (Rammelsberg, Pogg. **52.** 92.)

Cupric bromate ammonia, $Cu(BrO_3)_2$, $4NH_3$.

Completely sol. in a little H_2O, but decomp. by dilution.
Insol. in alcohol. (Rammelsberg, Pogg. **52.** 92.)

Didymium bromate, $Di(BrO_3)_3+9H_2O$.

Sol. in H_2O. (Marignac.)

Dysprosium bromate, $Dy(BrO_3)_3+9H_2O$.

Mpt. 78°. Easily sol. in H_2O. Difficultly sol. in alcohol. (Jantsch, B. 1911, **44.** 1275.)

Erbium bromate, $Er(BrO_3)_3+9H_2O$.

Very sol. in alcohol and H_2O.

Glucinum bromate.

Deliquescent.

Iron (ferrous) bromate, $Fe(BrO_3)_2$.

Sol. in H_2O, but solution decomp. very easily.

Iron (ferric) bromate, $5Fe_2O_3$, $Br_2O_5+30H_2O$.

Partially sol. in H_2O, with separation of a more basic salt. Sol. in HBO_3+Aq. (Rammelsberg, Pogg. **55.** 68.)

Lanthanum bromate, $La(BrO_3)_3+9H_2O$.

Sol. in 3½ pts. H_2O at 15°. (Marignac, Ann. Min. (5) **15.** 274.)
Mpt. 37.5° in its water of crystallization. 416 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31.** 913.)

Lead bromate, basic, $3PbO, Pb(BrO_3)_2+2H_2O$.

Ppt. (Strömholm, Z. anorg. 1904, **38.** 441.)

Lead bromate, $Pb(BrO_3)_2$.

Sl. sol. in H_2O. 13.37×10^{-4}g. are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

$+H_2O$. Sol. in 75 pts. cold H_2O. (Rammelsberg, Pogg. **52.** 96.)

Lithium bromate, $LiBrO_3$.

Very deliquescent, and sol. in H_2O. (Rammelsberg, Pogg. A. **55.** 63.)

Not deliquescent. (Politilitzin, B. **23.** 545 R.)

Sp. gr. of solution sat. at 18° = 1.833, and contains 60.4% $LiBrO_3$. (Mylius, B. 1897, **30.** 1718.)

$+H_2O$. Not deliquescent. (Potilitzin.)

Magnesium bromate, $Mg(BrO_3)_2+6H_2O$.

Efflorescent. Sol. in 1.4 pts. cold H_2O at 15°. Melts in its water of crystallization when heated. (Rammelsberg, Pogg. **52.** 89.)

Mercurous bromate, basic, $2Hg_2O, Br_2O_5$.

Insol. in warm H_2O. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercurous bromate, $Hg_2(BrO_3)_2$.

Decomp. by H_2O into basic salt. Difficultly sol. in HNO_3+Aq; easily sol. in HCl+Aq. (Rammelsberg.)

Mercuric bromate, basic, $2HgO, Br_2O_5+H_2O$.

Slowly decomp. by cold, quickly by hot H_2O into oxide and an acid salt.

Easily sol. in dil. acids. (Topsoë, W. A. B. 66, **2.** 2.)

Mercuric bromate, $HgBrO_3+2H_2O$.

Sol. in 650 pts. cold, and 64 pts. boiling H_2O. Sl. sol. in HNO_3+Aq. Easily sol. in HCl+Aq. (Rammelsberg, Pogg. **55.** 79.)

Mercuric bromate ammonia.

Sol. with decomp. in HCl+Aq. (Storer's Dict.)

Neodymium bromate, $Nd(BrO_3)_3+9H_2O$.

Mpt. 66.7°. 146 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31.** 915.)

Nickel bromate, $Ni(BrO_3)_2+6H_2O$.

Sol. in 3.58 pts. cold H_2O. (Rammelsberg, Pogg. **55.** 69.)

Nickel bromate ammonia, $Ni(BrO_3)_2, 2NH_3$.

Sol. in H_2O, with decomposition of the major portion. Insol. in alcohol. (Rammelsberg, *l. c.*)

$Ni(BrO_3)_2, 6NH_3$. Ppt. (Ephraim, B. 1915, **48.** 50.)

Potassium bromate, $KBrO_3$.

100 pts. H_2O dissolve 6.58 pts. $KBrO_3$ at 15° (Rammelsberg). 100 pts. H_2O dissolve 5.83 pts. $KBrO_3$ at 17.1° (Pohl. W. A. B. **6.** 595); at 0°, 3.11 pts.; at 20°, 6.92 pts.; at 40°, 13.24 pts.; at 60°, 22.76 pts.; at 80°, 33.90 pts.; at 100° 49.75 pts. $KBrO_3$. Sat. solution boils at 104°. (Kremers, Pogg. **97.** 5.)

1 l. H_2O at 25° dissolves 0.4715 moles $KBrO_3$. (Geffcken, Z. phys. Ch. 1904, **49.** 296.)

1 l. H_2O dissolves 0.478 mol. $KBrO_3$ at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Sp. gr. of $KBrO_3$+Aq at 19.5°.

$\%KBrO_3$	1	2	3	4	5
Sp. gr.	1.009	1.016	1.024	1.031	1.039
$\%KBrO_3$	6	7	8	9	10
Sp. gr.	1.046	1.054	1.062	1.070	1.079

(Gerlach, Z anal. **8.** 290.)

Solubility of $KBrO_3$ in salts+Aq at 25°.

Salt	Moles of $KBrO_3$ sol. in 1 liter of				
	.5-N solution	N solution	2-N solution	3-N solution	4-N solution
$NaNO_3$	0.5745	0.6497	0.7680	0.9026	1.031
NaCl	0.5220	0.5616	0.6042	0.6244	0.640

(Geffcken, Z. phys. Ch. 1904, **49.** 296.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Sl. sol. in alcohol. (Rammelsberg.)

Insol. in absolute alcohol.

Solubility in organic compds.+Aq at 25°.

Solvent	Mol. $KBrO_3$ sol. in 1 litre
Water	0.478
0.5-N Methyl alcohol	0.444
" Ethyl alcohol	0.421
" Propyl alcohol	0.409
" Tert. amyl alcohol	0.383
" Acetone	0.425
" Ether	0.395
" Formaldehyde	0.397
" Glycol	0.448
" Glycerine	0.451
" Mannitol	0.451
" Glucose	0.463
" Sucrose	0.431
" Urea	0.477
" Dimethyl pyrone	0.478
" Ammonia	0.445
" Diethylamine	0.384
" Pyridine	0.415
" Piperidine	0.396
" Urethane	0.433
" Formamide	0.473
" Acetamide	0.445
" Glycocoll	0.501
" Acetic acid	0.456
" Phenol	0.426
" Methylal	0.405
" Methyl acetate	0.420

(Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Praseodymium bromate, $Pr(BrO_3)_3+9H_2O$.

Mpt. 56.5°. 190 pts. are sol. in 100 pts. H_2O at 25°. (James, J. Am. Chem. Soc. 1909, **31.** 914.)

Samarium bromate, $Sm(BrO_3)_3+9H_2O$.

Mpt. 75°. 114 pts. are sol. in 100 pts. H_2O at 25°. Very sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, **31.** 915.)

Scandium bromate.

(Crookes, Roy. Soc. Proc. 1908, **80,** A, 518.)

Silver bromate, $AgBrO_3$.

1 pt. H_2O dissolves 0.00810 pt. $AgBrO_3$ at 24.5°. (Noyes, Z. phys. Ch. **6.** 246.)

Sol. in 595.3 pts. H_2O at 25°.

Sol. in 320.4 pts. HNO_3+Aq (sp. gr. 1.21) at 25°.

Sol. in 2.2 pts. NH_4OH+Aq (sp. gr. 0.96) at 25°. (Longi, Gazz. ch. it. **13.** 87.)

1 l. H_2O dissolves 1.71 g. $AgBrO_3$ at 27°. (Whitby, Z. anorg. 1910, **67.** 108.)

Sl. sol. in H_2O. 1.59 x 10^{-4} g. are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Insol. in HNO_3. (Löwig.) Easily sol. in NH_4OH+Aq.

Silver bromate ammonia, $AgBrO_3$, $2NH_3$.

Decomp. in air or by H_2O. (Rammelsberg, Pogg. **52.** 94.)

Sodium bromate, $NaBrO_3$.

Sol. in 2.7 pts. H_2O at 15°. (Rammelsberg.)

100 pts. H_2O dissolve at—

0°	20°	40°	60°	80°	100°	
27.54	34.48	50.25	62.5	75.75	90.9	pts. $NaBrO_3$.

(Kremers, Pogg. **94.** 271.)

Easily forms supersaturated solutions.

Sat. solution boils at 109°. (Kremers.)

$NaBrO_3$+Aq containing 10.10% $NaBrO_3$ has sp.gr. 20°/20° = 1.0818.

$NaBrO_3$+Aq containing 11.09% $NaBrO_3$ has sp. gr. 20°/20° = 1.0900.

(Le Blanc and Rohland, Z. phys. Ch. 1896 **19.** 278.)

Sp. gr. of $NaBrO_3$+Aq at 19.5°.

% $NaBrO_3$	5	10	15
Sp. gr.	1.041	1.083	1.129
% $NaBrO_3$	20	25	30
Sp. gr.	1.178	1.231	1.289

(Kremers, Pogg. **97.** 5, calculated by Gerlach, Z. anal. **8.** 290.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sodium bromate bromide, $3NaBrO_3$, $2NaBr+3H_2O$.

Decomp. by H_2O or alcohol. (Fritzsche.)

Strontium bromate, $Sr(BrO_3)_2+H_2O$.

Sol. in 3 pts. H_2O (Rammelsberg, Pogg. **52.** 84); less sol. in H_2O than $SrBr_2+6H_2O$. (Löwig.)

Thallous bromate, $TlBrO_3$.

Sl. sol. in hot H_2O; easily sol. in HNO_3+Aq. (Oettinger.)

Easily sol. in H_2O and dil. acids. (Ditte, A. ch. (6) **21.** 145.)

Terbium bromate, $Tb(BrO_3)_3+9H_2O$.

Not deliquescent. (Potratz, C. N. 1905, **92,** 3.)

Thallous bromate, $TlBrO_3$.

1 l. H_2O at 39.75° dissolves 2.216 x 10^{-2} g. mol. (Noyes and Abbott, Z. phys. Ch. 1895, **16.** 130.)

Sl. sol. in H_2O. 3.46 x 10^{-1} gram are contained in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Thallic bromate, $Tl(BrO_3)_3+3H_2O$.

Very hydroscopic. Easily decomp. by H_2O. (Gewecke, Z. anorg. 1912, **75.** 275.)

Thulium bromate, $Tm_2(BrO_3)_6+18H_2O$.

Pptd. from sat. aqueous solution by 95% alcohol.

NH_4OH is the best precipitant. (James, J. Am. Chem. Soc. 1911, **33.** 1342.)

Tin (stannous) bromate (?).

Insol. in H_2O; sol. in HCl+Aq.

Uranyl bromate, $4UO_3$, $3Br_2O_5+16H_2O$.

Sol. in H_2O. (Rammelsberg.)

Yttrium bromate, $Y(BrO_3)_3+9H_2O$.

More easily sol. in H_2O than $Y(IO_3)_3$. Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Mpt. 74°. 168 pts. are sol. in 100 pts. H_2O at 25°.

Sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, **31.** 916.)

Zinc bromate, $Zn(BrO_3)_2+6H_2O$.

Sol. in 1 pt. cold H_2O. (Rammelsberg, Pogg. **52.** 90.)

Zinc bromate ammonia, $Zn(BrO_3)_2$, $2NH_3+3H_2O$.

Decomp. by H_2O and alcohol. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **52.** 90.)

$Zn(BrO_3)_2$, $4NH_3$. Ppt. (Ephraim, B. 1915, **48.** 51.)

Perbromic acid.

See **Perbromic acid.**

Bromides.

Most bromides are sol. in H_2O, many in alcohol, and some in ether.

AgBr and Hg_2Br_2 are insol. in H_2O or acids; $PbBr_2$ and TlBr are sl. sol. therein. Cu_2Br_2 is insol. in H_2O, sol. in acids.

See under each element.

Bromine, Br_2.

1 pt. Br dissolves at 15° in 33 pts. H_2O. (Löwig, Pogg. **14.** 485.)

1 pt. Br dissolves at 15° in 31 pts. H_2O. (Dancer, Chem. Soc. **15.** 477.)

Solubility of Br in 100 pts. H_2O at t°.

t°	Pts. Br.	t°	Pts. Br	t°	Pts. Br
5	3.600	15	3.226	25	3.167
10	3.327	20	3.208	30	3.126

(Dancer, *l. c.*)

A sat. aqueous solution of Br contains 4.05% Br at 0°; 3.80% Br at 3°; 3.33%Br at 10°. (Roozeboom, R. t. c. **3.** 29, 59, 73, 84.)

1 l. H_2O dissolves 34 g. Br at 25°. (Jakowkin, Z. phys. Ch. 1896, **20.** 25.)

1 pt. is sol. in 30 pts. H_2O. (Dietze, Chem. Soc. 1899, **76** (2) 150.)

100 pts. H_2O dissolve at:

0°	10.34°	19.96°	30.17°	40.03°	49.85°
4.167	3.740	3.578	3.437	3.446	3.522

pts. bromine.

Liquid bromine as such is insol. in H_2O; only the vapor dissolves. (Winkler, Ch. Z. 1899, **23.** 688.)

1 l. H_2O dissolves 33.95 g. Br_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Solubility of bromine vapor in H_2O at t°.
α = coefficient of absorption.

t°	α	t°	α
0	60.5	42	8.6
2	54.1	44	7.9
4	48.3	46	7.4
6	43.3	48	6.9
8	38.9	50	6.5
10	35.1	52	6.1
12	31.5	54	5.8
14	28.4	56	5.4
16	25.7	58	5.1
18	23.4	60	4.9
20	21.3	62	4.6
22	19.4	64	4.4
24	17.7	66	4.2
26	16.3	68	4.0
28	15.0	70	3.8
30	13.8	72	3.6
32	12.7	74	3.4
34	11.7	76	3.3
36	10.9	78	3.1
38	10.1	80	3.0
40	9.4	..	...

(Winkler, Ch. Z. 1899, **23.** 688.)

Solubility of bromine vapor.
(Mean of many determinations)

Temp.	Pressure	Absorption coefficient
0.0	56–13mm.	60.53
9.94°	89–16	35.22
20.46	138–9	20.87
30.[illegible]8	179–12	13.65
40.31	229–26	9.22
50.25	274·53	6.50
60.04	314·46	4.84
69.98	154·54	3.82
80.22	396·74	2.94

Solubility of liquid bromine.
(The mean of many determinations)

Temp.	0.°	10.34°	19.96°	30.17°	40.03°	49.85°
Pts. H_2O that dissolve 1 pt. Br_2	24.0	26.74	27.94	29.10	29.02	28.38

Much less Br_2 is sol. in ice cold H_2O in the presence of bromine hydrate.

Solubility in presence of bromine hydrate.
(The mean of many determinations)

Temp.	0°	5.12°
Pts. H_2O that dissolve 1 pt. Br_2	42.39	26.26

(Winkler, Ch. Z. 1899, **23.** 688–689.)

Solubility of Br_2 in H_2O at 25° = 0.21 mols. in 1 l. (Bray, J. Am. Chem. Soc. 1910, **32.** 398.)

Sp. gr. of Br_2+Aq containing pts. Br in 1000 pts. solution.

Pts. Br.	Sp. gr.	Pts. Br.	Sp. gr.
10.72	1.00901	18.74–19.06	1.01491
10.68	1.00931	19.52–20.09	1.01585
12.05	1.00995	20.89–21.55	1.01807
12.21	1.01223	31.02–31.69	1.02367

(Slessor, N. Edin. Phil. J. **7.** 287.)

Sp. gr. of Br_2+Aq at 32.5°.

% Br_2 by weight	Sp. gr.
0.7214	0.999814
1.1172	1.002520
1.6448	1.006100
1.9956	1.008870
2.5960	1.013200

(Joseph, Chem. Soc. 1915, **107.** 3.)

Sol. in conc. HCl, HBr, conc. solutions of bromides, and in liquid SO_2. (Sestini, Zeit. Chem. **1868.** 718.)

Much more sol. in HCl+Aq than in H_2O.

100 ccm. HCl+Aq of 1.153 sp. gr. dissolve 36.4 g. Br at 12°.

More sol. in $SrCl_2$, and $BaCl_2$+Aq than in H_2O. (Berthelot, C. R. **100.** 761.)

Bromine is not more sol. in KBr+Aq than in H_2O (?). (Balard.)

KBr+Aq containing 1 pt. KBr to 6 pts. H_2O takes up as much Br as it already contains; when this solution is heated the dissolved Br is separated. 1 pt. KBr+1 pt. H_2O takes up twice as much Br as it already contains, much heat being evolved. This solution loses Br on exposure to the air or when heated. (Löwig.)

Solubility of Br_2 in KBr+Aq.

g. Mols. KBr per l.	g. at. Br dissolved per l at 18.5°	g. at. Br dissolved per l. at 26.5°.
0.00	0.4448	0.4282
0.01	0.4634	0.4490
0.02	0.4823	0.4671
0.03	0.5049	0.4925
0.04	0.5243	0.5101
0.05	0.5431	0.5301
0.06	0.5668	0.5530
0.07	0 5895	0.5636
0.08	0.6059	0.5920
0.09	0.6301	0.5981
0.1	0.6533	0.6488
0.2	0.8718	0.8591
0.3	1.0549	1 0787
0.4	1.3124	1.2704
0.5	1.5436	1.4731
0.6	1.7712	1.6717
0.7	2.0006	1.9197
0.8	2.2354	2.1029
0.9	2.4851	2.3349

The above figures indicate that below a concentration of 0.1 g. mol. KBr per l. just enough Br is dissolved to form KBr_3, while above that concentration somewhat larger amounts of Br are dissolved, which is greater at the lower temp.

(Worley, Chem. Soc. 1905, **87.** 1109.)

Solubility of Br_2 in NaBr+Aq at 25°.

g. NaBr per l.	g.-atoms Br_2 per l.	Sp. gr.
92.6	2.479	1.213
160.5	4.345	1.372
205.8	6.195	1.515
255.8	8.575	1.678
319.7	13.65	1.997
359.0	16.04	2.137
....	19.23	2.327
408.3	20.85	2.420

(Bell, J. Am. Chem. Soc. 1912, **34.** 14.)

Solubility in salts+Aq.

Solubility in 1 liter K_2SO_4+Aq at 25°.

K_2SO_4+Aq	g. Bromine
1-N	25.14
1/2-N	29.44
1/4-N	31.46
1/8-N	32.70
1/16-N	33.10

(Jakowkin, Z. phys. Ch. **1896,** 20, 26.)

Solubility in 1 liter Na_2SO_4+Aq at 25°.

Na_2SO_4+Aq	g. Bromine
1-N	25.07
1/2-N	29.20
1/4-N	31.33
1/8-N	32.94
1/16-N	33.26

(Jakowkin, *l. c.*)

Solubility in 1 liter $NaNO_3$+Aq at 25°.

$NaNO_3$+Aq	g. Bromine
1-N	28.80
1/2-N	31.35
1/4-N	32.62
1/8-N	33.33
1/16-N	33.74

(Jakowkin, *l. c.*)

Solubility in salts+Aq at 25°.

Salt +Aq.	g. Br_2 sol. in 1 liter
1/2-N.Na_2SO_4	23.90
1/2-N.K_2SO_4	24.80
1/2-N.$(NH_4)_2SO_4$	77 7
N $NaNO_3$	28 00
N KNO_3	28 95
N.NH_4NO_3	55 15
N.NaCl	55 90
N.KCl	57.40
N.NH_4Cl	82 2

(McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Solubility in $HgBr_2$+Aq at 25°.

10 ccm. of the solution contain:—

Millimols. Br_2	Millimols. Hg
2.125	0.
2.204	0.0560
2.216	0.0793
2.226	0.1284
2.231	0.2120

(Herz and Paul, Z. anorg. 1914, **85.** 215.)

1 l. N.$NH_4C_2H_3O_2$+Aq dissolves 340.5 g. Br_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Miscible in all proportions with liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

More sol. in alcohol than in H_2O; miscible with ether, CS_2, $CHCl_3$. (Sestini, Zeit. Chem. **1868.** 718.)

Somewhat soluble in glycerine. (Pelouze.) Sol. in benzene (Mansfield); insol. in benzene (Moride, A. ch. (3) **39.** 452). Sol. in warm chloral, bromal, and iodal. (Löwig, Pogg. **14.** 485.) Sol. in SCl_2 (Solly), and SBr_2. Sol. in conc. $HC_2H_3O_2$+Aq. (Balard.) Sol. in aqueous solution of potassium, sodium, or calcium acetates. (Cahours.)

Solubility in CS_2.

100 g. of the sat. solution contain at:

—95°	—110.5°	—116°
45.4	39.0	36.9 g. Br_2.

(Arctowski, Z. anorg. 1896, **11.** 274.)

Cryst. from CS_2 at —90° in fine needles. (Arctowski, Z. anorg. 1895, **10.** 25.)

Sp. gr. of Br_2+CCl_4 at 32.5°.

% Br_2 by weight	Sp. gr.
1.5449	1.58014
1.6454	1.58060
1.7990	1.58168
2.6676	1.58812
3.5833	1.59526

(Joseph, Chem. Soc. 1915, **107.** 3.)

Sp. gr. of Br_2+nitrobenzene at 32.5°.

% Br_2 by weight	Sp. gr.
1.5643	1.20225
3.2323	1.21449
4.6462	1.22518
6.1826	1.23603

(Joseph, Chem. Soc. 1915, **107.** 3.)

Very sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in acetone. (Eidmann, C. C **1899,** II, 1014; Naumann, B. 1904, **37.** 4328.)

Partition of Br_2 between water and other solvents.

W = millimols Bromine in 10 ccm. of the aqueous layer.

G = millimols Bromine in 10 ccm. of the other layer.

Other solvent	G	W	G/W
CCl_4	1.949	0.0853	22.73
	7.008	0.3085	22.71
	12.171	0.5300	23.13
	39.880	1.3132	30.32
	54.574	1.5560	35.01
75% by vol. CCl_4 +25% by vol. CS_2	3.567	0.0985	37.06
	7.304	0.1910	38.15
	10.833	0.2900	37.36
	13.922	0.3720	37.42
	17.230	0.4580	37.62
	25.637	0.6580	38.96
	40.625	0.9940	40.88
	54.035	1.2080	44.73
50% by vol. CCl_4+ 50% by vol. CS_2	3.592	0.0784	45.82
	6.820	0.1487	46.85
	10.148	0.2206	46.01
	13.866	0.3065	45.24
	16.616	0.3688	45.05
	42.975	0.8086	53.15
	55.965	0.9960	56.19
25% by vol. CCl_4 +75% by vol. CS_2	5.753	0.0884	65.05
	10.902	0.1682	64.82
	26.724	0.4970	65.65
	41.314	0.6331	65.26
	55.526	0.8520	65.17

Partition of Br_2, etc.—*Continued*

Other solvent	G	W	G/W
CS_2	7.750	0.1015	76.35
	10.600	0.1387	76.44
	14.696	0.1910	76.98
	17.999	0.2352	76.54
	26.345	0.3467	75.99
	40.625	0.5194	78.21
	57.038	0.7160	79.66

(Herz, Z. Elektrochem. 1910, **16.** 871.)

Partition coefficient for bromine between CS_2 and H_2O at 25°C.

A = concentration of the water layer.

C = concentration of the CS_2 layer.

A	C	N = C/A
7.545	691.9	91.71
4.109	338.6	82.41
2.660	217.4	81.72
2.544	207.7	81.66
1.740	140.38	80.67
1.2878	103.7	80.51
0.8073	64.44	79.83
0.5046	39.64	78.38

Partition coefficient for bromine between $CHBr_3$ and H_2O at 25°C.

A = concentration of the water layer.

C = concentration of the $CHBr_3$ layer.

A	C	N = C/A
5.424	373.6	68.88
3.838	264.7	68.80
2.368	161.5	68.19
1.348	90.17	66.90
0.766	50.49	65.84
0.366	23.62	64.85

Partition coefficient for bromine between CCl_4 and H_2O at 25°C.

A = concentration of the water layer.

C = concentration of the CCl_4 layer.

A	C	N = C/A
14.42	545.2	37.82
10.80	372.2	34.44
7.901	252.8	32.01
7.163	225.8	31.52
6.803	218.5	32.12
5.651	172.6	30.54
3.216	94.84	29.48
2.054	58.36	28.41
1.266	35.92	28.37
0.7711	21.53	27.92
0.5761	15.72	27.26
0.4476	12.09	27.02
0.3803	10.27	27.00
0.2478	6.691	27.00

(Jakowkin, Z. phys. Ch. 1895, 18. 588.)

Partition of bromine between CCl_4 and salts+Aq.
A = concentration of Br in H_2O layer.
C = concentration of Br in CCl_4 layer.

Partition of Br_2 between CCl_4 and $NaNO_3$+Aq at 25°.

$NaNO_3$+Aq	A	C
1-N	7.905	316.7
1/2-N	8.763	319.5
1/4-N	9.033	315.7
1/8-N	9.200	316.7
1/16-N	9.399	319.3

(Jakowkin, Z. phys. Ch. **1896**, 20, 25.)

Partition of Br_2 between CCl_4 and K_2SO_4+Aq at 25°.

K_2SO_4+Aq	A	C
1-N	5 982	255.4
1/2-N	6.843	253.4
1/4-N	7 354	252.8
1/8-N	7.585	250.3
1/16-N	7.498	242.3

(Jakowkin, *l. c.*)

Partition of Br_2 between CCl_4 and Na_2SO_4+Aq at 25°.

Na_2SO_4+Aq	A	C
1-N	5.934	254.6
1/2-N	6.838	253.4
1/4-N	7.402	254.4
1/8-N	7.609	252.8
1/16-N	7.713	251.2

(Jakowkin, *l. c.*)

Crystallizes at 4° with $10H_2O$.

Bromine chloride, BrCl.

Sol. in H_2O, CS_2, ether, etc.

Bromine fluoride, BrF_3.

Fumes in the air. Decomp. by H_2O. (Lebeau, C. R. 1905, **141.** 1019.)

Bromine oxides.

No oxides of bromine are known in the free state. *See* hypobromous, bromic, *and* perbromic acids.

Bromiridic acid.

Ammonium bromiridate, $(NH_4)_2IrBr_6$.

Less sol. in cold H_2O than the K salt. (Birnbaum, Zeit. Chem. **1865.** 22.)
Very sol. in cold H_2O. (Gutbier, B. 1909, **42.** 3910.)

Cæsium bromiridate, Cs_2IrBr_6.

Sol. in H_2O. (Gutbier, B. 1909, **42.** 3911.)

Potassium bromiridate, K_2IrBr_6.

Moderately sol. in cold, more easily in hot H_2O.
Insol. in alcohol or ether.
Sol. in cold H_2O and in HBr+Aq. (Gutbier, B. 1909, **42.** 3910.)

Rubidium bromiridate, Rb_2IrBr_6.

Very sol. in cold H_2O. Sol. in hot dil. HBr+Aq. (Gutbier, B. 1909, **42.** 3911.)

Sodium bromiridate.

Deliquescent. Easily sol. in H_2O, alcohol, or ether.

Bromiridous acid, $H_6Ir_2Br_{12}+6H_2O$.

Easily sol. in H_2O, alcohol, or ether. (Birnbaum, **1864.**)

Ammonium bromiridite, $(NH_4)_6Ir_2Br_{12}+H_2O$.
Difficultly sol. in H_2O. (Birnbaum.)

Potassium bromiridite, $K_6Ir_2Br_{12}+6H_2O$.
Efflorescent. Sol. in H_2O.

Silver bromiridite, $Ag_6Ir_2Br_{12}$.
Ppt. Insol. in H_2O or acids.

Sodium bromiridite, $Na_6Ir_2Br_{12}+24H_2O$.
Efflorescent. Very sol. in H_2O.

Bromocarbonatoplatin*di*amine carbonate, $^{CO_3}_{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2+4H_2O$.

Ppt.

Bromocarbonatoplatin*di*amine carbonate bromoplatin*di*amine nitrate,
$^{CO_3}_{Br_2}[Pt(N_2H_6)_2]_2(CO_3)_2$, $2Br_2Pt(N_2H_6)_2(NO_3)_2$.

Bromochloroplatin*di*amine chloride, $^{Br}_{Cl}Pt(N_2H_6)_2Cl_2$.

Very sl. sol. in H_2O. (Cleve.)

—— **chlorobromide,** $^{Br}_{Cl}Pt^{N_2H_6Cl}_{N_2H_6Br}$ (?).

Very sl. sol. in H_2O.

Bromochlororoplatinic acid.

Potassium bromochloroplatinate, K_2PtCl_5Br.
(Pitkin, J. Am. Chem. Soc. **2.** 408.)
Mixture. (Herty, J. Am. Chem. Soc. 1896, **18.** 130.)
$K_2PtCl_4Br_2$. Sl. sol. in cold H_2O; much more sol. in hot H_2O. (Pitkin.)
Mixture. (Herty.)
$K_2PtCl_3Br_3$. As above.
$K_2PtCl_2Br_4$. (Pigeon, A. ch. 1894, (7) **2.** 488.)
$K_2PtClBr_5$. (Pitkin.)

Bromochromic acid.

Potassium bromochromate, $KCrO_3Br_2 = CrO_2(Br)OK$.

Decomp. by H_2O. (Heintze, J. pr. (2) **4.** 225.)

***Di*bromochromium chloride,** $[Cr(H_2O)_4Br_2]Cl+2H_2O$.

Ppt. Nearly insol. in fuming HCl. (Bjerrum, B. 1907, **40.** 2918.)

Bromohydroxyloplatin*di*amine bromide, $\overset{OH}{Br}Pt(N_2H_6Br)_2$.

Very sl. sol. in H_2O. (Cleve.)

—— chloride, $\overset{OH}{Br}Pt(N_2H_6Cl)_2$.

Sol. in H_2O (Cleve.)

—— nitrate, $\overset{OH}{Br}Pt(N_2H_6NO_3)_2$.

Very sl. sol. in cold, moderately sol. in hot H_2O. (Cleve.)

Bromohydroxyloplatin*monodi*amine nitrate, $\overset{Br}{OH}Pt\overset{(NH_3)_2NO_3}{NH_3NO_3}+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromomercurosulphurous acid.

Ammonium bromomercurosulphite, NH_4SO_3HgBr.

Sol. in H_2O. (Barth, Z. phys. Ch. **9.** 215.)

Potassium bromomercurosulphite, KSO_3HgBr.

As above. (B.)

Bromomolybdenum bromide, $Br_4Mo_3Br_2$ = **molybdenum *di*bromide,** $MoBr_2$.

Insol. in H_2O or acids, or even in boiling aqua regia. Easily sol. in dilute, decomp. by conc. alkalies+Aq. (Blomstrand, J. pr. **82.** 436.)

Bromomolybdenum chloride, $Br_4Mo_3Cl_2+3H_2O$.

Insol. in acids. (Blomstrand.)

Bromomolybdenum chromate, $Br_4Mo_3CrO_4+2H_2O$.

Insol. in dil. acids. Sol. in hot conc. HCl +Aq. Insol. in alkali chromates+Aq. (Atterberg.)

Bromomolybdenum fluoride, $Br_4Mo_3F_2+3H_2O$.

Insol. in H_2O. (Atterberg.)

Bromomolybdenum hydroxide, $Br_4Mo_3(OH)_2$.

Completely sol. in alkalies if not heated over 90°. (Atterberg.)

$+2H_2O$.

$+8H_2O$.

Bromomolybdenum iodide hydroxide, $2Br_4Mo_3I_2$, $Br_4Mo_3(OH)_2+8H_2O$.

Precipitate. (Blomstrand, J. pr. **77.** 92.)

Bromomolybdenum molybdate, $Br_4Mo_3MoO_4$

Precipitate. (Atterberg.)

Bromomolybdenum phosphate, $Br_4Mo_3H_4(PO_4)_2$.

Precipitate. Insol. in H_2O. (Atterberg.)

Bromomolybdenum sulphate, $Br_4Mo_3SO_4+3H_2O$.

Precipitate. Sl. sol. in boiling H_2SO_4. (Atterberg.)

***Di*bromomolybdous acid,** $MoOBr_2(OH)+1\frac{1}{2}H_2O$.

Sol. in H_2O. Very hydroscopic. (Weinland, Z. anorg. 1905, **44.** 86.)

***Tetra*bromomolybdous acid,** $MoBr_4(OH)+2H_2O$.

Sol. in H_2O. Hydroscopic. (Weinland, *l. c.*)

***Di*ammonium *penta*bromomolybdite,** $MoBr_5O(NH_4)_2$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

***Di*cæsium *penta*bromomolybdite,** $MoBr_5OCs_2$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

Calcium *tetra*bromomolybdite, $(MoBr_4O)_2Ca+7H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*

***Mono*lithium *tetra*bromomolybdite,** $MoBr_4(OLi)+4H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland. *l. c.*)

Magnesium *penta*bromomolybdite, $MoBr_5(OMg)+7H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

***Mono*potassium *tetra*bromomolybdite,** $MoBr_4(OK)+2H_2O$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

***Di*potassium *penta*bromomolybdite,** $MoBr_5OK_2$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

***Di*rubidium *penta*bromomolybdite,** $MoBr_5ORb_2$.

Hydroscopic. Sol. in H_2O. (Weinland, *l. c.*)

Bromonitratoplatin*di*amine nitrate, $\overset{Br}{NO_3}Pt\overset{N_2H_6NO_3}{N_2H_6NO_3}$.

Decomp. by H_2O. (Cleve.)

—— sulphate, $\overset{Br}{NO_3}Pt(N_2H_6)_2SO_4+H_2O$.

Sl. sol. in H_2O.

Bromonitritoplatin*semidi*amine nitrite, $NO_2Br_2Pt(NH_3)_2NO_2$.
Sl. sol. in H_2O. (Blomstrand.)

Bromonitrous acid.

Platinum silver bromonitrite, $PtAg_2Br_2(NO_2)_4$.
Ppt. (Miolati, Gazz. ch. it. 1900, **30.** 588.)

Bromopalladic acid.

Ammonium bromopalladate, $(NH_4)_2PdBr_6$.
Difficultly sol. in cold H_2O. Decomp. by hot H_2O and by hot conc. H_2SO_4. (Gutbier, B. 1905, **38.** 1907.)

Cæsium bromopalladate, Cs_2PdBr_6.
Difficultly sol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Potassium bromopalladate, K_2PdBr_6.
Difficultly sol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Rubidium bromopalladate, Rb_2PdBr_6.
Insol. in cold H_2O. Decomp. by hot H_2O or by hot conc. H_2SO_4. (Gutbier, *l. c.*)

Bromopalladious acid.

Ammonium bromopalladite, $(NH_4)_2PdBr_4$.
Very stable. Sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 381.)
Very sol. in cold H_2O.
Can be cryst. from a very small amount of hot H_2O. (Gutbier, B. 1905, **38.** 2387.)

Barium bromopalladite.
Not deliquescent. Sol. in H_2O. (v. Bonsdorff.)

Cæsium bromopalladite, Cs_2PdBr_4.
Very sol. in H_2O. (Gutbier, B. 1905, **38.** 2388.)

Manganese bromopalladite, $MnPdBr_4$.
Sol. in H_2O and alcohol. (v. Bonsdorff.)
$+7H_2O$. Very sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 382.)

Potassium bromopalladite, K_2PdBr_4.
Easily sol. in H_2O. (Joannis, C. R. **95.** 295.)
Very stable. Sol. in H_2O. (Smith, Z. anorg. 1894, **6.** 381.)
$+2H_2O$. Unstable in the air. (Smith, *l. c.*)

Rubidium bromopalladite, Rb_2PdBr_4.
Can be cryst. from a very small amount of hot H_2O. (Gutbier, B. 1905, **38.** 2388.)

Sodium bromopalladite, $Na_2PdBr_4+4\frac{1}{2}H_2O$.
Very deliquescent. Sol. in H_2O. (Smith, *l. c.*)

Strontium bromopalladite, $SrPdBr_4+6H_2O$.
Stable in the air. Very sol. in H_2O. (Smith, *l. c.*)

Zinc bromopalladite.
Sol. in H_2O. (v. Bonsdorff.)

Bromophosphatoplatin*di*amine phosphate, $BrPt(N_2H_6)_2+2H_2O$.
$\diagdown\ \diagup$
PO_4
Sl. sol. in H_2O. (Cleve.)

Bromophosphoric acid.

Thorium bromophosphate, $ThBr_4, 3(3ThO_2, 2P_2O_5)$.
Insol. in most acids and in fused alkali carbonates. Decomp. by long boiling with conc. H_2SO_4. (Colani, C. R. 1909, **149.** 208.)

Bromoplatinamine bromide, $Br_2Pt(NH_3Br)_2$.
Sl. sol. in H_2O. (Cleve, Sv. V. A. H. **10, 9.** 31.)

—— **nitrite,** $Br_2Pt(NH_3NO_2)_2$.
Very sl. sol. in H_2O. (Cleve.)

Bromoplatin*di*amine bromide, $Br_2Pt(N_2H_6)_2Br_2$.
Only sl. sol. in hot H_2O. (Cleve.)

—— **chloride,** $Br_2Pt(N_2H_6)_2Cl_2$.
Very sl. sol. in H_2O. (Cleve.)

—— ***di*chromate,** $Br_2Pt(N_2H_6)_2Cr_2O_7$.
Sl. sol. in H_2O.

—— **nitrate,** $Br_2Pt(N_2H_6NO_3)_2$.
Sl. sol. in cold, rather easily sol. in hot H_2O. (Cleve.)

—— **phosphate,** $Br_2Pt[N_2H_6PO_2(OH)_2]_2+2H_2O$.
Rather easily sol. in hot H_2O. (Cleve.)

—— **sulphate,** $Br_2Pt(N_2H_6)_2SO_4$.
Very sl. sol. in H_2O.

Bromoplatin*monodi*amine nitrate, $Br_2Pt\begin{matrix}(NH_3)_2NO_3\\ NH_3NO_3\end{matrix}+H_2O$.
Easily sol. in H_2O.

—— **sulphate,** $Br_2Pt\begin{matrix}(NH_3)_2\\ NH_3\end{matrix}SO_4+H_2O$.
Moderately sol. in H_2O. (Cleve.)

Bromoplatin*semidi*amine bromide, $Br_3Pt(NH_3)_2Br$.
Sl. sol. in cold H_2O. (Cleve.)

Bromo*di*platin*di*amine anhydronitrate, $Br_2Pt_2\begin{matrix}(N_2H_6)_2(NO_3)_2.\\ (NH_3NH_2)_2\end{matrix}$
Sol. in HNO_3+Aq.

Bromo*di*platin*di*amine chloride, $Br_2Pt_2(N_2H_6)_4Cl_4$.
Ppt. (Cleve.)

—— **nitrate,** $Br_2Pt_2(N_2H_6)_4(NO_3)_4+2H_2O$.
Moderately sol. in hot H_2O.

—— **sulphate,** $Br_2Pt_2(N_2H_6)_4(SO_4)_2+2H_2O$.
Ppt. (Cleve.)

Bromoplatinic acid, $H_2PtBr_6+9H_2O$.

Very deliquescent, and sol. in H_2O, alcohol, ether, chloroform, or acetic acid. (Topsoë, J. B. **1868.** 273.)

Ammonium bromoplatinate, $(NH_4)_2PtBr_6$.
Sol. in 200 pts. H_2O at 15°. (Topsoë.)
100 pts. $(NH_4)_2PtBr_6$+Aq sat. at 20° contain 0.59 pt. dry salt. (Halberstadt, B. **17.** 2965.)

Barium bromoplatinate, $BaPtBr_6+10H_2O$.
Sl. deliquescent. Very sol. in H_2O.

Cæsium bromoplatinate, Cs_2PtBr_6.
Sl. sol. in dil. HBr+Aq. (Obermaier, Dissert.)

Calcium bromoplatinate, $CaPtBr_6+12H_2O$.
Sl. deliquescent. Very sol. in H_2O.

Cobalt bromoplatinate, $CoPtBr_6+12H_2O$.
Deliquescent.

Copper bromoplatinate, $CuPtBr_6+8H_2O$.
Very deliquescent; sol. in H_2O.

Lead bromoplatinate, $PbPtBr_6$.
Easily sol. in H_2O, but decomp. by large amount.

Lead *tetra*bromoplatinate, $[PtBr_4(OH)_2]Pb$, PbOH.
Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Magnesium bromoplatinate, $MgPtBr_6+12H_2O$.
Not deliquescent.

Manganese bromoplatinate, $MnPtBr_6+6H_2O$.
Sol. in H_2O.
$+12H_2O$. Sol. in H_2O.

Mercuric *tetra*bromoplatinate, $[PtBr_4(OH)_2]Hg$
Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Nickel bromoplatinate, $NiPtBr_6+12H_2O$.
Deliquescent.

Potassium bromoplatinate, K_2PtBr_6.
Sl. sol. in H_2O. Insol. in alcohol. (v. Bonsdorff, Pogg. **19.** 344.)
Sol. in 10 pts. boiling H_2O. (Pitkin, C. N. **41.** 218.)
100 pts. K_2PtBr_6+Aq sat. at 20° contain 2.02 pts. dry salt. (Halberstadt, B. **17.** 2962.)

Praseodymium bromoplatinate, $PrBr_3,PtBr_4+10H_2O$.
Deliquescent; very sol. in H_2O; sol. in HBr. (Von Schule, Z. anorg. 1898, **18.** 353.)

Rubidium bromoplatinate, Rb_2PtBr_6.
Sl. sol. in dil. HBr+Aq. (Obermaier. Dissert.)

Silver bromoplatinate, Ag_2PtBr_6.
Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Silver *tetra*bromoplatinate, $[PtBr_4(OH)_2]Ag_2$.
Ppt.; insol. in H_2O. (Miolati, *l. c.*)

Sodium bromoplatinate, $Na_2PtBr_6+6H_2O$.
Easily sol. in H_2O and alcohol.

Strontium bromoplatinate, $SrPtBr_6+10H_2O$.
Sl. deliquescent. Very sol. in H_2O.

Thallium *tetra*bromoplatinate, $[PtBr_6(OH)_2]Tl_2$.
Insol. in H_2O. (Miolati, C. C. **1900,** II. 810.)

Ytterbium bromoplatinate, $YbBr_3.3H_2PtBr_6+30H_2O$.
Ppt. (Cleve, Z. anorg. 1902, **32.** 138.)

Zinc bromoplatinate, $ZnPtBr_6+12H_2O$.
Sol. in H_2O.

Bromoplatinocyanhydric acid, $H_2Pt(CN)_4Br_2$.

See **Perbromoplatinocyanhydric acid.**

Potassium bromoplatinocyanide, $5K_2Pt(CN)_4$, $K_2Pt(CN)_4Br_2+18H_2O$.
Sol. in H_2O.

Bromoplatinous acid.

Potassium bromoplatinite, $K_2PtBr_4+2H_2O$.
Extremely sol. in H_2O. (Billmann and Andersen, B. 1903, **36.** 1566.)

Bromopurpureochromium bromide, $BrCr(NH_3)_5Br_2$.

Less sol. in H_2O than chloropurpureochromium chloride. (Jörgensen, J. pr. (2) **25.** 83.)

—— **bromoplatinate,** $BrCr(NH_3)_5PtBr_6$.
(Jörgensen, *l. c.*)

—— **chloride,** $BrCr(NH_3)_5Cl_2$.
More sol. in H_2O than the bromide. (Jörgensen, *l. c.*)

Bromopurpureochromium chromate, $BrCr(NH_3)_5CrO_4$.

Precipitate. (Jörgensen, *l. c.*)

—— **nitrate,** $BrCr(NH_3)_5(NO_3)_2$.

More sol. than bromide and less than chloride. (Jörgensen, *l. c.*)

Bromopurpureocobaltic bromide, $CoBr(NH_3)_5Br_2$.

Sol. in 530 pts. H_2O at 16°. Insol. in alcohol, NH_4Br, KBr, or HBr+Aq. More sol. in hot H_2O containing a little HBr. (Jörgensen, J. pr. (2) **19.** 49.)

Bromopurpureocobaltic mercuric bromide, $CoBr(NH_3)_5Br_2$, $3HgBr_2$.

More sol. in H_2O than the corresponding $HgCl_2$ salt. (J.)

—— **bromoplatinate.**

Very sl. sol. in cold H_2O. (J.)

—— **chloride,** $CoBr(NH_3)_5Cl_2$.

Difficultly sol. in cold H_2O, but much more easily than the bromide. Insol. in dil. HCl+Aq, and in alcohol.

—— **mercuric chloride,** $CoBr(NH_3)_5Cl_2$, $3HgCl_2$.

Sl. sol. in H_2O.

—— **chloroplatinate.**

Nearly or quite insol. in H_2O. (J.)

—— **chromate,** $CoBr(NH_3)_5CrO_4$.

Nearly insol. in H_2O.

—— **dithionate,** $CoBr(NH_3)_5S_2O_6$.

Nearly insol. in H_2O.

—— **fluosilicate,** $CoBr(NH_3)_5SiF_6$.

Very sl. sol. in cold H_2O; insol. in alcohol.

—— **nitrate,** $CoBr(NH_3)_5(NO_3)_2$.

More sol. in H_2O than the bromide, but less than the chloride. Wholly insol. in dil. HNO_3+Aq or alcohol.

—— **oxalate,** $CoBr(NH_3)_5C_2O_4$.

Nearly insol. in H_2O.

—— **sulphate,** $CoBr(NH_3)_5SO_4$.

Can be crystallized from very dil. H_2SO_4+Aq. Insol. in alcohol.
+$6H_2O$. Efflorescent.

Bromopurpureorhodium bromide, $BrRh(NH_3)_5Br_2$.

Much less easily sol. in H_2O than the chlorochloride. Insol. in dil. HBr+Aq and alcohol. (Jörgensen, J. pr. (2) **27.** 433.)

—— **bromoplatinate,** $BrRh(NH_3)_5PtBr_6$.

Almost insol. in H_2O.

—— **fluosilicate,** $BrRh(NH_3)_5SiF_6$.

Sl. sol. in H_2O. Sol. in boiling NaOH+Aq as roseo salt.

Bromopurpureorhodium nitrate, $BrRh(NH_3)_5(NO_3)_2$.

Sl. sol. in H_2O, but much more sol. than the bromide.

Bromorhodous acid.

Ammonium bromorhodite, $(NH_4)_2RhBr_5$.

Sol. in H_2O. (Goloubkine, Chem. Soc. 1911, **100** (2) 45.)
Sol. in H_2O. (Gutbier, B. 1908, **41.** 215.)

Barium bromorhodite, $BaRhBr_5$.

Sol. in H_2O. (Goloubkine, *l. c.*)

Cæsium bromorhodite, Cs_2RhBr_5.

Difficultly sol. in H_2O. (Gutbier, *l. c.*)

Potassium bromorhodite, K_2RhBr_5.

Very sol. in H_2O. (Goloubkine, *l. c.*)
Sol. in H_2O. (Gutbier, *l. c.*)

Rubidium bromorhodite, Rb_2RhBr_5.

Sol. in H_2O. (Goloubkine, *l. c.*)
Difficultly sol. in H_2O. (Gutbier, *l. c.*)

Sodium bromorhodite, Na_2RhBr_5.

Very sol. in H_2O. (Goloubkine, *l. c.*)

Bromoruthenic acid.

Potassium bromoruthenate, K_2RuBr_6.

Very sol. in H_2O. (Howe, J. Am. Chem. Soc. 1904, **26.** 946.)

Potassium ***aquo*****bromoruthenate,** $K_2Ru(H_2O)Br_5$.

Ppt. (Howe, *l. c.*)

Rubidium bromoruthenate, Rb_2RuBr_6.

Sol. in H_2O. (Howe, *l. c.*)

Rubidium ***aquo*****bromoruthenate,** $Rb_2Ru(H_2O)Br_5$.

Ppt. (Howe, *l. c.*)

Bromoruthenious acid.

Cæsium bromoruthenite, $CsRuBr_5+H_2O$.

Ppt. (Howe, J. Am. Chem. Soc. 1904, **26.** 945.)

Potassium bromoruthenite, K_2RuBr_5.

Very sol. in H_2O with decomp. Very sol. in dil. HBr. (Howe, *l. c.*)

Rubidium bromoruthenite, $Rb_2RuBr_5+H_2O$.

Sol. in dil. HBr. (Howe, *l. c.*)

Bromoselenic acid.

Ammonium bromoselenate, $(NH_4)_2SeBr_6$.

Sol. in H_2O with decomp. (Muthmann and Schäfer, B. **26.** 1008.)

Cæsium bromoselenate, Cs_2SeBr_6.

Sl. sol. in H_2O. (Lenher, J. Am. Chem. Soc. 1898, **20.** 571.)

Potassium bromoselenate, K_2SeBr_6.

As NH_4 salt. (M. and S.)

Rubidium bromoselenate, Rb_2SeBr_6.
Less sol. in H_2O than K salt. (Lenher, *l. c.*)

Bromo*pyro*selenious acid.

Ammonium bromo*pyro*selenite, $NH_4Br, 2SeO_2 + 2H_2O$.
More easily sol. in H_2O than corresponding Cl compound. (Muthmann and Schäfer, B. 1893, **26.** 1014.)

Potassium bromo*pyro*selenite, $KBr, 2SeO_2 + 2H_2O$.
Sol. in H_2O. (Muthmann and Schäfer, B. **26.** 1008.)

Bromosmic acid.

Ammonium bromosmate, $(NH_4)_2OsBr_6$.
Only sl. sol. in H_2O. (Rosenheim, Z. anorg. 1899, **21.** 135.)

Cæsium bromosmate, Cs_2OsBr_6.
Nearly insol. in H_2O and dil. HBr. (Gutbier, B. 1913, **46.** 2103.)

Potassium bromosmate, K_2OsBr_6.
Only sl. sol. in H_2O. (Rosenheim, *l. c.*)

Rubidium bromosmate, Rb_2OsBr_6.
Difficultly sol. in H_2O and in dil. HBr. (Gutbier, *l. c.*)

Silver bromosmate, Ag_2OsBr_6.
Ppt., insol. in H_2O. (Rosenheim, *l. c.*)

Sodium bromosmate, $Na_2OsBr_6 + 4H_2O$.
Sol. in H_2O. (Rosenheim, *l. c.*)

Bromostannic acid, $H_2SnBr_6 + 8H_2O$.

Very deliquescent. Sol. in H_2O. (Seubert, B. **20.** 794.)

Ammonium bromostannate, $(NH_4)_2SnBr_6$.
Very deliquescent, and sol. in H_2O. (Raymann and Preis, A. **223.** 323.)

Cæsium bromostannate.
Sol. in H_2O. (Raymann and Preis.)

Calcium bromostannate, $CaSnBr_6 + 6H_2O$.
Very deliquescent. Sol. in H_2O. (Raymann and Preis.)

Cobalt bromostannate, $CoSnBr_6 + 10H_2O$.
Deliquescent. (Raymann and Preis.)

Ferrous bromostannate, $FeSnBr_6 + 6H_2O$.
Deliquescent. (Raymann and Preis.)

Lithium bromostannate, $Li_2SnBr_6 + 6H_2O$.
Extremely deliquescent. (Leteur, C. R. **113.** 541.)

Magnesium bromostannate, $MgSnBr_6 + 10H_2O$.
Deliquescent. (Raymann and Preis.)

Manganous bromostannate, $MnSnBr_6 + 6H_2O$.
Deliquescent. (Raymann and Preis.)

Nickel bromostannate $NiSnBr_6 + 8H_2O$.
Deliquescent. (Raymann and Preis.)

Potassium bromostannate, K_2SnBr_6.
Sol. in H_2O (Topsøë.)

Rubidium bromostannate.
Sol. in H_2O. (Raymann and Preis.)

Sodium bromostannate, $Na_2SnBr_6 + 6H_2O$.
Not deliquescent, but extremely sol. in H_2O. (Seubert, B. **20.** 796.)

Strontium bromostannate, $SrSnBr_6 + 6H_2O$.
Very hydroscopic, and sol. in H_2O. (Raymann and Preis.)

Bromosulphatoplatin*di*amine sulphate,

$$\begin{matrix}Br > Pt(N_2H_6)_2SO_4 \\ SO_4 \\ Br > Pt(N_2H_6)_2SO_4\end{matrix} + H_2O.$$

Rather easily sol. in hot H_2O.

Bromosulphobismuthous acid.

Cuprous bromosulphobismuthite, $2Cu_2S, Bi_2S_3, 2BiSBr$.
Stable in the air and insol. in H_2O at ord. temp. Partially decomp. by boiling H_2O. Decomp. by mineral acids with the evolution of H_2S. (Ducatte, C. R. 1902, **134.** 1212.)

Lead bromosulphobismuthite, $PbS, Bi_2S_3, 2BiSBr$.
Insol. in H_2O. Decomp. by boiling H_2O. Decomp. by dil. mineral acids with evolution of H_2S. (Ducatte, *l. c.*)

Bromotantalum bromide, $(Ta_6Br_{12})Br_2 + 7H_2O$.

Stable in the air when in the solid state. Sol. in H_2O without decomp. Sol. in propyl alcohol. (Chapin, J. Am. Chem. Soc. 1910, **32.** 328.)

Bromotantalum chloride, $(Ta_6Br_{12})Cl_2 + 7H_2O$.
(Chapin, *l. c.*)

Bromotantalum hydroxide, $(Ta_6Br_{12})(OH)_2 + 10H_2O$.
Sl. sol. in HCl. Stable in the air below 100°.
Sol. in alcohol. Insol. in ether. (Chapin, *l. c.*)

Bromotantalum iodide, $(Ta_6Br_{12})I_2 + 7H_2O$.
(Chapin, *l. c.*)

Bromotelluric acid.

Ammonium bromotellurate, $(NH_4)_2TeBr_6$.
Less sol. in H_2O than K salt. (Muthmann and Schmidt, B. 1893, **26.** 1011.)

Cæsium bromotellurate, Cs_2TeBr_6.

Decomp. by H_2O.

100 pts. HBr+Aq (sp. gr. 1.49) dissolve 0.02 pt. at 22°.

100 pts. HBr+Aq (sp. gr. 1.08) dissolve 0.13 pt. at 22°.

Insol. in alcohol. (Wheeler, Sill. Am. J. **145.** 267.)

Potassium bromotellurate, $K_2TeBr_6+3H_2O$.

Sol. in little, decomp. by much H_2O. (v. Hauer.)

Contains $2H_2O$. (Wheeler, Sill. Am. J. **145.** 267.)

Efflorescent.

100 pts. HBr+Aq (sp. gr. 1.49) dissolve 6.57 pts. at 22°.

100 pts. HBr+Aq (sp. gr. 1.08) dissolve 62.90 pts. at 22°.

Anhydrous. Stable on air. (Wheeler.)

Rubidium bromotellurate, Rb_2TeBr_6.

Sol. in a little hot H_2O, but H_2TeO_3 separates on cooling.

100 pts. HBr+Aq (sp. gr. 1.49) dissolve 0.25 pt. at 22°.

100 pts. HBr+Aq (sp. gr. 1.08) dissolve 3.88 pts. at 22°. (Wheeler.)

Bromotetramine chromium bromide, $CrBr(NH_3)_4Br_2+H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **chloride,** $CrBr(NH_3)_4Cl_2+H_2O$.

Sol. in H_2O. (Cleve.)

—— **sulphate,** $CrBr(NH_3)_4SO_4+H_2O$.

Easily sol. in H_2O. (Cleve.)

Bromotetramine cobaltic sulphate, $BrCo(NH_3)_4SO_4$, or $Br_2Co_2(NH_3)_8(SO_4)_2$.

Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2652.)

Cadmium, Cd.

Not attacked by H_2O. Sol. in HCl, or dil. H_2SO_4+Aq, but more easily in HNO_3+Aq. Sol. in $HC_2H_3O_2$+Aq.

Chemically pure Cd like Zn is almost insol. in dil. acids, with the exception of HNO_3. (Weeren, B. 1891, **24.** 1798.)

Sol. in $HClO_3$+Aq without evolution of H. (Hendrixson, J. Am. Chem. Soc. 1904, **26.** 756.)

Cadmium is sol. in molten $CdCl_2$ and can be recryst. therefrom. (Auerbach, Z. anorg. 1901, **28.** 42.)

From 4 g. Cd in 32 g. molten $CdCl_2$ at 650°, 2.197 g. were dissolved in ½ hr. (Helfenstein, Z. anorg. 1900, **23.** 295.)

Moderately quickly sol. in $K_2S_2O_8$+Aq. More slowly sol. in $(NH_4)_2S_2O_8$+Aq. (Levi, Gazz. ch. it. 1908, **38** (1) 583.)

Sol. in $(NH_3)_2S_2O_8$+Aq without evolution of gas. (Turrentine, J. phys. Chem. 1907, **11.** 627.)

Sol. in sulphostannates+Aq. (Storch, B. 1883, **16.** 2015.)

½ ccm. oleic acid dissolves 0.0293 g. Cd in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Not attacked by sugar solution. (Klein and Berg, C. R. **102.** 1170.)

Cadmium amalgam, Cd_2Hg_7.

Stable from 0°–44°. Can be cryst. from Hg without decomp. if temp. does not exceed 44°. (Kerp. Z. anorg. 1900, **25.** 68.)

Cadmium amide, $Cd(NH_2)_2$.

Decomp. by H_2O. (Bohart, J. phys. Chem. 1915, **19.** 543.)

Cadmium arsenide, Cd_3As.

(Descamps, C. R. **86.** 1022.)

Cd_3As_2. Sol. in dil. cold HNO_3. Attacked by aqua regia. (Granger, C. R. 1904, **138.** 575.)

Cadmium azoimide, $Cd(N_3)_2$.

Ppt. (Curtius, J. pr. 1898, (2) **58.** 294.)

Cadmium ***sub*****bromide,** Cd_4Br_7.

Decomp. by H_2O. (Morse and Jones, Am. Ch. J. 1890, **12.** 490.)

Cadmium bromide, $CdBr_2$.

Deliquescent. Very sol. in H_2O.

Solubility in H_2O at t°

t°	% $CdBr_2$	t°	% $CdBr_2$
—4	32.0	48	60.0
—1	34.7	71	61.2
+1	36.3	104	61.8
2	36.0	155	63.7
9	41.9	170	65.2
14	46.0	215	69.9
25	52.6	232	70.1
35	59.6	245	71.5

Solid phase above 100° is $CdBr_2+1\frac{1}{2}H_2O$. (Étard, A. ch. 1894, (7) **2.** 541.)

See also under $CdBr_2+H_2O$ and $CdBr_2+4H_2O$.

Sp. gr. of $CdBr_2$+Aq at 19.5° containing:

5	10	15	20	25 % $CdBr_2$,
1.043	1.090	1.141	1.199	1.260
30	35	40	45	50 % $CdBr_2$.
1.326	1.400	1.481	1.578	1.680

(Kremers, calculated by Gerlach, Z. anal. **8.** 280.)

$CdBr_2$+Aq containing 18.06% $CdBr_2$ has sp. gr. 20°/20° = 1.1378.

$CdBr_2$+Aq containing 21.39% $CdBr_2$ has sp. gr. 20°/20° = 1.1666.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of $CdBr_2$+Aq containing 35.84% $CdBr_2$ = 1.4231 at 19.4°/4°. (Hallwachs, W. Ann. 1899, **68.** 27.)

Sp. gr. of $CdBr_2$+Aq at 18°/4°.

% $CdBr_2$	33.289	23.973	20.552	11.983
Sp. gr.	1.384	1.252	1.209	1.112
% $CdBr_2$	6.543	3.734	1.927	
Sp. gr.	1.106	1.030	1.017	

(de Muynck, W. Ann. 1894, **53**. 561.)

Sp. gr. of $CdBr_2$+Aq at 18°.

% $CdBr_2$	1	5	10	15	20
Sp. gr.	1.0072	1.0431	1.0907	1.1432	1.1991
% $CdBr_2$	25	30	35	40	43
Sp. gr.	1.2605	1.3296	1.4052	1.4915	1.5467

(Grotrian, W. Ann. 1883, **18**. 193.)

Sp. gr. of $CdBr_2$+Aq.

% $CdBr_2$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0324	17.90	0.99901	0.99900
	22.75	0.99702	
0.0748	17.23	0.99949	0.99935
	21.50	0.99863	
0.154	17.67	1.00008	1.00002
	23.10	0.99896	
0.253	17.23	1.00119	0.00100
	22.95	0.99986	
0.506	18.07	0.00308	1.00310
	22.65	1.00212	
1.013	18.00		1.00750

(Wershofen, Z. phys. Ch. 1890, **5**. 493.)

Sp. gr. of $CdBr_2$+Aq at 20°.

Normality of $CdBr_2$+Aq	% $CdBr_2$	Sp. gr.
2.774	46.574	1.6198
1.997	37.53	1.4469
0.973	22.53	1.2293
0.5138	12.46	1.1211

(Forchheimer, Z. phys. Ch. 1900, **34**. 29.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20**. 827.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84**, 27.)

Sol. in HCl+Aq, $HC_2H_3O_2$, alcohol, or ether. (Berthemot, A. ch. **44**. 387.)

Sol. in 0.94 pt. H_2O, 3.4 pts. abs. alcohol, 250 pts. ether, and 16 pts. alcohol-ether (1 : 1) (Eder, Dingl. **221**. 89.)

Anhydrous $CdBr_2$ is sol. in acetone. (Krug and M'Elroy.)

1 g. $CdBr_2$ is sol. in 64.5 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.8073. (Naumann, B. 1904, **37**. 4337.)

Sol. in acetone. (Eidmann, C. C. **1899**, II. 1014.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, **9**, 647.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)

Sol. in chinoline. (Beckmann and Gabel, Z. anorg. 1906, **51**. 236.)

100 g. benzonitrile dissolve 0.857 g. $CdBr_2$ at 18°. (Naumann, B. 1914, **47**. 1370.)

Mol. weight determined in piperidine. (Ferchland, Z. anorg. 1897, **15**, 17.)

$+H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

35°	40°	45°	60°	80°	100°	
60.29	60.65	60.75	61.10	61.29	61.63	g. $CdBr_2$.

(Dietz, Z. anorg. 1899, **20**. 261.)

$+1\frac{1}{2}H_2O$. (Étard, A. ch. 1894, (7) **2**. 541.)

$+4H_2O$. Efflorescent. (Rammelsberg, Pogg. **55**. 241.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	18°	30°	38°	
37.92	48.90	56.90	61.84	g. $CdBr_2$.

Sp. gr. of sat. solution at 18° = 1.683.

(Dietz, Z. anorg. 1899, **20**. 261.)

100 g. sat. solution of $CdBr_2+4H_2O$ in absolute alcohol contain 20.93 g. $CdBr_2$ at 15°.

100 g. sat. solution of $CdBr_2+4H_2O$ in absolute ether contain 0.4 g. $CdBr_2$ at 15°. (Eder, Dingl. **221**. 89.)

Cadmium hydrogen bromide.

Decomp. by H_2O. (Berthelot, C. R. **91**. 1024.)

Cadmium cæsium bromide, $CdBr_2$, CsBr.

Easily sol. in H_2O. (Wells and Walden, Z. anorg. **5**. 270.)

$CdBr_2$, 2CsBr. Decomp. by H_2O into above comp. (W. and W.)

$CdBr_2$,3CsBr. Decomp. by H_2O into $CdBr_2$, CsBr. (W. and W.)

Cadmium potassium bromide, $CdBr_2$, KBr+$\frac{1}{2}H_2O$.

Sol. in 0.79 pt. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221**. 89.)

$+H_2O$. Sol. in H_2O without decomp. from 0.4°–112.5°. (Rimbach, B. 1905, **38**, 1554.)

100 pts. of the solution contain at:

0.4°	15.8°	50°	112.5°	
53.75	58.68	68.25	78.10	pts. of the salt.

$CdBr_2$, 4KBr. Sol. in 1.40 pts. H_2O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221**. 89.)

Cannot be prepared in a pure state as it is decomp. by H_2O below 160°. (Rimbach, B. 1905, **38**. 1560.)

Cadmium rubidium bromide, $CdBr_2$, RbBr.

Sol. in H_2O without decomp. from 0.4° to 107.5°.

100 pts. of the solution contain at:

0.4°	14.5°	49.2°	107.5°	
32.65	41.87	58.54	75.77	pts. of the salt.

(Rimbach, B. 1905, **38**. 1556.)

$CdBr_2$, 4RbBr. Sol. in H_2O without decomp. from 0.5° to 114.5°.

100 pts. of the solution contain at:

0.5°	13.5°	51.5°	114.5°	
47.95	55.17	68.82	79.04	pts. of the salt.

(Rimbach, B. 1905, **38**. 1561.)

Cadmium sodium bromide, $CdBr_2$, $NaBr+2\frac{1}{2}H_2O$.

Sol. at 15° in 1.04 pts. H_2O, 3.7 pts. abs. alcohol, and 190 pts. ether (sp. gr. 0.729). (Eder, Dingl. **221.** 89.)

$3CdBr_2$, $2NaBr+6H_2O$. Stable in conc. solutions and decomp. only by great dilution. (Jones and Knight, Am. Ch. J. 1899, **22.** 134.)

Cadmium bromide ammonia, $CdBr_2$, $2NH_3$.

Can be crystallized out of warm NH_4OH+Aq. (Croft, Phil. Mag. **21.** 356.)

$CdBr_2$, $3NH_3$. (Tassily, C. R. 1897, **124.** 1022.)

$CdBr_2$, $4NH_3$. Decomp. by H_2O. (Croft.)

Cadmium bromide cupric oxide, $CdBr_2$, $3CuO+3H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 383.)

Cadmium bromide hydrazine, $CdBr_2$, $2N_2H_4$.

Easily sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 280.)

Cadmium bromide hydroxylamine, $CdBr_2$, $2NH_2OH$.

Sol. in hot H_2O with formation of a basic salt. Sol. in dil. acids. Insol. in alcohol and ether. (Adams, Am. Ch. J. 1902, **28.** 218.)

Cadmium *sub*chloride, Cd_4Cl_7.

Decomp. by H_2O and by acids. (Morse and Jones, Am. Ch. J. 1890, **12.** 490.)

Cadmium chloride, $CdCl_2$.

Sol. at	20°	40°	60°	80°	100°
in	0.71	0.72	0.72	0.70	0.67 pts. H_2O.

(Kremers. Pogg. **103.** 57.)

Sat. $CdCl_2+Aq$ contains % $CdCl_2$ at t°.

t°	% $CdCl_2$	t°	% $CdCl_2$
—7	43.5	120	63.0
+1	47.6	150	64.8
6	49.7	165	68.2
7	51.3	170	68.4
10	51.6	180	70.1
19	52.7	190	71.9
25	52.9	200	72.0
61	57.9	235	76.0
82	58.8	270	77.7

(Étard, A. ch. 1894, (7) **2.** 536.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
10.94	12.74	13.15	13.16 mol. $CdCl_2$.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 19.)

See also under $CdCl_2+H_2O$, $CdCl_2+2\frac{1}{2}H_2O$, and $CdCl_2+4H_2O$.

Sp. gr. of $CdCl_2+Aq$ containing pts. $CdCl_2$ to 100 pts. H_2O.

13	26.9	41 pts. $CdCl_2$,
1.1068	1.2106	1.3100
55.8	72.5	114.2 pts. $CdCl_2$.
1.4060	1.5060	1.7266

(Kremers, Pogg. **103.** 57.)

$CdCl_2+Aq$ containing 8.91% $CdCl_2$ has sp. gr. 20°/20° = 1.0715. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of $CdCl_2+Aq$ at room temp. containing:

% $CdCl_2$	11.09	16.30	24.786
Sp. gr.	1.1093	1.1813	1.3199

(Wagner, W. Ann. 1883, **18.** 266.)

Sp. gr. of $CdCl_2+Aq$ at 18°/4°.

% $CdCl_2$	57.524	41.547	29.977
Sp. gr.	1.852	1.515	1.330
% $CdCl_2$	21.431	14.761	
Sp. gr.	1.210	1.142	

(de Muynck, W. Ann. 1894, **53.** 561.)

Sp. gr. of $CdCl_2+Aq$ at 18°.

% $CdCl_2$	1	5	10	15
Sp. gr.	1.0063	1.0436	1.0919	1.1443
% $CdCl_2$	20	25	30	35
Sp. gr.	1.2007	1.2620	1.3305	1.4075
% $CdCl_2$	40	45	50	
Sp. gr.	1.4878	1.5775	1.6799	

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of $CdCl_2+Aq$ at 25°.

Concentration of $CdCl_2+Aq$	Sp. gr.
1-normal	1.0779
1/2- "	1.0394
1/4- "	1.0197
1/8- "	1.0098

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. of $CdCl_2+Aq$.

% $CdCl_2$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0503	17.59	0.99920	0.99910
	24.27	0.99781	
0.0999	17.70	0.99964	0.99958
	22.06	0.99833	
0.200	18.31	1.00038	1.00044
	24.00	0.99920	
0.399	16.86	1.00239	1.0022
	24.21	1.00083	
0.599	17.49	1.00406	1.0039
	25.12	1.00238	
0.769	17.58	1.00580	1.0057
	21.76	1.00496	
0.997	17.55	1.00754	1.0075
	19.65	1.00713	

(Wershofen, Z. phys. Ch. 1890, **5.** 492.)

Sp. gr. of $CdCl_2+Aq$ at t°.

t°	Normality of $CdCl_2+Aq$	g. $CdCl_2$ in 100 g. of solution	Sp. gr. t°/4°
20.5	3.80	44.42	1.5645
"	2.61	34.22	1.3941
"	1.76	25.90	1.2435
"	1.29	19.91	1.1977
"	0.93	14.88	1.1404
"	0.52	8.84	1.0801

(Oppenheimer, Z. phys. Ch. 1898, **27.** 454.)

Sp. gr. of $CdCl_2$+Aq at t°.

t°	Concentration of $CdCl_2$+Aq	Sp. gr.
22	1 pt. $CdCl_2$ in 1.3458 pts. H_2O	1.6128
18.7	1 " " " 2.7005 " "	1.2896
17.2	1 " " " 53.988 " "	1.0155
16	1 " " " 54.18 " "	1.0152
17	1 " " " 57.479 " "	1.0136
22	1 " " " 77.232 " "	1.0076

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Solubility in KCl+Aq at t°.

t°	100 g. H_2O dissolve g. $CdCl_2$	g. KCl	Solid phase
19.3	111.30	...	$CdCl_2+2\frac{1}{2}H_2O$
	59.59	6.70	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2, KCl+H_2O$
	26.98	11.09	$CdCl_2, KCl+H_2O$
	11.61	30.04	$CdCl_2, KCl+H_2O+CdCl_2, 4KCl$
	1.44	34.76	$CdCl_2, 4KCl+KCl$
	.	33.94	KCl
29.7	129.65		$CdCl_2+3\frac{1}{2}H_2O$
	97.62	0.70	$CdCl_2+2\frac{1}{2}H_2O$
	68.23	7.08	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2, KCl+H_2O$
	47.12	9.89	$CdCl_2, KCl+H_2O$
	32.67	13.06	"
	24.26	16.10	"
	15.99	25.97	"
	15.47	33.58	$CdCl_2, KCl+H_2O+CdCl_2, 4KCl$
	2.42	37.66	$CdCl_2, 4KCl+KCl$
	. .	37.21	KCl
40.1	133.85	...	$CdCl_2+H_2O$
	92.15	2.70	$CdCl_2+H_2O+CdCl_2, KCl+H_2O$
	51.90	11.50	$CdCl_2, KCl+H_2O$
	37.91	15.21	"
	24.45	21.73	"
	18.97	35.51	"
	19.92	37.63	$CdCl_2, KCl+H_2O+CdCl_2, 4KCl$
	2.98	40.45	$CdCl_2, 4KCl+KCl$
	....	40.36	KCl
54.5	133.90	...	$CdCl_2+H_2O$
	102.15	2.32	$CdCl_2+H_2O+CdCl_2, KCl+H_2O$
	44.01	18.39	$CdCl_2, KCl+H_2O$
	26.13	43.78	$CdCl_2, KCl+H_2O+CdCl_2, 4KCl$
	4.20	45.52	$CdCl_2, 4KCl+KCl$
	....	43.00	KCl

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 34.)

Solubility in NaCl+Aq at t°.

t°	100 g. H_2O dissolve g. $CdCl_2$	g. NaCl	Solid phase
19.3	111.30	...	$CdCl_2+2\frac{1}{2}H_2O$
	116.64	7.52	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2, 2NaCl+3H_2O$
	85.15	12.19	$CdCl_2, 2NaCl+3H_2O$
	40.01	25.67	"
	5.96	36.76	$CdCl_2, 2NaCl+3H_2O+NaCl$
	....	35.84	NaCl
29.7	129.65	. .	$CdCl_2+2\frac{1}{2}H_2O$
	132.67	9.63	$CdCl_2+2\frac{1}{2}H_2O+CdCl_2, 2NaCl+3H_2O$
	123.54	10.10	$CdCl_2, 2NaCl+3H_2O$
	106.16	12.92	"
	91.10	15.41	"
	43.74	27.46	"
	9.43	37.54	$CdCl_2, 2NaCl+3H_2O+NaCl$
	. . .	35.88	NaCl
40.1	133.85	. .	$CdCl_2+H_2O$
		15.14	$CdCl_2+H_2O+CdCl_2, 2NaCl+3H_2O$
	137.03		
	48.17	29.50	$CdCl_2, 2NaCl+3H_2O$
	13.31	38.16	$CdCl_2, 2NaCl+3H_2O+NaCl$
	. . .	36.18	NaCl
54.5	133.90	. .	$CdCl_2+H_2O$
	140.42	19.10	$CdCl_2+H_2O+CdCl_2, 2NaCl+3H_2O$
	52.76	32.97	$CdCl_2, 2NaCl+3H_2O$
	22.53	39.07	$CdCl_2, 2NaCl+3H_2O+NaCl$
	....	36.82	NaCl

At 34.5°, $CdCl_2+2\frac{1}{2}H_2O \rightarrow CdCl_2+H_2O$ and water.
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 28.)

Insol. in $SbCl_3$. (Klemensiewicz, C. A. **1909**, 269.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. or sl. sol. in ethyl alcohol, furfurol, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl oxalate, ethyl nitrate, amyl nitrite, o-nitrotoluene, pyridine, piperidine, and quinoline. Sol. in salicylic aldehyde. (Lincoln, J. phys. Chem. 1899, **3.** 461.)
Insol. in anhydrous ether. (Hampe, Ch. Z. 1887, **II**, 847.)
Readily sol. in alcohol.
100 pts. absolute methyl alcohol dissolve 1.71 pts. $CdCl_2$ at 15.5°.
100 pts. absolute ethyl alcohol dissolve 1.52 pts. $CdCl_2$ at 15.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)
100 g. $CdCl_2+CH_3OH$ contain 1.5 g. $CdCl_2$.

at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

Somewhat sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone; insol. in methylal. (Eidmann, C. C. **1899**, II, 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Difficultly sol. in ethylacetate. (Naumann, B. 1910, **43.** 314.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

At 18°, 100 g. benzonitrile dissolve 0.06332 g. $CdCl_2$. (Naumann, B. 1914, **47,** 1370.)

Insol. in toluene. (Baxter and Hines, Am. Ch. J. 1904, **31.** 222.)

Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

$+H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

10°	20°	40°	60°
57.47	57.35	57.51	57.77
80°	100°		
58.41	59.52 g. $CdCl_2$.		

110° is bpt. of the sat. solution.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+2\frac{1}{2}H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

—10°	0°	18°	30°	36°
44.35	47.37	52.53	56.27	57.91 g. $CdCl_2$.

Sp. gr. of sat. solution = 1.741.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+4H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

—9°	0°	+10°	+15°
43.58	49.39	55.58	59.12 g. $CdCl_2$.

(Dietz, Z. anorg. 1899, **20.** 257.)

$+5H_2O$. (Worobieff, Z. anorg. 1898, **18.** 386.)

Cadmium hydrogen chloride, $CdCl_2$, $2HCl+7H_2O$.

Decomp. in air. (Berthelot, C. R. **91.** 1024.)

Cadmium cæsium chloride, $CdCl_2$, $2CsCl$.

Easily sol. in H_2O and dil. $HCl+Aq$; insol. in conc. $HCl+Aq$. (Godeffroy, B. **8.** 9.)

Nearly insol. in $CsCl+Aq$. (Wells and Walden, Z. anorg. **5.** 266.)

$CdCl_2$, $CsCl$. Sl. sol. in H_2O; nearly insol. in $CdCl_2+Aq$. (Wells and Walden.)

Cadmium calcium chloride, $2CdCl_2$, $CaCl_2+7H_2O$.

Rather deliquescent, and very sol. in H_2O. When ignited is only sl. sol. in H_2O with evolution of heat. (v. Hauer, J. pr. **63.** 432.)

$CdCl_2$, $2CaCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium cobaltous chloride, $2CdCl_2$, $CoCl_2+12H_2O$.

Deliquescent. Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium cupric chloride, $CdCl_2$, $CuCl_2+4H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium hydrazine chloride, $CdCl_2$, N_2H_4HCl.

Unstable in the air when moist. Very sol. in H_2O; sl. sol. in alcohol; sol. in NH_3+Aq. (Curtius, J. pr. 1894, (2) **50.** 334.)

$CdCl_2,2N_2H_4HCl+4H_2O$. Very sol. in H_2O; sl. sol. in alcohol. (Curtius, J. pr. 1894, (2) **50.** 335.)

Cadmium iron (ferrous) chloride, $2CdCl_2$, $FeCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **17.** 331.)

Cadmium lithium chloride, $CdCl_2$, $LiCl+3\frac{1}{2}H_2O$.

Very deliquescent. Decomp. by solution in H_2O, but not in alcohol. (Chassevant, A. ch. (6) **30.** 39.)

Cadmium magnesium chloride, $2CdCl_2$, $MgCl_2+12H_2O$.

Deliquescent in moist, stable in dry air. Easily sol. in H_2O with absorption of heat. Much more sol. in hot than in cold H_2O. (v. Hauer.)

Solubility in H_2O at t°.

t°	G. Cd_2MgCl_6 in 100 g. solution	G. Cd_2MgCl_6 in 100 g. H_2O
2.4	45.61	83.86
26.8	49.69	98.77
45.5	53.51	115.10
67.2	58.14	138.90
121.8	65.48	189.69

(Rimbach, B. 1897, **30.** 3084.)

$CdCl_2$, $2MgCl_2+12H_2O$. Very deliquescent. (v. Hauer.)

Cadmium manganese chloride, $2CdCl_2$, $MnCl_2+12H_2O$.

Deliquescent in moist, efflorescent in dry air. Sol. in H_2O. (v. Hauer.)

Cadmium nickel chloride, $CdCl_2$, $2NiCl_2+12H_2O$.

Sol. in H_2O. (v. Hauer, W. A. B. **20.** 40.)

$2CdCl_2$, $NiCl_2+12H_2O$. Sol. in H_2O. (v. Hauer.)

Cadmium potassium chloride, $CdCl_2$, $KCl+\frac{1}{2}H_2O$.

Sol. in H_2O without decomp. (v. Hauer.)

$+H_2O$. 100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°	
2.65	3.21	3.72	4.33 mol. $CdCl_2$, $KCl+H_2O$.	

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 26.)

Solubility in H_2O at t°.

t°	G. $CdKCl_3$ in 100 g. solution	G. $CdKCl_3$ in 100 g. H_2O
2.6	21.87	27.99
15.9	26.60	36. 4
41.5	35.66	55.34
60.6	40.67	68.55
105.1	51.67	106.91

(Rimbach, B. 1897, **30.** 3079.)

$CdCl_2$, 2KCl. 100 pts. H_2O at 15.5° dissolve 33.45 pts. Sl. sol. in alcohol. (Croft, Phil. Mag. (3) **21.** 356.)

Solubility in salts+Aq at 16°.

$CdCl_2$, 2KCl is sol. without decomp. in the following salt solutions at 16°.

Salt	Mols. salt in 100 mols H_2O	In 1 litre of the solution mole			Sp. gr. of the solution
		$CdCl_2$	KCl	RCl	
LiCl	9.3	0.166	0.663	4.483	1.1380
$CaCl_2$	3.8	0.270	1.080	1.887	1.2333
KCl	2.378	0.507	3.195	...	1.214

(Rimbach, B. 1905, **38.** 1568,)

$CdCl_2$, 4KCl. More sol. in H_2O than $CdCl_2$, KCl. (v. Hauer.)

100 g. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
41.65	49.05	57.55	69.91 g. $CdCl_2$, 4KCl.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 24.)

Solubility in H_2O at t°.

t°	100 pts. solution contain pts.		
	Cd	Cl	K
4.0	3.64	9.84	8.31
23.6	5.66	14.02	11.52
50.2	9.10	18.09	13.60
108.8	11.97	23.08	17.10
109.0	11 91	23.15	17.22

(Rimbach, B. 1897, **30.** 3080.)

Decomp. by H_2O.

Can be recryst. without decomp. from LiCl, $CaCl_2$, or $MgCl_2+Aq$. (Rimbach, B. 1905, **38.** 1565.)

The salt is sol. without decomp. in HCl+Aq containing 19.8 mole HCl per 100 mole H_2O at 16°.

1 l. of the solution contains 0.033 mole $CdCl_2$, 0.132 mole KCl and 8.828 mole HCl; sp. gr. of the solution = 1.1403. (Rimbach, B. 1905, **38.** 1568.)

Cadmium rubidium chloride, $CdCl_2$, 2RbCl.

Sol. in H_2O and HCl+Aq. (Godeffroy, B. 8. 9.)

$CdCl_2$, RbCl. Solubility in H_2O at t°.

100 pts. by wt. of the solution contain pts. by wt. RbCl, $CdCl_2$.

t°	Pts. RbCl, $CdCl_2$
1.2	12.97
14.5	16.80
41.4	25.31
57.6	30.83
103.9	46.62

$CdCl_2$, RbCl is sol. in H_2O without decomp. from 0–104°. (Rimbach, B. 1902, **35.** 1303.)

$CdCl_2$, 4RbCl.

Solubility of $CdCl_2$, 4RbCl and $CdCl_2$, RbCl in H_2O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. Rb	Mol.-% mono-salt	Mol.-% tetra-salt
0.7	0.65	6.52	14.73	30	70
8.8	1.07	7.37	16.13	24	76
13.8	1.32	7.86	16.93	16	84
42.4	3.21	11.35	22.45	14	86
59.0	4.61	13.41	25.31	33	67
108.4	8.94	18.57	31.15	..	..

(Rimbach, B. 1902, **35.** 1305.)

Decomp. by H_2O between 0° and 108°. (Rimbach, B. 1905, **38.** 1571.)

Sol. in conc. HCl without decomp. (Rimbach, B. 1905, **38.** 1571.)

Not sol. in $CaCl_2+Aq$ and LiCl+Aq without decomp. (Rimbach, B. 1905, **38.** 1571.)

Cadmium sodium chloride, $CdCl_2$, $2NaCl+3H_2O$.

Sol. in 1.4 pts. H_2O at 16°. (Croft.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
3.93	4.29	4.73	5.18 mol. $CdCl_2$, $2NaCl+3H_2O$.

Stable between 19° and 55°.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37.** 25.)

Sl. sol. in alcohol or wood alcohol. (Croft.)

Cadmium strontium chloride, $2CdCl_2$, $SrCl_2+7H_2O$.

Sol. in H_2O. (v. Hauer.)

Cadmium chloride ammonia, $CdCl_2$, $2NH_3$.

Nearly insol. in H_2O. (v. Hauer.)

$CdCl_2$, $3NH_3+\frac{1}{4}H_2O$.

$CdCl_2$, $4NH_3+\frac{1}{2}H_2O$.

$CdCl_2$, $5NH_3$. (André, C. R. **104.** 908.)

$CdCl_2$, $6NH_3$. Difficultly sol. in cold H_2O. (Schüler, A. **87.** 34.)

Cadmium chloride cupric oxide, $CdCl_2$, $3CuO+3H_2O$.

Not decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 378 and 174.)

Cadmium chloride hydrazine, $CdCl_2$, $2N_2H_4$.

Insol. in H_2O.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 279.)

$+H_2O$. Insol. in H_2O; easily sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 345.)

Cadmium chloride hydroxylamine, $CdCl_2$, $2NH_2OH$.

Sl. sol. in cold, somewhat more in warm H_2O. Very sol. in hydroxylamine+Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) **3.** 116.)

Aq solution sat. at 20° contains about 1%. (Antonoff, C. C. **1905**, II. 810.)

Cadmium fluoride, CdF_2.

Difficultly sol. in H_2O. Easily sol. in HF+Aq. (Berzelius, Pogg. **1.** 26.)

Very sol. in H_2O; insol. in 95% alcohol; sol. in HCl, H_2SO_4, or HNO_3+Aq with evolution of HF. (Poulenc, C. R. **116.** 582.)

1 l. H_2O dissolves 0.289 mol. CdF_2 at 25°, or 100 cc. sat. aqueous solution contains 4.36 g. CdF_2 at 25°. (Jaeger, Z. anorg. 1901, **27.** 35.)

1 l. of 1.08-N HF dissolves 0.372 mol. CdF_2 at 25°. (Jaeger, Z. anorg. 1901, **27.** 35.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Cadmium ceric fluoride, $CdF_2,2CeF_4+7H_2O$.

Ppt. Decomp. by H_2O. (Rimbach, A. 1909, **368.** 106.)

Cadmium columbium fluoride.

See **Fluocolumbate, cadmium.**

Cadmium molybdenyl fluoride.

See **Fluoxymolybdate, cadmium.**

Cadmium silicon fluoride.

See **Fluosilicate, cadmium.**

Cadmium stannic fluoride.

See **Fluostannate, cadmium.**

Cadmium titanium fluoride.

See **Fluotitanate, cadmium.**

Cadmium zirconium fluoride.

See **Fluozirconate, cadmium.**

Cadmous hydroxide, CdOH.

Insol. in H_2O. Decomp. by acids into cadmic salt. (Morse and Jones, Am. Ch. J. **12.** 488.)

Cadmium hydroxide, CdO_2H_2.

Insol. in H_2O.

1 l. CdO_2H_2+Aq contains 0.0026 g. CdO_2H_2 at 25°. (Bodländer, Z. phys. Ch. 1898, **27.** 66.)

Solubility in $H_2O=2.6 \times 10^{-4}$. (Herz, Z. anorg. 1900, **24.** 126.)

Sol. in acids; very sol. in NH_4OH+Aq; insol. in KOH, NaOH, Na_2CO_3, K_2CO_3, and $(NH_4)_2CO_3+Aq$.

Easily sol. in $(NH_4)_2SO_4$, NH_4Cl, NH_4NO_3, and NH_4 succinate+Aq. (Wittstein.)

Freshly pptd. CdO_2H_2 is sol. in alkali haloids+Aq. (Bersch, Z. phys. Ch. 1891, **8.** 392.)

Solubility in NH_4OH+Aq increases with increase in concentration of NH_4OH. (Euler, B. 1903, **36.** 3401.)

Solubility in NH_4OH+Aq at 25°.

NH_3 norm.	g. CdO per l.
0.5	0.24
1.0	0.62
1.8	1.33
4.6	4.92

(Bonsdorff, Z. anorg. 1904, **41.** 187.)

Insol. in ethyl, and methyl amine+Aq. (Wurtz.)

Very sl. sol. in HCN+Aq even when freshly pptd. (Schüler, A. **87.** 48.)

Not pptd. in presence of Na citrate (Spiller), and many non-volatile organic substances. (Rose.)

Cadmium iodide, CdI_2.

Sol. in 1.13 pts. H_2O at 15°. (Eder, Dingl. **221.** 89.)

Sol. at	20°	40°	60°	80°	100°
in	1.08	1.00	0.93	0.86	0.75 pts. H_2O.

(Kremers, Pogg. **103.** 57.)

Sat. CdI_2+Aq contains at:

−4°	+2°	+10°	13°	24°	32°
42.4	43.7	45.2	44.8	46.5	47.4% CdI_2.
54°	64°	76°	94°	95°	135°
49.5	50.1	52.4	55.1	54.7	62.9% CdI_2.
140°	165°	185°	202°	202°	255°
63.1	68.1	70.7	73.4	73.2	84.5% CdI_2.

(Étard, A. ch. 1894, (7) **2.** 545.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	18°	50°	75°	100°
44.39	46.02	49.35	52.65	56.08 g. CdI_2.

(Dietz, Z. anorg. 1899, **20.** 262.)

Sp. gr. of CdI_2+Aq containing pts. CdI_2 to 100 pts. H_2O.

21.4	43.7	88.5 pts. CdI_2.
1.1681	1.328	1.6139

(Kremers, Pogg. **111.** 60.)

Sp. gr. of CdI_2+Aq at 19.5° containing:

5	10	15	20	25 % CdI_2,
1.044	1.088	1.138	1.194	1.253
30	35	40	45	50 % CdI_2.
1.319	1.395	1.476	1.575	1.680

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sp. gr. of CdI_2+Aq at 18°.

% CdI_2	1	5	10	15	20
Sp. gr.	1.0071	1.0425	1.0883	1.1392	1.1943
% CdI_2	25	30	35	40	45
Sp. gr.	1.2550	1.3228	1.4000	1.4816	1.5741

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of CdI_2+Aq.

g. CdI_2 per l.	Sp. gr.	g. CdI_2 per l.	Sp. gr.
98.85	1.08	289.5	1.237
197.7	1.162	400	1.328

(Barbier and Roux, Bull. Soc. 1890, (3) **3.** 425.)

Sp. gr. of CdI_2+Aq.

% CdI_2	t°	Sp. gr. at t°	Sp. gr. at 18°
0 0429	17.68	0.99915	0.99908
	22.88	0.99807	
0.100	17.55	0.99965	0.99956
	22.91	0.99363	
0.204	17.76	1.00052	1.0005
	22.79	0.99948	
0.399	17.40	0.00223	1.0021
	24.30	1.00082	
0.600	18.00		1.0038
0.800	17.44	1.00564	1.0056
	23.11	1.00442	
1.00	18.00		1.0072

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sp. gr. CdI_2+Aq at 18°/4° containing:

31.123	13.677	9.559 % CdI_2.
1.338	1.125	1.086

(de Muynck, W. Ann. 1894, **53.** 561.)

CdI_2+Aq containing 10.97% CdI_2 has sp. gr. 20°/20° = 1.0982.

CdI_2+Aq containing 16.53% CdI_2 has sp. gr. 20°/20° = 1.1562.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of CdI_2+Aq at 20°.

Normality of CdI_2+Aq	% CdI_2	Sp. gr.
1.924	44.53	1.5807
0.951	27.07	1.2837
0.447	14.40	1.1355
0.211	7.26	1.0630

(Forchheimer, Z. phys. Ch. 1900, **34.** 29.)

CdI_2+Aq containing 1 pt. CdI_2 in 2.2691 pts. H_2O at 17° has sp. gr. = 1.3341. (Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Sol. in sat. HI+Aq.

Sol. in warm NH_4OH+Aq.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Difficultly sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 215.)

Sol. in 15 pts. alcohol. (Vogel, N. Rep. Pharm. **12.** 393.)

Sol. in 0.98 pt. abs. alcohol. (Eder, Dingl. **221.** 89.)

Sp. gr. of CdI_2+alcohol.

% CdI_2	Sp. gr. 20°/20°
0	0.7949
7.28	0.8470

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Sol. in 5.2 mols. methyl, 7 mols. ethyl, and 9.8 mols. propyl alcohol at 20°. (Timofejew, C. R. **112.** 1224.)

Sol. in 3.6 pts. ether. (Eder, *l. c.*)

Sol. in 2.0 pts. alcohol-ether (1 : 1). (Eder, *l. c.*)

Very sl. sol. in anhydrous abs. ether. (Hampe, Ch. Z. 1887, **11.** 847.)

100 g. of sat. solution in abs. ether contain 0.143 g. CdI_2 at 12°. (Tyrer, Proc. Chem. Soc. 1911, **27.** 142.)

Solubility in ether+Aq at 12°.

% H_2O in ether	% CdI_2	% H_2O in ether	% CdI_2	% H_2O in ether	% CdI_2
0.0	0.143	0.50	3.36	1.00	7.30
0.10	0.78	0.70	4.77	1.10	8.27
0.30	2.07	0.90	6.46	1.14	8.68

(Tyrer, Proc. Chem. Soc. **27.** 142.)

Solubility in benzene at 16° = 0.01%
" 35° = 0.02%
Solubility in ethyl ether at 0° = 0.03%
" 15.5° = 0.04%
" 20.3° = 0.05%

(Linebarger, Am. J. Sci. 1895, (3) **49.** 52.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

1 g. CdI_2 is sol. in 4 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.994. (Naumann, B. 1904, **37.** 4338.)

Sp. gr. of CdI_2+acetone.

% CdI_2	Sp. gr. 20°/20°.
0	0.7998
12.02	0.8929

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

100 g. benzonitrile dissolve 1.6295 g. CdI_2 at 18°. (Naumann, B. 1914, **47.** 1370.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Sl. sol. in ethylamine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in CS_2. (Arctowski, Z. anorg. 1849, **6.** 257.)

Solubility in methyl acetate = 0.7–1.5%; 2.1% at bpt. (Schröder and Steiner, J. pr. 1909, (2) **79.** 49.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

1 pt. is sol. in 54.3 pts. ethyl acetate at 18°. The sat. solution has D18°/4° = 0.9145. (Naumann, B. 1910, **43.** 318.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, **9.** 647.)

Mol. weight determined in piperidine, pyridine, methyl and ethyl sulphide. (Werner, Z. anorg. 1897, **15.** 17.)

Cadmium hydrogen iodide, CdI_2, $HI+3H_2O$.

Decomp. in air. (Dobroserdow, C. C. 1900, II. 527.)

Cadmium cæsium iodide, CdI_2, $CsI+H_2O$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5.** 271.)

CdI_2, 2CsI. As above.

CdI_2, 3CsI. Decomp. by H_2O into the above salt.

Cadmium hydrazine iodide, CdI_2,$2N_2H_4HI$.

Sol. in H_2O. (Ferratini, C. A. **1912.** 1612.)

Cadmium mercuric iodide.

Very sol. in H_2O. (Berthemot, J. Pharm. **14.** 613.)

CdI_2, $3HgI_2$. Sol. in H_2O. Can be recrystallized in alcohol. (Clarke and Kebler, Am. Ch. J. **5.** 235.)

Cadmium potassium iodide, CdI_2, $KI+H_2O$.

Sol. in 0.94 pt. H_2O at 15°. (Eder, Dingl. **221.** 89.)

CdI_2, $2KI+2H_2O$. Deliquescent. Extremely sol. in H_2O. Sol. at 15° in 0.73 pt. H_2O. Sl. sol. in alcohol and wood spirit, but less than CdI_2. (Croft.)

Sol. at 15° in 1.4 pts. absolute alcohol, 24.5 pts. ether (0.729 sp. gr.), and 4.5 pts. alcohol-ether (1 : 1). (Eder, *l. c.*)

Sp. gr. of K_2CdI_4+Aq at 18°.

$\%K_2CdI_4$	1	5	10	15	20
Sp. gr.	1.0065	1.0384	1.0808	1.1269	1.1770

$\%K_2CdI_4$	25	30	35	40	45
Sp. gr.	1.2313	1.2890	1.3557	1.4282	1.5065

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of K_2CdI_4+Aq.

$\%K_2CdI_4$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0328	18		0.99895
0.0596	18		0.99921
0.0804	18		0.99938
0.100	17.12	0.99962	0.99945
	21.82	0 99872	
0.250	18		1.0007
0.500	18		1.0027
1.003	17.32	1.0068	1.0067
	20.63	1.0061	

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Cadmium sodium iodide, CdI_2, $2NaI+6H_2O$.

Deliquescent. (Croft.)

Sol. at 15° in 0.63 pt. H_2O, 0.86 pt. abs. alcohol, and 10.1 pts. ether (sp. gr. 0.729). (Eder, Dingl. **221.** 89.)

Cadmium strontium iodide, CdI_2, SrI_2+ $8H_2O$.

Deliquesces in moist, effloresces in dry air; sol. in H_2O. (Croft.)

Cadmium iodide ammonia, CdI_2, $2NH_3$.

Decomp. by H_2O. (Rammelsberg.)

CdI_2, $4NH_3$. (Dawson and McCrae, Chem. Soc. 1900, **77.** 1246.)

CdI_2, $6NH_3$. Decomp. by H_2O; sol. in warm, less sol. in cold NH_4OH+Aq. (Rammelsberg.)

Cadmium iodide hydrazine, CdI_2, $2N_2H_4$.

Easily sol. in warm NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 281.)

Cadmium iodide hydroxylamine, CdI_2, $3NH_2OH$.

Sol. in H_2O and alcohol. Insol. in ether. (Adams, Am. Ch. J. 1902, **28.** 218.)

Cadmium iodide selenide, CdI_2, 3CdSe.

Easily decomp. (Fonzes-Diacon, C. R. 1900, **131.** 897.)

Cadmium iodosulphide, CdI, 2CdS.

Ppt. (Naumann, B. 1904, **37.** 4338.)

Cadmium *sub*oxide, Cd_4O.

Decomp. by H_2O, acids and NH_4OH+ Aq. (Tanatar, Z. anorg. 1901, **27.** 433.)

Cd_2O. Properties as cadmous hydroxide. (Morse and Jones.)

Cadmium oxide, CdO.

Insol. in H_2O. Sol. in acids. Sol. in NH_4OH+Aq. Insol. in $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4Cl+Aq, less in NH_4NO_3+ Aq. (Brett, **1837.**)

Insol. in KOH, NaOH, K_2CO_3, and Na_2CO_3 +Aq.
See also **Cadmium hydroxide.**

Solubility in (calcium sucrate+sugar)+Aq.
1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.22 g. CdO.
1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.48 g. CdO.
(Bodenbender, J. B. **1865.** 600.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Cadmium ***per*****oxide,** Cd_5O_8 or Cd_3O_5(?). (Haas.)
CdO_2, $Cd(OH)_2$. (Kouriloff, A. ch. (6) **23.** 431.)
Very stable towards H_2O. Insol. in NH_4OH +Aq. (Haas, B. 1884, **17.** 2253.)
$4CdO_2$, $Cd(OH)_2$. Ppt. Insol. in NaOH+Aq. (Eykmann, C. C. **1905,** I. 1629.)
$5CdO_2$,$CdO+3H_2O$. Ppt. (Teletow, C. A. **1912,** 43.)

Cadmium oxybromide, CdO, $CdBr_2+H_2O$.
Decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1023.)
$+2H_2O$. Stable in dry air; insol. in H_2O. (Tassily, C. R. 1897, **124.** 1022.)
$+3H_2O$. Slowly decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1022.)
$+7H_2O$. (Mailhe, C. R. 1901, **132.** 1561.)

Cadmium oxychloride, $CdCl_2$, $CdO+H_2O$.
Sl. sol. in hot H_2O. (Habermann, M. Ch. **5.** 432.)
$+7H_2O$. (Mailhe, Bull. Soc. 1901, (3) **25.** 791.)
2CdO, $CdCl_2$. Insol. in H_2O, but slowly decomp. thereby. (Canzoneri, Gazz. ch. it. 1897, **27.** (2) 486.)

Cadmium oxyiodide, CdO, CdI_2+H_2O.
Decomp. by H_2O. (Tassily, C. R. 1897, **124.** 1023.)
$+3H_2O$. Stable in dry air; insol. in H_2O. (Tassily, C. R. 1897, **124.** 1022.)

Cadmium phosphide, Cd_3P_2.
Sol. in HCl+Aq with evolution of PH_3. (Stromeyer.)
Cd_2P. Sol. in conc. HCl+Aq. (Emmerling, B. **12.** 152.)
Easily decomp. by acids. (Kulisch, A. **231.** 327.)
CdP_2. Decomp. by boiling conc. HCl+Aq. (Renault, C. R. **76.** 283.)

Cadmium selenide, CdSe.
Sol. in HCl+Aq. (Uelsmann, A. **116.** 122.)
Easily decomp. by acids. (Fonzes-Diacon, C. R. 1900, **131.** 897.)

Cadmium sulphide, CdS.
Insol. in H_2O.
Solubility in H_2O at 16-18° = 6.6 x 10^{-6} mols. per l. (Biltz, Z. phys. Ch. 1907, **58.** 291.)
1 l. H_2O dissolves 9.00 x 10^{-6} mols. CdS (artificial greenockite) at 18°.
1 l. H_2O dissolves 8.86 x 10^{-6} mols. pptd. CdS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)
Difficultly sol. in hot dil. HCl+Aq. Easily sol. in cold conc. HCl+Aq. (Stromeyer.) Sol. in HNO_3+Aq (Meissner), and boiling dil. H_2SO_4+Aq (1 : 6). (A. W. Hoffmann, A. **115.** 286.) Very sl. sol. in NH_4OH+Aq. (Wackenroder, Repert. **46.** 226.) Insol. in KOH, or $(NH_4)_2S$+Aq. Appreciably sol. in an acid solution of NH_4Cl. (Baxter and Hines, Z. anorg. 1905, **44.** 160.)
Much more sol. in $(NH_4)_2S$+Aq than usually supposed. (Ditte, C. R. **85.** 402.). Solubility increases by warming, and at 68° is twice that at ordinary temperatures. A sat. solution of $(NH_4)_2S$ dissolves about 2 g. CdS to a litre. Alkali sulphides dissolve much less. (Ditte.)
Fresenius (Z. anal. **20.** 236) could not confirm the above. According to Fresenius, CdS is not appreciably sol. in $(NH_4)_2S$+Aq.
Insol in Na_2SO_3 or KCN+Aq. (Fresenius.)
Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett.)
Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, -stannates+Aq. (Storch, B. **16.** 2015.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Min. *Greenockite.* Sol. in HCl+Aq.

Colloidal.—Solution of 4 g. colloidal C in a litre H_2O remains transparent several days. If it contains 11 g. CdS in a litre, it is completely coagulated in 24 hours. Solutions of salts of the following concentration cause an immediate coagulation in an aqueous solution of CdS containing 3.62 g. in a litre.

KCl	1 : 1615
KBr	1 : 727
KI	1 : 57
KCN	1 : 166
$KClO_3$	1 : 1666
KNO_3	1 : 1000
$K_2S_2O_6$	1 : 5000
K_2SO_4	1 : 833
$K_3Fe(CN)_6$	1 : 166
$K_4Fe(CN)_6$	<1 : 100
K_2CrO_4	1 : 400
$K_2Cr_2O_7$	1 : 3571
NaCl	1 : 2666
$Na_2S_2O_3$	1 : 98
$NaHCO_3$	1 : 333
Na_2CO_3	1 : 166
Na_2HPO_4	1 : 202

$NaC_2H_3O_2$	1 : 2451
Na benzoate	1 : 10,000
$(NH_4)_2C_2O_4$	1 : 588
$BaCl_2$	1 : 11,764
$Ba(NO_3)_2$	1 : 8032
BaS_2O_6	1 : 5617
$MgSO_4$	1 : 41,666
$MnSO_4$	1 : 22,222
$CdSO_4$	1 : 250,000
$Cd(NO_3)_2$	1 : 285,714
$Pb(ClO_3)_2$	1 : 209
$Pb(C_2H_3O_2)_2$	1 : 147,058
$Hg(CN)_2$	<1 : 20
$Al_2(SO_4)_3$	1 : 232,558
Alum	1 : 192,377
Chrome alum	1 : 42,555
HCl	1 : 4807
H_2SO_4	1 : 8000
$HC_2H_3O_2$	1 : 15
$H_2C_2O_4$	1 : 23,255
Succinic acid	<1 : 100
Tartaric acid	1 : 333

(Prost, Belg. Acad. Bull. (3) **14.** 312; J. B. **1887.** 537.)

Cadmium *penta*sulphide, CdS_5.

Insol. in H_2O. (Schiff, A. **115.** 74.)
Mixture of CdS and S. (Follenius, Z. anal. **13.** 412.)

Cadmium potassium sulphide, $K_2Cd_3S_4$.

(Milbauer, Z. anorg. 1904, **42.** 439.)

Cadmium sodium sulphide, $3CdS, Na_2S$.

Decomp. by H_2O. (Schneider, J. pr. (2) **8.** 29.)

Cadmium sulphoiodide.

See **Cadmium iodosulphide.**

Cadmium telluride, CdTe.

Not attacked by dil. acids. Attacked in the cold only by HNO_3. (Tibbals, J. Am. Chem. Soc. 1909, **31.** 908.)

Cadmic acid.

Potassium cadmate.

Insol. in H_2O, but gradually decomp. when in contact therewith. (Meunier, C. R. **63.** 330.)

Cæsium, Cs.

Decomp. H_2O with great violence. (Setterberg, A. **211.** 100.)
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Cæsium acetylide acetylene, Cs_2C_2, C_2H_2.

Insol. in C_6H_6 and in $CHCl_3$. (Moissan, C. R. 1903, **136.** 1218.)

Cæsium amide, $CsNH_2$.

Decomp. by H_2O. Very sol. in liquid NH_3. (Rengade, C. R. 1905, **140.** 1185.)

Cæsium ammonia, Cs,NH_3.

Sol. in liquid NH_3. (Moissan, C. R. 1903, **136.** 1177.)

Cæsium azoimide, CsN_3.

Deliquescent. Stable in aq. solution.

224.2 pts. sol. in	100 pts.	H_2O	at 0°
307.4 " "	100 "	H_2O	" 16°
1.0366 " "	" 100 "	abs. alcohol	" 16°

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 283.)

Cæsium bromide, CsBr.

Ppt. (Chabrié, C. R. 1901, **132.** 679.)
Sat. CsBr+Aq at 25° contains 55.23% CsBr. (Foote, Am. Ch. J. 1907, **37.** 125.)

Cæsium *tri*bromide, $CsBr_3$.

Sol in H_2O; decomp. by alcohols. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*bromide, $CsBr_5$.

Very unstable. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Cæsium cobalt bromide, Cs_2CoBr_4.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)
Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)
Cs_3CoBr_5. Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)
Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium copper bromide, $CsBr, CuBr_2$.

Sol. in H_2O without decomp. (Wells and Walden, Z. anorg. **5.** 304.)
$2CsBr, CuBr_2$. (W. and W.)

Cæsium iridium bromide.

See **Bromiridate, cæsium.**

Cæsium iron (ferric) bromide, $CsFeBr_4$.

Sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)
$Cs_2FeBr_5+H_2O$. (Walden, Z. anorg. 1894, **7.** 332.)

Cæsium lead bromide, $CsBr, 2PbBr_2$.

Nearly stable in aqueous solution. (Walden, Sill. Am. J. **145.** 127.)
$CsBr, PbBr_2$. Decomp. by H_2O. (Walden.)
$4CsBr, PbBr_2$. As above.
Solubility determinations show that the double salts formed by cæsium and lead bromides at 25° are $CsPb_2Br_5$, $CsPbBr_3$ and Cs_4PbBr_6. (Foote, Am. Ch. J. 1907, **37.** 125.)

Cæsium magnesium bromide, $CsBr, MgBr_2+6H_2O$.

Sol. in H_2O. (Wheeler and Campbell, Z. anorg. **5.** 275.)

Cæsium mercuric bromide, $CsBr, 2HgBr_2$.

Not decomp. by H_2O. 100 pts. solution sat. at 16° contain 0.807 pt. $CsBr, 2HgBr_2$. Sl. sol. in hot strong alcohol, from which $CsBr, HgBr_2$ separates on cooling. (Wells, Sill. Am. J. **144.** 221.)

$CsBr, HgBr_2$. Decomp. by H_2O into above salt. Sol. in alcohol without decomp. (Wells.)

$2CsBr, HgBr_2$. Decomp. by H_2O into $CsBr, 2HgBr_2$.

$3CsBr, HgBr_2$. As above.

Cæsium molybdenyl bromide, $2CsBr, MoOBr_3$.

(Weinland and Knöll, Z. anorg. 1905, **44.** 107.)

Cæsium nickel bromide, $CsNiBr_3$.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 126.)

Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium osmium bromide.

See **Bromosmate, cæsium.**

Cæsium palladium bromide.

See **Bromopalladate, cæsium** and **bromopalladite, cæsium.**

Cæsium platinum bromide.

See **Bromoplatinate, cæsium.**

Cæsium ruthenium bromide.

See **Bromoruthenite, cæsium.**

Cæsium selenium bromide.

See **Bromoselenate, cæsium.**

Cæsium tellurium bromide.

See **Bromotellurate, cæsium.**

Cæsium thallic bromide, $CsBr, TlBr_3$.

Sol. in H_2O with decomp. (Pratt, Z. anorg. 1895, **9.** 19.)

By recryst. from H_2O, forms $3CsBr, 2TlBr_3$. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

$3CsBr, 2TlBr_3$. Can be recryst. unchanged from H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 402.)

Cæsium tin (stannic) bromide.

See **Bromostannate, cæsium.**

Cæsium zinc bromide, $3CsBr, ZnBr_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

$2CsBr, ZnBr_2$. As above.

Cæsium bromide columbium oxybromide, $2CsBr, CbOBr_3$.

Unstable in moist air. Decomp. by H_2O. (Weinland, B. 1906, **39.** 3059.)

Cæsium bromochloride, $CsBr_2Cl$.

Properties as $CsBr_3$. (Wells.)

$CsBrCl_2$. As above. (Wells.)

Cæsium mercuric bromochloride, $Cs_3HgCl_3Br_2$.

Decomp. by H_2O finally to $HgBr_2$. (Wells, Sill. Am. J. **144.** 121.)

Cs_2HgCl_2Br. As above.

$CsHgClBr_2$. As above.

$CsHg_2ClBr_4$. As above.

$CsHg_5ClBr_{10}$. As above.

Cæsium bromochloroiodide, $CsBrClI$.

More sol. in H_2O than in alcohol. Not decomp. at once by ether. (Wells.)

Cæsium bromoiodide, $CsBrI_2$.

Decomp. by H_2O. Sol. in alcohol. Decomp. by ether with residue of CsBr. (Wells, Sill. Am. J. **143.** 17.)

$CsBr_2I$. More sol. in H_2O than in alcohol. Not decomp. by ether.

$CsBr_2I+Aq$ sat. at 20° contains about 4.45% $CsBr_2I$. (Wells.)

Cæsium carbide, Cs_2C_2.

Decomp. by cold H_2O. (Moissan, C. R. 1903, **136.** 1221.)

Cæsium chloride, CsCl.

Very deliquescent; sol. in H_2O and alcohol.

Solubility of CsCl at t°.

t°	Pts. by wt. of CsCl in 100 pts. solution
0.3	61.9
10	63.5
20	64.9
30	66.3
40	67.4

(Hinrichsen, Z. phys. Ch. 1904, **50.** 99.)

Solubility of CsCl at t°.

t°	% CsCl	t°	% CsCl
0	61.7	60	69.7
10	63.6	70	70
20	65.1	80	71.4
30	66.4	90	72.2
40	67.5	100	73.0
50	68.0	119.4	74.4

(Berkeley, Trans. Roy. Soc. 1904, **203.** A. 208.)

A normal solution of CsCl has sp. gr. at 25° = 1.1076. (Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. at 20°/4° of a normal solution of CsCl = 1.125815. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of CsCl+Aq.

G. equiv. CsCl per l. at 18°	Sp. gr. at 6°/6°	Sp. gr. at 18°/18°	Sp. gr. at 30°/30°
0.504	1.06556	1.06483	1.06452
1.002	1.12962	1.12825	1.12750
2.007	1.25705	1.25452	1.25307
3.994	1.50514	1.50100	1.49859

(Clausen, W. Ann. 1914, (4) **44.** 1071.)

Solubility of $CsCl+FeCl_3$ in H_2O at 21°.

Substance added		Pts. by weight in 100 pts. of solution	
$FeCl_3$ grams	CsCl grams	$FeCl_3$	CsCl
0	65	0	65.0
0.6	11.6	0.45	55.18
1.4	10.2	2.1	52.38
2.2	8 8	5.24	51.44
2.0	7.4	7.8	47.70
3.8	6.0	8.93	41.15
4.6	4.6	15.34	25.25
5.4	2.8	21.65	14.96
6.2	1.4	27.96	8 42
35	0.2	48 71	0.94
35	0	83.89	0

(Hinrichsen, Z. phys. Ch. 1904, **50.** 96.)

Solubility of $CsCl+HgCl_2$ in H_2O at 25°.

Solution contains		Solid phase
% CsCl	% $HgCl_2$	
65.61	0.00	CsCl
65.78	0.215	$CsCl+Cs_3HgCl_5$
62.36	0.32	Cs_3HgCl_5
57.01	0.64	"
52.35	1 23	"
51.08	1.44	$Cs_3HgCl_5+Cs_2HgCl_4$
49.30	1.49	Cs_2HgCl_4
45.95	1.69	"
45.23	1.73	$Cs_2HgCl_4+CsHgCl_3$
38.63	1.32	$CsHgCl_3$
17.03	0.51	"
1.53	0.42	"
0.61	2.64	$CsHgCl_3+CsHg_2Cl_5$
0.49	2.91	$CsHg_2Cl_5$
0.40	3.78	$CsHg_2Cl_5+CsHg_5Cl_{11}$
0.44	4.63	"
0.41	4.68	$CsHg_5Cl_{11}$
0.25	5.65	"
0.18	7.09	$CsHg_5Cl_{11}+HgCl_2$
0.00	6.90	$HgCl_2$

(Foote, Am. Ch. J. 1903, **30.** 340.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899, II.** 1014.)

100 g. solution in acetone sat. at 25° contain 0.032 g. CsCl. (Foote and Haigh, J. Am. Chem. Soc. 1911, **33.** 461.)

Solubility of $CsCl+HgCl_2$ in acetone at 25°.

Solution contains		Solid phase
% $HgCl_2$	% CsCl	
57.74	0.00	$HgCl_2$
57.79	0.13	$HgCl_2+CsHg_5Cl_{11}$
57.74	0.20	$CsHg_5Cl_{11}$
52.54	0.22	"
49.83	0.32	"
44.32	0.50	$CsHg_5Cl_{11}+CsHg_2Cl_5$
44.46	0.44	"
39.65	0.48	$CsHg_2Cl_5$
28.48	0.48	"
26.96	0.52	$CsHg_2Cl_5+CsHgCl_3$
27.32	0 61	"
21.50	0.46	$CsHgCl_3$
13.08	0.45	"
0.16	0.19	Mixtures of salts
0.17	0.25	"
0.02	0.11	"
0.00	0 032	CsCl

(Foote and Haigh, J. Am. Ch. Soc. 1911, **33.** 461.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Solubility in glycol at ord. temp.=10.6–10.8%. (de Coninck, Belg. Acad. Bull. **1905.** 359.)

Insol. in anhydrous pyridine and in 97% pyridine+Aq. Sl. sol. in 95% pyridine+Aq and in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Cæsium chromium chloride, $2CsCl,CrCl_3+H_2O$.

Stable in the air. Sol. in H_2O. (Wells, Z. anorg. 1895, **10.** 182.)

$2CsCl,CrCl_3+4H_2O$; hydroscopic; very sol. in H_2O. (Wells, *l. c.*)

Cæsium *tetra-aquo***chromium chloride,** $CrCl_2(OH_2)_4.Cl$, 2CsCl.

Ppt. (Werner, B. 1901, **34.** 1602.)

Cæsium cobalt chloride, $CsCoCl_3+2H_2O$.

Decomp. by H_2O and alcohol. (Campbell, Z. anorg. 1894, **8.** 126.)

Cs_2CoCl_4. Decomp. by H_2O and by alcohol. (Campbell, Z. anorg. 1894, **8.** 126.)

Cs_3CoCl_5. Decomp. by H_2O and by alcohol. (Campbell, Z. anorg. 1894, **8.** 126.)

Cæsium cuprous chloride, CsCl, Cu_2Cl_2.

Decomp. by H_2O into $CuCl_2$, CsCl. (Wells, Z. anorg. **5.** 306.)

3CsCl, Cu_2Cl_2. (Wells.)

6CsCl, Cu_2Cl_2. (Wells.)

Cæsium cupric chloride, 2CsCl, $CuCl_2$.

Easily sol. in H_2O and dil. HCl+Aq; insol. in conc. HCl+Aq. (Godeffroy, B. **8.** 9.)

Sol. in small amount H_2O without decomp. (Wells and Dupee, Z. anorg. **5.** 300.)

$+2H_2O$. Efflorescent. (W. and D.)

$3CsCl, 2CuCl_2+2H_2O$.

$CsCl, CuCl_2$. Sol. in H_2O without decomp. (W. and D.)

Cæsium gold chloride.

See **Chloraurate, cæsium.**

Cæsium iridium *tetra*chloride.

See **Chloriridate, cæsium.**

Cæsium iron (ferric) chloride, $CsFeCl_4+\frac{1}{2}H_2O$.

Sol. in H_2O. Decomp. in the air. (Walden, Z. anorg. 1894, **7.** 332.)

$Cs_2FeCl_5+H_2O$. Sol. in H_2O. (Walden.)

$Cs_3FeCl_6+H_2O$. Sol. in H_2O. (Walden.)

Cæsium lanthanum chloride, $Cs_3LaCl_6+4H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium lead chloride, $CsCl, 2PbCl_2$.

Nearly stable in aqueous solution. (Campbell, Sill. Am. J. **145.** 126.)

$CsCl, PbCl_2$. Decomp. by H_2O. (Campbell.)

$4CsCl, PbCl_2$. As above. (Campbell.)

Cæsium lead *tetra*chloride.

See **Chloroplumbate, cæsium.**

Cæsium magnesium chloride, $CsCl, MgCl_2+6H_2O$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

Cæsium manganous chloride, $CsCl, MnCl_2+2H_2O$.

Not deliquescent; sol. in H_2O. (Saunders, Am. Ch. J. **14.** 143.)

$2CsCl, MnCl_2$. (Godeffroy.)

$+2\frac{1}{2}H_2O$. (Godeffroy.)

$+3H_2O$. Sol. in H_2O. Conc. HCl+Aq precipitates anhydrous salt from aqueous solution. (Godeffroy, B. **8.** 9.)

The only salt which exists contains $2H_2O$. (Saunders, Am. Ch. J. **14.** 143.)

Cæsium manganic chloride, $2CsCl, MnCl_3$.

Easily decomp. (Meyer and Best, Z. anorg. 1899, **22.** 187.)

Cæsium mercuric chloride, $CsCl, HgCl_2$.

100 pts. solution sat. at 17° contain 1.406 pts. $CsHgCl_3$. Not decomp. by H_2O. Insol. in absolute alcohol, but sol. on diluting with 1/3 vol. H_2O. (Wells, Sill. Am. J. **144.** 221.)

$2CsCl, HgCl_2$. Easily sol. in H_2O and dil. HCl+Aq; insol. in conc. HCl+Aq. (Godeffroy.)

$3CsCl, HgCl_2$. Decomp. by H_2O; on recrystallizing from H_2O, $CsCl, HgCl_2$ is finally formed. (Wells, Sill. Am. J. **144.** 221.)

$CsCl, 5HgCl_2$. Decomp. by H_2O. (Wells.)

Solubility determinations show that the only double salts of CsCl and $HgCl_2$ which exist at 25° are Cs_3HgCl_5, Cs_2HgCl_4, $CsHgCl_3$, $CsHg_2Cl_5$, $CsHg_5Cl_{11}$. (Foote, Am. Ch. J. 1903, **30.** 340.)

Cæsium molybdenum chloride, $Cs_2MoCl_5+H_2O$.

Sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903,** II. 652.)

Cæsium molybdenyl chloride, $CsCl, MoO_2Cl_2+H_2O$.

Hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 93.)

$2CsCl, MoO_2Cl_2$. Hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 92.)

$2CsCl, 6MoO_2Cl_2+22H_2O$ Very hygroscopic. Decomp. by H_2O. (Weinland and Knöll, Z. anorg. 1905, **44.** 94.)

$2CsCl, MoOCl_3$. Only sl. sol. in H_2O. (Nordenskjöld, B. 1901, **34.** 1573.)

Cæsium neodymium chloride, $Cs_3NdCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium nickel chloride, $2CsCl, NiCl_2$.

As the corresponding Cu salt.

$CsNiCl_3$. Decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium palladium *di*chloride.

See **Chloropalladite, cæsium.**

Cæsium palladium *tetra*chloride.

See **Chloropalladate, cæsium.**

Cæsium praseodymium chloride, $Cs_3PrCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium rhodium chloride.

See **Chlororhodite, cæsium.**

Cæsium ruthenium chloride.

See **Chlororuthenite, cæsium and chlororuthenate, cæsium.**

Cæsium *oxy*ruthenium chloride, $Cs_2RuO_2Cl_4$.

Ppt.; decomp. by H_2O; sol. in cold HCl. (Howe, J. Am. Chem. Soc. 1901, **23.** 779.)

Cæsium samarium chloride, $Cs_3SmCl_6+5H_2O$.

Very hydroscopic. Easily sol. in H_2O. (R. J. Meyer, Z. anorg. 1914, **86.** 273.)

Cæsium silver chloride, 2CsCl, AgCl.

Easily decomp. by H_2O. (Wells and Wheeler, Sill. Am. J. **144.** 155.)

Cæsium tellurium chloride.

See **Chlorotellurate, cæsium.**

Cæsium thallic chloride, 2CsCl, $TlCl_3$.

By recryst. from H_2O forms 3CsCl, $2TlCl_3$. (Pratt, Am. J. Sci. 1895, (3) **49.** 398.)

$+H_2O$. Readily sol. in hot H_2O but 3CsCl, $2TlCl_3$ cryst. from the solution. (Pratt, Am. J. Sci. 1895, (3) **49.** 399.)

3CsCl, $2TlCl_3$. Can be recryst. from H_2O without change. (Pratt, Am. J. Sci. 1895, (3) **49.** 401.)

3CsCl, $TlCl_3+2H_2O$. Sol. in 36.4 pts. H_2O at 17° and 3 pts. at 100°. (Godeffroy, Zeitsch. d. allgem. österr. Apothekerv. **1880.** No. 9.)

Cæsium tin (stannic) chloride.

See **Chlorostannate, cæsium.**

Cæsium titanium chloride, $TiCl_3$, $2CsCl+H_2O$.

Difficultly sol. in H_2O. (Stähler, B. 1904, **37.** 4409.)

Cæsium tungsten chloride, $Cs_3W_2Cl_9$.

Nearly insol. in cold H_2O.

Sol. in a hot mixture of equal pts. H_2O and conc. HCl.

Nearly insol. in conc. HCl.

Sol. in very dil. NaOH+Aq.

Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 574.)

Cæsium uranous chloride, Cs_2UCl_6.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Cæsium uranyl chloride, 2CsCl, $(UO_2)Cl_2$.

Sol. in H_2O. (Wells, Z. anorg. 1895, **10.** 183.)

100 pts. of the solution contain at 29.75°, 56.07 pts. UO_2Cl_2, 2CsCl. (Rimbach, B. 1904, **37.** 468.)

Pptd. from aq. solution by gaseous HCl. (Wells, Am. J. Sci. 1894, (3) **50.** 251.)

Cæsium vanadium chloride, $Cs_2VdCl_5+H_2O$.

Difficultly sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Cæsium zinc chloride, 3CsCl, $ZnCl_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

2CsCl, $ZnCl_2$. Easily sol. in H_2O and dil. HCl+Aq. Insol. in conc. HCl+Aq. (Godeffroy.)

Cæsium chloride chromic oxychloride, 2CsCl, $CrOCl_3$.

Decomp. in the air.

Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4045.)

Cæsium chloride columbium oxychloride, 2CsCl, $CbOCl_3$.

Decomp. by H_2O. (Weinland, B. 1906, **39.** 3057.)

Cæsium chloroiodide, $CsCl_2I$.

Properties as CsBrClI. (Wells.)

$CsCl_4I$. Sl. sol. in H_2O, from which it can be recrystallized without decomp. (Wells and Wheeler.)

Cæsium mercuric chloroiodide, $Cs_2HgCl_2I_2$.

Decomp. instantly by H_2O to HgI_2. (Wells.)

Cæsium fluoride, CsF.

Ppt. (Chabrié, C. R. 1901, **132.** 680.)

$+1\frac{1}{2}H_2O$. 100 g. H_2O dissolve 366.5 g CsF at 15°. (de Forcrand, C. R. 1911, **152.** 1210.)

Cæsium hydrogen fluoride, $CsHF_2$.

Ppt. (Chabrié, C. R. 1901, **132.** 680.)

Cæsium tantalum fluoride.

See **Fluotantalate, cæsium.**

Cæsium tellurium fluoride, CsF, TeF_4.

Decomp. by H_2O. (Wells, Am. J. Sci. 1901, (4) **12.** 190.)

Cæsium titanium fluoride.

See **Fluotitanate, cæsium.**

Cæsium zirconium fluoride.

See **Fluozirconate, cæsium.**

Cæsium hydride, CsH.

Decomp. by H_2O with evolution of H_2. (Moissan, C. R. 1903, **136.** 589.)

Cæsium hydroxide, CsOH.

Very deliquescent, and sol. in H_2O. Sol. in alcohol.

79.41% CsOH is contained in a sat. aq. solution at 15°. (de Forcrand, C. R. 1909, **149.** 1344.)

75.08% CsOH is contained in sat. aq. solution at 30°. (Schreinemakers, C. C. **1909,** I. 11.)

Cæsium iodide, CsI.

Sol. in H_2O.

100 pts. H_2O dissolve 44 pts. CsI at 0°; 66.3 pts. at 14.5°; 160 pts. at 61°.

Sp. gr. of CsI+Aq sat. at 14°=1.393. (Betekoff, Bull. Soc. Pétersb. (4) **2.** 197.)

Cæsium *per*iodide.

Solubility determinations show that CsI_3 and CsI_5 are the only periodides of cæsium existing between —4° and +73°. (Foote, Am. Ch. J. 1903, **29.** 203.)

Cæsium *tri*iodide, CsI_3.

1 ccm. sat. $CsI+Aq$ dissolves 0.0097 g. CsI_3, and sp. gr. of solution is 1.154. Only sl. decomp. by solution in H_2O. Much more sol. in alcohol than in H_2O. Not immediately decomp. by ether. (Wells, Sill. Am. J. **143.** 17.)

Cæsium *penta*iodide, CsI_5.

Cæsium cobalt iodide, Cs_2CoI_4.

Decomp. by H_2O. (Campbell, Z. anorg. 1894, **8.** 12.)

Deliquescent; decomp. by H_2O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) **48.** 418.)

Cæsium lead iodide, $CsPbI_3$.

Sl. sol. in hot $CsI+Aq$. (Wheeler, Sill. Am. J. **145.** 129.)

Cæsium mercuric iodide, $CsI, 2HgI_2$

Decomp. by H_2O finally into HgI_2. (Wells, Sill. Am. J. **144.** 221.)

$2CsI, 3HgI_2$. Decomp. by H_2O finally into HgI_2.

CsI, HgI_2. As above.

$2CsI, HgI_2$. Decomp. by H_2O; insol. in alcohol.

$3CsI, HgI_2$. As above.

Cæsium silver iodide, CsI, AgI.

(Penfield, Z. anorg. **1.** 100.)

$CsI, 2AgI$. More sol. in hot than in cold acetone. (Marsh, Chem. Soc. 1913, **103.** 782.)

Cæsium tellurium iodide.

See **Iodotellurate, cæsium.**

Cæsium thallic iodide, CsI, TlI_3.

Decomp. by H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

Cæsium zinc iodide, $3CsI, ZnI_2$.

Sol. in H_2O. (Wells and Campbell, Z. anorg. **5.** 275.)

$2CsI, ZnI_2$. As above.

Cæsium oxide, Cs_2O.

Absorbs H_2O and CO_2 from the air. Decomp. by H_2O and by liquid NH_3. (Rengade, C. R. 1906, **143.** 593.)

Cæsium *di*oxide, Cs_2O_2.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1537.)

Cæsium *tri*oxide, Cs_2O_3.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1537.)

Cæsium *tetr*oxide, Cs_2O_4.

Decomp. by H_2O. (Rengade, C. R. 1905, **140.** 1538.)

Cæsium sulphide, Cs_2S+4H_2O.

Deliquescent; very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 300.)

Cæsium *di*sulphide, Cs_2S_2.

Anhydrous. Sol. in H_2O. Hydroscopic. (Biltz, Z. anorg. 1906, **50.** 72.)

$+H_2O$. From Cs_2S_2+Aq. Hydroscopic. (Biltz, Z. anorg. 1906, **50.** 72.)

Cæsium *tri*sulphide, Cs_2S_3.

Anhydrous. Sol. in H_2O. Not hydroscopic. (Biltz, Z. anorg. 1906, **50.** 75.)

$+H_2O$. From Cs_2S_3+Aq. (Biltz, Z. anorg. 1906, **50.** 76.)

Cæsium *tetra*sulphide, Cs_2S_4.

Sol. in H_2O. Insol. in abs. alcohol. (Biltz, Z. anorg. 1906, **48.** 305.)

Cæsium *penta*sulphide, Cs_2S_5.

Mpt. 2°. Not hydroscopic. Very sol. in cold 70% alcohol. (Biltz, B. 1905, **38.** 129.)

Cæsium hydrogen sulphide, CsHS.

Deliquescent; very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 300.)

Cæsium copper *tetra*sulphide, $CsCuS_4$.

Sl. sol. in cold H_2O.

Decomp. by conc. and dil. HCl, H_2SO_4 and HNO_3.

Sl. sol. in alcohol. (Biltz, B. 1907, **40.** 978.)

Calcium, Ca.

Decomp. H_2O violently. Slowly attacked by cold H_2SO_4. Dil. H_2SO_4+Aq or $HCl+Aq$ attack violently and dissolve. Dil. HNO_3+Aq oxidizes, but fuming HNO_3 scarcely attacks even on boiling. (Bunsen and Matthiessen.) Not attacked by anhydrous alcohol. (Lies-Bodart and Jobin, A. ch. (3) **54.** 364.)

Pure Ca is only very slowly decomp. by H_2O at ordinary temp.; sol. in HCl, HNO_3, H_2SO_4. (Moissan, C. R. 1898, **129.** 589.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

½ ccm. oleic acid dissolves 0.0334 g. Ca in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Calcium amalgam, Ca_3Hg_4.

Decomp. H_2O readily. (Feré, C. R. 1898, **127.** 619.)

$CaHg_5$. Rapidly decomp. in moist air. (Schürger, Z. anorg. 1900, **25.** 425.)

Calcium amide, $Ca(NH_2)_2$.

(Moissan, A. ch. 1899, (7) **18.** 326.)

Calcium ammonia, Ca, $4NH_3$.

Decomp. at ordinary temp.; takes fire in contact with the air; sl. sol. in liquid NH_3. (Moissan, C. R. 1898, **127.** 691.)

Ca,$6NH_3$. (Kraus, J. Am. Chem. Soc. 1908, **30.** 665.)

Calcium arsenide, Ca_3As_2.

Decomp. by cold H_2O; insol. in cold fuming HNO_3; very sol. in hot HNO_3. (Lebeau, C. R. 1899, **128.** 98.)

Calcium azoimide, $Ca(N_3)_2$.

Hydroscopic; explosive.

38.1	pts. sol. in 100 pts.	H_2O	at 0°
45.0	" " " 100 "	H_2O	" 15.2
0.211	" " " 100 "	abs. alcohol	" 16.

Sol. in H_2O; decomp. when heated and on standing in the air. (Dennis, Z. anorg. 1898, **17.** 21.)

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 286.)

Calcium boride, CaB_6.

Not decomp. by H_2O at 250°; sol. in fused oxidizing agents.

Insol. in aq. acids; sl. sol. in conc. H_2SO_4; sol. in dil. or conc. HNO_3. (Moissan, C. R. 1897, **125.** 631–32.)

Calcium bromide, $CaBr_2$.

Very deliquescent. 100 pts. H_2O dissolve—

at 0°	20°	40°	60°	105°
125	143	213	278	312 pts. $CaBr_2$.

(Kremers, Pogg. **103.** 65.)

Sat. $CaBr_2$+Aq contains at:

—22°	—22°	—14°	—7°	—5°
50.5	50.2	52.5	52.6	52.6% $CaBr_2$
+8°	9°	11°	20°	50°
53.1	55.1	55.7	57.1	62.6% $CaBr_2$

(Étard, A. ch. 1894, (7) **2.** 540.)

Sp. gr. of $CaBr_2$+Aq at 19.5° containing:

5	10	15	20	25 %$CaBr_2$,
1.044	1.089	1.139	1.194	1.252
30	35	40	45	50 % $CaBr_2$.
1.315	1.385	1.461	1.549	1.641

(Kremers, Pogg. **99.** 444, calculated by Gerlach, Z. anal. **8.** 285.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Very sol. in alcohol. (Henry.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

$+4H_2O$. (Kuznetzov, C. A. **1911.** 842.)

$+6H_2O$.

Calcium manganous bromide, $CaMnBr_4+4H_2O$.

Sl. hydroscopic. Unstable. (Ephraim, Z. anorg. 1910, **67.** 377.)

Calcium mercuric bromide.

Decomp. by H_2O. (v. Bonsdorff.)

Calcium molybdenyl bromide, $CaBr_2$, $2MoOBr_3+7H_2O$.

(Weinland and Knöll, Z. anorg. 1905, **44.** 112.)

Calcium stannic bromide.

See **Bromostannate, calcium.**

Calcium bromide ammonia, $CaBr_2$, $6NH_3$.

Sol. in H_2O. (Rammelsberg, Pogg. **55.** 239.)

Calcium bromide hydrazine, $CaBr_2$, $3N_2H_4$.

Easily sol. in H_2O. (Franzen, Z. anorg. 1908, **60.** 288.)

Calcium bromofluoride, $CaBr_2$, CaF_2.

Decomp. by H_2O. (Defacqz, A. ch. 1904, (8) **1.** 357.)

Calcium carbide, CaC_2.

Sp. gr. 2.22 at 18°. Insol. in fuming HNO_3 and conc. H_2SO_4 but readily decomp. by dil. acids and H_2O. (Moissan, Bull. Soc. 1894, (3) **11.** 1005.)

Insol. in HCl in the cold, but decomp. at red heat. Strong min. acids do not act in the cold; sol. in glacial acetic in the cold; sol. in fused alkali. (Venable, J. Am. Chem. Soc. 1895, **17.** 307–310.)

Calcium chloride, $CaCl_2$.

Very deliquescent. Very sol. in H_2O with evolution of heat.

Anhydrous $CaCl_2$ is sol. in 1.459 pts. H_2O. (Gerlach.)

Anhydrous $CaCl_2$ is sol. in 1.58 pts. H_2O at 10.2°. (Kremers, Pogg. **108.** 65.)

Anhydrous $CaCl_2$ is sol. in 1.35 pts. H_2O at 20°; 0.83 pt. H_2O at 40°; 0.72 pt. H_2O at 60°. $CaCl_2+6H_2O$ is sol. in 0.5 pt. H_2O at 0°, and 2.05 pt. at 16°. (Gmelin.)

$CaCl_2$ is sol. in 1.5 pts. cold, and 0.8 pt. boiling H_2O. (Fourcroy.)

$CaCl_2$+Aq sat. in the cold contains 40.7% $CaCl_2$. (Fourcroy.)

$CaCl_2$+Aq sat. at 12.5° contains 53.8% $CaCl_2$. (Hassenfratz.)

100 pts. H_2O dissolve 165.7 pts. $CaCl_2+6H_2O$ at 0°; 7141 pts. at 40°. (Tilden, Chem. Soc. **45.** 409.)

100 pts. H_2O dissolve 60.3 pts. $CaCl_2$ from $CaCl_2+6H_2O$ at 0°, and solution has sp. gr. = 1.367. (Engel, Bull. Soc. (2) **47.** 318.)

Solubility of $CaCl_2+6H_2O$ in H_2O at t°.

t°	Sat. solution contains % $CaCl_2$	Sat. solution contains % $CaCl_2+6H_2O$
−22	32.24	63.61
0	36.91	72.82
+ 7.39	38.77	76.49
13.86	41.03	80.95
19.35	42.50	83.85
23.46	44.15	87.11
24.47	45.33	89.44
27.71	46.30	91.35
29.53	50.67	99.97

(Hammerl, W.A.B. **72, 2.** 287.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	59.39	13.86	69.49
5	64.83	19.35	73.91
7.88	66.20	21 89	79.77

(Hammerl, calculated by Bakhuis Roozeboom, R. t. c. **8.** 5.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
0	49.6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179.5	325
71	136	86	145	...	...

(Mulder, Scheik. Verhandel. **1864.** 107.)

If solubility S = pts. anhydrous $CaCl_2$ in 100 pts. solution, $S=32+0.2148t$ from −18° to +6°; $S=54.5+0.0755t$ from 50° to 120°. (Étard, C. R. **98.** 1432.)

According to Bakhuis Roozeboom, the solubility of $CaCl_2$ varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments.

Solubility of $CaCl_2+6H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
20 4	75.1	28.0	88.8	29.5	96.07
25.05	81.67	28.9	92.05	30.2	102.7

There are two modifications of $CaCl_2+4H_2O$, α and β.

Solubility of $CaCl_2+4H_2O\beta$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
18 4	103 3	35.0	122.74
25 0	108.8	38.4	127.50
30.0	114.1	....	....

Solubility of $CaCl_2+4H_2O\alpha$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
22.0	92 67	35.95	107.21
24 7	95.59	40.00	115 3
29 8	100.6	45.00	129.9

Solubility of $CaCl_2+2H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$	t°	Pts. $CaCl_2$
40	128.1	95.8	156.5	139	191.0
45	129.9	115	169.5	155	214.3
50	132.3	124	176.0	165	236.2
59.5	136.5	137	187.6	174	275.7
80.5	145.3	...	...	...	..

Solubility of $CaCl_2+H_2O$ in 100 pts. H_2O at t°.

t°	Pts. $CaCl_2$
191	306
235	331

(Bakhuis Roozeboom, R. t. c. **8.** 1.)

Sp. gr. of $CaCl_2$+Aq.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
3.95	1.03	20 85	1.18	34.57	1 33
7.66	1.06	23 93	1.21	36.49	1.36
11.23	1.09	26 86	1.24	38 31	1.39
14.42	1.12	29.67	1.27	40.43	1.42
17.60	1.15	32.35	1 30	41 91	1 45

(Richter.)

Sp. gr. of $CaCl_2$+Aq at 19.5° containing pts. $CaCl_2$ to 100 pts. H_2O.

Pts. $CaCl_2$	Sp. gr.	Pts. $CaCl_2$	Sp. gr.
6.97	1.0545	36.33	1 2469
12 58	1.0954	50 67	1 3234
23.33	1.1681	62 90	1 3806

(Kremers, Pogg. 99. 444.)

Sp. gr. of $CaCl_2$+Aq. G=sp. gr. at 15° if % is $CaCl_2$, according to Gerlach; S=sp. gr. at 18.3° if % is $CaCl_2+6H_2O$, according to Schiff.

%	G	S	%	G	S
1	1.00852	1.0039	36	1.35610	1.1575
2	1.01704	1.0079	37	1.36790	1.1622
3	1.02555	1.0119	38	1.37970	1 1671
4	1.03407	1.0159	39	1.39150	1.1719
5	1.04259	1.0200	40	1.40330	1.1768
6	1.05146	1.0241	41	...	1.1816
7	1.06033	1.0282	42	...	1.1865
8	1.06921	1.0323	43	...	1.1914
9	1.07808	1.0365	44	...	1.1963
10	1.08695	1.0407	45	...	1.2012
11	1.09628	1.0449	46	...	1.2062
12	1.00561	1.0491	47	...	1.2112
13	1.10494	1.0534	48	...	1.2162
14	1.12427	1.0577	49	...	1.2212
15	1.13360	1.0619	50	...	1.2262
16	1.14332	1.0663	51	...	1.2312
17	1.15305	1.0706	52	...	1.2363
18	1.16277	1.0750	53	...	1.2414
19	1.17250	1.0794	54	...	1.2465
20	1.18222	1.0838	55	...	1.2516
21	1.19251	1.0882	56	...	1.2567
22	1.20279	1 0927	57	...	1.2618
23	1.21308	1.0972	58	...	1.2669
24	1.22336	1.1017	59	...	1.2721
25	1.23365	1.1062	60	...	1.2773
26	1.24450	1.1107	61	...	1.2825
27	1.25535	1.1153	62	..	1.2877
28	1.26619	1.1199	63	...	1.2929
29	1.27704	1.1246	64	...	1.2981
30	1 28789	1.1292	65	...	1.3034
31	1.29917	1.1339	66	...	1.3087
32	1.31045	1.1386	67	...	1 3140
33	1.32174	1.1433	68	...	1 3193
34	1.33602	1.1480	69	...	1.3246
35	1 34430	1.1527	70	...	1.3300

(Calculated by Gerlach, Z. anal. **8**, 283.)

Sp. gr. of $CaCl_2$+Aq : a = no. of *half molecules* in grammes dissolved in 1000 g. H_2O; b=sp. gr. at 24.3° when a=$CaCl_2+6H_2O$ (½ mol.=109.5 g.); c=sp. gr. at 24.3° when a=$CaCl_2$ (½ mol.=55.5 g.).

a	b	c	a	b	c
1	1.041	1.043	7	1.198	1.258
2	1.076	1.084	8	1.214	..
3	1.106	1.122	9	1.229	..
4	1.133	1.159	10	1.242	...
5	1.157	1.193	11	1.255	...
6	1.179	1 227	..	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $CaCl_2$+Aq at 18°.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
5	1.0409	25	1 2305
10	1.0852	30	1.2841
15	1.1311	35	1 3420
20	1.1794	.	

(Kohlrausch, W. Ann. **1879.** 1.)

$CaCl_2$+Aq sat. at 0° has sp. gr.=1.367. (Engel, Bull. Soc. 1887, (2) **47.** 318.)

Sp. gr. of $CaCl_2$+Aq at 9.5°C.

Mass of salt per unit mass of solution	Density of solution (g per cc.)
0 00191	1.00168
0.00381	1.00317
0.00570	1.00465
0.00759	1.00615
0.00947	1.00765
0.01320	1.01050

(McGregor, C. N. 1887, **55.** 6.)

Sp. gr. of $CaCl_2$+Aq at 25°.

Concentration of $CaCl_2$+Aq.	Sp. gr.
1-normal	1.0446
1/2- "	1.0218
1/4- "	1.0105
1/8- "	1.0050

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. at 16°/4° of $CaCl_2$+Aq containing 12.1638% $CaCl_2$=1.10489. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

Sp. gr. of $CaCl_2$+Aq at 17.925°C.

% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.	% $CaCl_2$	Sp. gr.
0.0	0.99869	13	1.11206	33	1.31562
0.1	0.99954	14	1.12130	34	1.32689
0.2	1.00037	15	1.13067	35	1.33821
0.3	1.00116	16	1.14016	36	1.34956
0.4	1.00201	17	1.14969	37	1.36100
0.6	1.00371	18	1.15926	38	1.37242
0.8	1.00539	19	1.16920	39	1.38400
1.0	1.00703	20	1.17910	40	1.39489
1.5	1.01127	21	1.18897	41	1.40641
2	1.01548	22	1.19901	42	1.41770
3	1.02386	23	1.20901	43	1.42882
4	1.03238	24	1.21918	44	1.44007
5	1.04089	25	1.22941	45	1.45124
6	1.04951	26	1.23969	46	1.46238
7	1.05822	27	1.25030	47	1.47329
8	1.06680	28	1.26092	48	1.48450
9	1.07569	29	1.27182	49	1.49573
10	1.08467	30	1.28271	50	1.50676
11	1.09373	31	1.29360	51	1.51778
12	1.10288	32	1.30461		

(Pickering, B. 1894, **27.** 1385.)

Sp. gr. of $CaCl_2$+Aq at t°.

t°	Concentration of $CaCl_2$+Aq	Sp. gr.
20	1 pt. $CaCl_2$ in 7.1045 pts. H_2O	1.1062
20	1 " " " 164.25 " "	1.0032

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Sp. gr. of $CaCl_2$+Aq at 20°.

g. mols. $CaCl_2$ per l.	Sp. gr.
0.010	1.000982
0.025	1.002539
0.050	1.004874
0.075	1.006814
0.10	1.008971
0.25	1.02267
0.50	1.04451
0.75	1.06641
1.00	1.08744

(Jones and Pearce, Am. Ch. J. 1907, **38.** 696.)

Sat. $CaCl_2$+Aq forms a crust at 150°, and contains 178 pts. $CaCl_2$ to 100 pts. H_2O. (Gerlach.)

Sat. $CaCl_2$+Aq boils at 180°. (Rüdorff.)

B.-pt. of $CaCl_2$+Aq containing pts. $CaCl_2$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 440); L=according to Legrand (A. ch. (2) **39.** 43).

B.-pt.	G	L	B.-pt.	G	L
101°	6.0	10	134°	...	117.2
102	11.5	16.5	135	119	...
103	16.5	21.6	136	...	123.5
104	21.0	25.8	138	...	129.9
105	25.0	29.4	140	137.5	136.3
106	29.0	32.6	142	...	142.8
107	32.5	35.6	144	...	149.4
108	35.5	38.5	145	157	...
109	38.5	41.3	146	...	156.2
110	41.5	44.0	148	...	163.2
111	....	46.8	150	178	170.5
112	....	49.7	152	..	178.1
113	....	52.6	154	...	186.0
114	....	55.6	155	200	...
115	55.0	58.6	156	...	194.3
116	....	61.6	158	...	203.0
117	....	64.6	160	222	212.1
118	....	67.6	162	...	221.6
119	....	70.6	164	...	231.5
120	69.0	73.6	165	245	..
121	...	76.7	166	...	241.9
122	....	79.8	168	..	252.8
123	....	82.9	170	268	264.2
124	...	86.0	172	...	276.1
125	....	89.1	174	...	285.5
126	...	92.2	175	292	...
128	...	98.4	176	...	301.4
130	101	104.6	178	305	314.8
130.4	102.67	...	179.5	...	325.0
132	....	110.9	...	...	...

B.-pt. of $CaCl_2$+Aq.

% $CaCl_2$	B.-pt.	% $CaCl_2$	B.-pt.
5.6	101°	17.5	104°
10.3	102	20.0	105
14.5	103	....	...

(Skinner, Chem. Soc. **61.** 340.)

Less sol. in HCl+Aq than in H_2O. HCl+Aq sat. at 12° dissolves 27% $CaCl_2$, which crystallizes out with $2H_2O$. (Ditte, C. R. **92.** 242.)

Solubility of $CaCl_2$ in HCl+Aq at 0°.

Sp. gr. of solutions	g. per 100 cc. solution	
	$CaCl_2$	HCl
1.367	51.45	0.0
1.344	46.45	3.32
1.326	42.80	5.83
1.310	36.77	10.66
1.283	29.84	15.84
1.250	20.12	23.05
1.238	11.29	34.62

(Engel, C. R. 1887, **104,** 434.)

$CaCl_2+CaO_2H_2$. Solubility of $CaCl_2+CaO_2H_2$ in H_2O at 25°.

% $CaCl_2$	% CaO_2H_2	Solid phase
5.02	0.101	CaO_2H_2
10.00	0.115	"
12.94	0.128	"
15.14	0.140	"
17.20	0.145	"
18.15	0.148	$CaO_2H_2+CaCl_2$, $4CaO.14H_2O$
18.01	0.152	$CaCl_2$, $4CaO.14H_2O$
21.02	0.147	"
23.80	0.146	"
24.33	0.147	"
28.37	0.170	"
29.54	0.180	"
32.67	0.225	CaO_2H_2(?)
33.21	0.245	$CaCl_2$, $4CaO.14H_2O$
33.72	0.254	$CaCl_2$, $4CaO.14H_2O+CaCl_2$, $CaO.2H_2O$
34.36	0.173	$CaCl_2$, $CaO.2H_2O$
38.61	0.060	"
41.32	0.048	"
44.30	0.030	"
44.60	0.029	$CaCl_2$, $6H_2O+CaCl_2$, $CaO.2H_2O$
44.77	. . .	$CaCl_2.6H_2O$

(Schreinemakers and Figee, Chem. Weekbl. 1911, **8.** 685.)

See also under **Calcium hydroxide**

$CaCl_2+KCl$. 100 pts. H_2O dissolve 56 pts. $CaCl_2$ at 7°; 100 pts. H_2O dissolve 31 pts. KCl at 7°; 100 pts. H_2O dissolve 63.5 pts. $CaCl_2$+4.9 pts. KCl at 7°. (Mulder, J. B. **1866.** 67.)

$CaCl_2+NaCl$. 100 pts. H_2O dissolve 53 pts. $CaCl_2$ at 4°, and 56 pts. at 7°; 100 pts. H_2O dissolve 35.7 pts. NaCl at 4°, and 35.7 pts. at 7°; 10C pts. H_2O dissolve 57.6 pts. $CaCl_2$+2.4 pts. NaCl at 4°; 100 pts. H_2O dissolve 59.5 pts. $CaCl_2$+4.6 pts. NaCl at 7°. (Mulder, *l. c.*)

100 g. H_2O dissolve 72.6 g. $CaCl_2$+16.0 g. NaCl at 15°. (Rüdorff.)

Sol. in sat. KNO_3+Aq. (Fourcroy.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in 1 pt. strong boiling alcohol. (Wenzel.)

Sol. in 8 pts. alcohol at 15°, and in 1 pt. spirits of wine. (Bergman.)

Sol. in 0.7 pt. boiling absolute alcohol. (Otto.)

Sol. in 1.43 pts. boiling absolute alcohol at 78.3°. (Graham.)

Solubility of $CaCl_2$ in methyl alcohol.

$CaCl_2$ forms with methyl alcohol two complexes: $CaCl_2.4CH_3OH$ and $CaCl_2.3CH_3OH$.

Solubility of $CaCl_2$, $4CH_3OH$ in CH_3OH.

t°	% by weight of $CaCl_2$, $4CH_3OH$
0	33.3
10	37.6
20	42.2
30	47.0
40	52.0
50	57.3
55	60.0
56	61.3

Solubility of $CaCl_2$, $3CH_3OH$ in CH_3OH.

t°	% by weight of $CaCl_2$, $3CH_3OH$
55	60.5
75	63.1
95	66.3
115	70.3
135	75.2
155	81.8
165	86.2
170	89.5
174	93.5
177 (mpt.)	100

(Menschutkin, Z. anorg. 1907, **52.** 21.)

Solubility of $CaCl_2$ in ethyl alcohol.

$CaCl_2$ forms with ethyl alcohol a complex, $CaCl_2.3C_2H_5OH$.

Solubility of $CaCl_2.3C_2H_5OH$ in C_2H_5OH at t°.

t°	% by weight of $CaCl_2.3C_2H_5OH$	t°	% by weight of $CaCl_2.3C_2H_5OH$
0	34.8	80	86.8
20	46.0	85	89.2
40	58.7	90	91.9
60	73.0	95	96.2
70	80.8	97 mpt.	100

(Menschutkin, Z. anorg. 1907, **52.** 23.)

Sp. gr. at 16°/4° of $CaCl_2$+alcohol containing 5.668% $CaCl_2$=0.83636. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

B.-pt. of an alcoholic solution of $CaCl_2$.

% $CaCl_2$	B.-pt.
2.4	78.43°+ 0.70°
5.39	78.43 + 2.15
8.01	78.32 + 4.18
9.93	78.43 + 5.55
15.94	78.43 +11.75

(Skinner, Chem. Soc. **61.** 340.)

Sl. sol. in propyl alcohol. (Berthelot.)

100 g. propyl alcohol dissolve 10.75 g. $CaCl_2$. (Schlamp, Z. phys. Ch. 1894, **14,** 276.)

Sl. sol. in amyl alcohol. (Bouis.)

Pptd. from alcoholic solution by ether. (Döbbereiner.)

Sol. in wood-spirit; sol. in lignone (Liebig); insol. in lignone. (Gmelin.)

Insol. in acetone; sol. in butyl alcohol. (Wurtz.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Solubility in acetone+Aq at 20°.

$CaCl_2$ will salt out acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of $CaCl_2$, acetone and H_2O just become homogeneous at 20°. 100 g. of the solution contain:

g. $CaCl_2$	g. H_2O	g. acetone
13.03	52.49	34.48
8.5	45.37	46.15
6.38	39.51	54.11
5.35	35.95	58.70
4.11	31.8	64.09
3.58	29.88	66.54
3.31	28.59	68.10
3.04	27.03	69.93
2.77	26.67	70.56
13.90	53.47	32.63
10.12	48.86	41.02
8.47	45.59	45.94
6.92	41.24	51.84
6.31	39.15	54.54
5.28	36.09	58.63
4.94	34.72	60.34
4.37	33.8	61.83
1.99	23.38	74.63
1.6	21.4	77.00
1.35	19.92	78.73
18.787	55.301	25.913
12.443	52.153	35.404
10.70	49.61	39.69
9.59	47.75	42.66
8.82	46.04	45.14
7.48	42.75	49.77
7.07	41.54	51.39
6.72	40.48	52.8
30.04	49.39	20.57
18.23	55.01	26.76
15.49	54.00	30.51
13.18	52.52	34.3
11.40	50.20	38.40
28.09	51.71	20.20
26.81	52.01	21.18
22.67	55.66	21.67
18.189	56.21	25.60
31.21	48.00	20.81
2.23	24.93	72.84
1.82	22.27	75.89
0.68	15.87	83.44
0.58	14.93	84.49
0.45	13.55	86.00
0.48	14.49	85.13
0.27	12.31	87.42
0.20	9.95	89.85
0.15	9.05	90.81

(Frankforter, J. Am. Chem. Soc. 1914, **36.** 1125.)

Sol. in many compound ethers, as ethyl acetate (Liebig), ethyl lactate (Strecker).

Sol. in considerable quantity in amyl sulphocyanide. (Medlock, Chem. Soc. **1.** 374.)

Sol. in valyl. (Kolbe.)

Very sol. in conc. $HC_2H_3O_2$. (Liebig.)

Solubility of $CaCl_2$ in acetic acid.

$CaCl_2$ forms with acetic acid a complex, $CaCl_2$, $4CH_3COOH$.

Solubility of $CaCl_2$, $4CH_3COOH$ in CH_3COOH at t°.

t°	% by wt. $CaCl_2$, $4CH_3COOH$
11.1	42.0
30	47.6
35	50.0
40	54.7
45	63.0
50	69.5
60	79.5
65	84.5
70	91.2
73	100.0

(Menschutkin, Z. anorg. 1907, **54.** 95.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sl. sol. in anhydrous pyridine.

Sol. in 97%, 95% and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

100 g. sat. solution of $CaCl_2$ in sat. sugar+Aq at 31.25° contain 42.84 g. sugar+25.25 g. $CaCl_2$, or 100 g. H_2O dissolve 135.1 g. sugar +79.9 g. $CaCl_2$ at 31.25°. (Köhler, Z. Ver. Zuckerind, 1907, **47.** 447.)

$+H_2O$. (Bakhuis Roozeboom.) *See above.*

$+2H_2O$. (Bakhuis Roozeboom.) *See above.*

$+4H_2O$. Two modifications. (Bakhuis Roozeboom.) *See above.*

α and β modifications (α=stable form.) (Kuznetzov, C. A. **1911,** 842.)

$+6H_2O$. Very deliquescent. Sol. in H_2O with absorption of much heat.

250 pts. $CaCl_2+6H_2O$ with 100 pts. H_2O at 10.8° lower the temp. 23.2°. (Rüdorff, B. **2.** 68.)

Melts in crystal H_2O at 28° (Tilden, Chem. Soc. **45.** 409); at 30.2° (Bakhuis Roozeboom.)

Sat. solution in H_2O contains at:

—22°	—17°	—5°	—5°	+4°
31.5	32.4	35.1	35.2	36.5% salt,
8°	22°	29°	35°	49°
37.9	42.1	46.1	49.0	55.1% salt,
63°	80°	104°	115°	
55.9	57.5	58.5	58.6% salt.	

(Étard, A. ch. 1894, (7) **2.** 532.)

Sat. solution of $CaCl_2+6H_2O$ contains

44.77 g. $CaCl_2$ at 25°. (Schreinemakers and Figee, Chem. Weekbl. 1911, **8.** 685.)
See also above.

Solubility of $CaCl_2+6H_2O$ in ethyl alcohol+Aq under addition of increasing amounts of $CaCl_2$.

Per cent of alcohol by volume	G. $CaCl_2$ added	Grams $CaCl_2$ in 5 cc. of solution
92.3		1.430
97.3		1.409
99.3		1.429
"	1	1.529
"	2	1.561
"	3	1.590
"	4	1.641
"	5	1.709

(Bödtker, Z. phys. Ch. 1897, **22.** 510.)

Calcium hydroxylamine chloride, $CaCl_2$, $3NH_2OH$, HCl.

(Antonow, J. Russ. Phys. Chem. Soc. 1905, **37.** 479.)

Calcium iodine *tri*chloride, $2ICl_3$, $CaCl_2+8H_2O$.

Hydroscopic. (Weinland, Z. anorg. 1902, **30.** 142.)

Calcium mercuric chloride, $CaCl_2$, $5HgCl_2+8H_2O$.

Decomp. by cold H_2O, which dissolves out $CaCl_2$, but all dissolves on heating. (v. Bonsdorff, **1829.**)

$CaCl_2$, $2HgCl_2+6H_2O$. Deliquescent. Very sol. in H_2O. (v. Bonsdorff.)

$CaCl_2$, $6HgCl_2+6H_2O$. Very deliquescent. Decomp. by H_2O. (Strömholm, J. pr. 1902, (2) **66.** 521.)

Calcium lead chloride, basic.

See **Calcium lead oxychloride.**

Calcium magnesium chloride, $CaCl_2$, $2MgCl_2+12H_2O$.

Min. *Tachhydrite.* Deliquescent.

100 pts. H_2O dissolve 160.3 pts. at 18.75°. By dissolving 20 pts. in 80 pts. H_2O the temp. is raised 7.75°. (Bischof.)

Calcium mercuric chloride, basic, $CaCl_2$, $2HgO+4H_2O$.

See **Calcium mercuric oxychloride.**

Calcium thallic chloride, $2TlCl_3$,$CaCl_2+6H_2O$.

Can be cryst. from H_2O. (Gewecke A. 1909, **366.** 222.)

Calcium tin (stannic) chloride.

See **Chlorostannate, calcium.**

Calcium uranium chloride, $CaCl_2$,UCl_4.

Decomp. by H_2O. (Aloy, Bull. Soc. 1899, (3) **21.** 265.)

Calcium zinc chloride.

$CaZnCl_4+5\frac{1}{2}H_2O$, and $Ca_2ZnCl_6+6H_2O$. Very hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 379.)

Calcium chloride ammonia, $CaCl_2$, $8NH_3$.

Sol. in H_2O with decomp. (Faraday.)

Calcium chloride hydrazine, $CaCl_2$, $2N_2H_4$(?).

Ppt. (Franzen, Z. anorg. 1908, **60.** 288.)

Calcium chloride hydroxylamine, $CaCl_2$, NH_2OH+5H_2O.

Not hygroscopic. (Antonow, J. Russ. Phys. Chem. Soc. 1905, **37.** 479.)

$CaCl_2$, $2NH_2OH$.

$+H_2O$. Aqueous solution sat. at 20° contains 56.6 pts. salt.

$+2H_2O$. (Antonow, *l. c.*)

$2CaCl_2$, $3NH_2OH+6H_2O$. (Antonow, *l. c.*)

$2CaCl_2$, $5NH_2OH+4H_2O$. (Antonow, *l. c.*)

Calcium chloride lead oxide, $CaCl_2$, $3PbO+3H_2O$.

See **Calcium lead oxychloride.**

Calcium chloroferrite, CaO, $CaCl_2$, Fe_2O_3.

Insol. in H_2O. (le Chatelier, C. R. **99.** 276.)

Calcium chlorofluoride, CaF_2, $CaCl_2$.

Decomp. by H_2O, by very dil. HCl, HNO_3 or acetic acid, by hot dil. or conc. H_2SO_4. Sol. in conc. HCl or HNO_3. Insol. in, and not decomp. by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) **1.** 355.)

Calcium cyanamide, basic, $CN_2(CaOH)_2+6H_2O$.

Sl. sol. in H_2O. (Meyer, J. pr. 1878, (2) **18.** 425.)

Calcium cyanamide, $CaCN_2$.

Decomp. by H_2O. (Meyer, J. pr. 1878, (2) **18.** 425.)

Calcium *sub*fluoride, CaF.

Decomp. by H_2O.

Sol. in hot dil. HCl and somewhat sol. in dil. acetic acid.

Somewhat sol. in boiling absolute alcohol. (Wöhler, Z. anorg. 1909, **61.** 81.)

Calcium fluoride, CaF_2.

Sol. in 26,923 pts. H_2O at 15.5°. (Wilson, Ch. Gaz. **1850.** 366.)

1 l. H_2O dissolves 16 mg. CaF_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

16.3 mg. in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

When pptd. not completely insol. in H_2O; scarcely sol. in dil., more sol. in conc. $HCl+Aq$; decomp. by conc. H_2SO_4; not decomp. by dil. alkaline solutions. (Fresenius.)

Not decomp. by conc. H_2SO_4 below 40°, but forms a transparent syrup. CaF_2 is pptd. from this solution by addition of H_2O.

Sol. in conc. HCl, and HNO_3+Aq in the same way, but the liquid is not viscid. Very sl. sol. in HF. Boiling $HCl+Aq$ dissolves slightly. Decomp. by boiling HNO_3+Aq.

Sol. in NH_4 salts+Aq. (Rose.)

Partly decomp. by boiling K_2CO_3, and Na_2CO_3+Aq. (Dulong, A. ch. **82.** 278.)

Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Min. *Fluorite* (*Fluorspar*). Calculated from electrical conductivity of CaF_2+Aq. 1 l. H_2O dissolves 14 mg. CaF_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Calcium hydrogen fluoride, $CaH_2F_4+6H_2O$.

Decomp. by boiling H_2O. Sol. in $HF+Aq$. (Fremy, A. ch. (3) **47.** 35.)

Calcium tantalum fluoride.

See **Fluotantalate, calcium.**

Calcium stannic fluoride.

See **Fluostannate, calcium.**

Calcium titanium fluoride.

See **Fluotitanate, calcium.**

Calcium fluoiodide, CaF_2,CaI_2.

Very deliquescent. Decomp. by cold H_2O, more rapidly by hot H_2O, by dil. HCl, HNO_3, H_2SO_4 conc. H_2SO_4, and by alcohol and by ether if these reagents are not absolute. (Defacqz, A. ch. 1904, (8) **1.** 358.)

Calcium hydride, CaH.

Decomp. by $HCl+Aq$. (Winkler, B. **24.** 1975. (Moldenhauer, Z. anorg. 1913, **82.** 136.)

CaH_2. Readily decomp. by H_2O and dil. acids, almost insol. in conc. acids. Insol. in benzene, turpentine and alkyl haloids. (Moissan, C. R. 1898, **127.** 30–31.)

Decomp. H_2O and ether; sol. in dil. H_2SO_4 and HNO_3; almost insol. in conc. H_2SO_4 and HNO_3: (von Lengyll, C. C. **1898,** II. 262.)

Insol. in CCl_4, CS_2, alcohols and ethers. No known solvent. (Moissan, C. C. **1903,** I. 863.)

Calcium hydrosulphide, CaS_2H_2.

Cryst. with $6H_2O$. Extremely sol. in H_2O and alcohol. ¼ of its weight of H_2O at ordinary temp. more than suffices to hold it in solution. (Divers and Shimidzu, Chem. Soc. **45.** 271.)

Sp. gr. of aqueous solution containing 32% anhydrous CaS_2H_2 (64% $CaS_2H_2+6H_2O$) = 1.255; 37.5% CaS_2H_2 (75.5% $CaS_2H_2+6H_2O$) = 1.310. (Divers and Shimidzu.)

Calcium hydroxide, CaO_2H_2.

See also **Calcium oxide.**

Sl. sol. in cold, and less in hot H_2O.

1 pt. CaO dissolves at t° in pts. H_2O.

t°	Pts. H_2O	Authority
20	450	Davy.
0	656	Phillips (A. Phil. **17.** 107)
	700	Bergman (Essays, etc.).
13	785	Pavesi and Rotondi (B. **7.** 817)
18	780	Bineau (A. ch. (3) **51.** 290).
19.5	806	P. and R. (*l. c.*).
23	814	P. and R. (*l. c.*).
18 75	960	Abl.
54 4	972	Dalton (Syst. **2.** 231).
15 6	778	Dalton (*l. c.*).
15 6	752	Phillips (*l. c.*).
15 6	731	Wittstein (Repert. Pharm. **1.** 182).
15 6	741	Tichborne (Bull. Soc. (2) **17.** 24).
100	1270	Dalton (*l. c.*).
100	1280	Phillips (*l. c.*).
100	1330	Wittstein (*l. c.*).
100	1340	Tichborne (*l. c.*).
100	1500	Bineau (*l. c.*).
100	1758	Tichborne (*l. c.*).

Solubility in H_2O. 1000 pts. CaO_2H_2+Aq sat. at t° contain pts. CaO.

t°	Pts. CaO		
	From Nitrate	Marble	Hydrate
0	1.362	1.381	1.430
10	1.311	1.342	1.384
15	1.277	1.299	1.344
30	1.142	1.162	1.195
45	0.996	1.005	1.033
60	0.884	0.868	0.885
100	0.562	0.576	0.584

(Lamy, C. R. **86.** 333.)

Solubility of CaO_2H_2 in H_2O at t°.

t°	Pts. H_2O to 1 pt. CaO	Pts. CaO in 100 pts. H_2O	t°	Pts. H_2O to 1 pt. CaO	Pts. CaO in 100 pts. H_2O
0	759	0.131	60	1136	0.088
10	770	0.129	70	1235	0.080
20	791	0.126	80	1362	0.073
30	862	0.116	90	1579	0.063
40	932	0.107	100	1650	0.060
50	1019	0.098	...	....	...

(Maben, Pharm. J. Trans. (3) **14.** 505.)

1 pt. CaO_2H_2 is sol. in 640 pts. H_2O at 19°, and 3081 pts. at 150°. (Shenstone and Cundall, Chem. Soc, **53.** 550.)

1000 g. H_2O dissolve 1.251 g. CaO. (Carles, Arch. Pharm. (3) **4.** 558.)

Solubility of CaO_2H_2 in H_2O. 100 pts. H_2O dissolve pts. CaO at t°.

t°	Pts. CaO	t°	Pts. CaO
20	0.1374	80	0.0845
40	0.1162	100	0.0664
60	0.1026	..	...

(Zahorsky, Z. anorg. **3.** 34.)

1 pt. CaO is sol. in pts. H_2O at t°.

t°	15°	20°	25°	30°	35°	40°	45°
pts. H_2O	776	813	848	885	924	962	1004

t°	50°	55°	60°	65°	70°	75°	80°
pts. H_2O	1044	1108	1158	1244	1330	1410	1482

(Herzfeld, C. C. **1897,** I, 932.)

100 g. sat. CaO_2H_2+Aq contain g. CaO at t°:

t°	5	10	15	20	25
g. CaO	0.135	0.1342	0.132	0.1293	0.1254

t°	30	35	40	50	60
g. CaO	0.1219	0.1161	0.1119	0.0981	0.0879

t°	70	80	90	100
g. CaO	0.0781	0.074	0.0696	0.0597

(Guthrie, J. Soc. Chem. Ind. 1901, **20.** 223.)

Solubility in H_2O at high temp.
1 litre of the solution contains at:

120°	150°	190°
0.305	0.169	0.084 g. CaO.

(Herold, Z. elektrochem. 1905, **11.** 421.)

Solubility in H_2O at t°.

t°	1 g. CaO is sol. in g. H_2O at t°
2	768.5
10	786.8
15	804.3
20	826.4
25	868.7
30	908.2
40	988.1
50	1083.0
60	1179.0
70	1274.8
80	1368.1

(Moody, Chem. Soc. 1908, **93.** 1772.)

Sat. CaO_2H_2+Aq contains at:

95°	76°
0.0580	0.0705% by wt. CaO.

(Tschugaeff, Z. anorg. 1914, **86.** 159.)

100 g. sat. solution of CaO_2H_2 in H_2O at 25° contain 0.117 g. CaO_2H_2. (Cameron and Potter, J. phys. Ch. 1911, **15.** 70.)
Readily sol. in most acids.

Sol. in H_3BO_3+Aq at 30°. (Sborgi, Real. Ac. Linc. 1913, (5) **22.** I, 715 and 798.)
Sol. in NH_4Cl+Aq. Much more sol. in NaCl+Aq than in H_2O. (Rose.)

Solubility of CaO_2H_2 in NH_4Cl+Aq at 25°.

Concentration of NH_4Cl+Aq in millimols per liter	Solubility of CaO_2H_2 in millimols per liter
0.00	20.22
21.76	29.08
43.52	39.23
87.03	59.68

(Noyes and Chapin, Z. phys. Ch. 1899, **28.** 520.)

Solubility of CaO_2H_2 in $CaCl_2$+Aq. 100 pts. $CaCl_2$+Aq of given strength dissolve pts. CaO at t°.

t°	$CaCl_2$+Aq 5% $CaCl_2$	$CaCl_2$+Aq 10% $CaCl_2$	$CaCl_2$+Aq 15% $CaCl_2$	$CaCl_2$+Aq 20% $CaCl_2$	$CaCl_2$+Aq 25% $CaCl_2$	$CaCl_2$+Aq 30% $CaCl_2$
20	0.1370	0.1661	0.1993	0.1857*	0.1661*	0.1630*
40	0.1160	0.1419	0.1781	0.2249	0.3030*	0.3684*
60	0.1020	0.1313	0.1706	0.2204	0.2989	0.3664
80	0.0936	0.1328	0.1736	0.2295	0.3261	0.4122
100	0.0906	0.1389	0.1842	0.2325	0.3710	0.4922

* In these cases, ppts. of $3CaO.\ CaCl_2+15H_2O$ were formed.

(Zahorsky, Z. anorg. **3.** 34.)

See also $CaCl_2+CaO_2H_2$ under **Calcium chloride.**

Solubility in $Ca(NO_3)_2$+Aq at 25°.

Sp. gr. 25°/25°	g. CaO as $Ca(OH)_2$ in 100 g. H_2O	g. $Ca(NO_3)_2$ in 100 g. H_2O	Solid phase
1.0249	0.096	3.38	$Ca(OH)_2$
1.0484	0.109	8.52	
1.0940	0.125	13.42	
1.1383	0.181	20.73	$Ca(OH)_2$ and solid solution CaO, xN_2O_5, yH_2O
1.1840	0.187	28.98	Solid solution CaO, xN_2O_5, yH_2O
1.2101	0.198	32 84	
1 2287	0.212	36.83	
1.2290	0.213	37.55	
1.2541	0.224	40.25	
1.2581	0.230	41.98	
1.2826	0 260	47.00	
1.2905	0 263	47.16	
1.3337	0.332	58.67	
1.3735	0.429	69.40	
1.4195	0.545	83.03	Solid solution CaO, xN_2O_5, yH_2O and $Ca(NO_3)_2$, $3\frac{1}{2}H_2O$
1.4840	0.449	99.70	$Ca(NO_3)_2$, $3\frac{1}{2}H_2O$
1.5330	0.371	115 50	
1 5809	0.303	135.30	$Ca(NO_3)_2$, $3\frac{1}{2}H_2O$ and $Ca(NO_3)_2$, $4H_2O$.
1.5842	0.000	139.30	$Ca(NO_3)_2$, $4H_2O$

(Cameron and Robinson, J. phys. Chem. 1907, **11.** 275.)

Solubility of CaO_2H_2 in $Ca(NO_3)_2$+Aq.
Temp. = 25°.

G. per 100 g. sat. solution		Solid phase
CaO	$Ca(NO_3)_2$	
0.1150	0	CaO_2H_2
0.0978	4.84	"
0.1074	9.36	"
0.1193	13.77	"
0.1444	22.46	"
0.1650	27.83	"
0.1931	32.94	"
0.2579	40.66	"
0.3060	44.44	"
0.2802	45.28	$Ca_2N_2O_7.3H_2O$
0.2314	47.79	"
0.1894	51.07	"
0.1659	53.20	"
0.1486	55.25	"
0.0836	57.72	$Ca(NO_3)_2.4H_2O$
0	57.98	"

Temp. = 100°.

0.0561	0	CaO_2H_2
0.0550	2.42	"
0.0624	4.91	"
0.1110	15.39	"
0.1200	16.10	"
0.155	21.86	"
0.269	33.03	"
0.480	42.26	"
0.973	50.94	"
1.261	53.75	"
1.477	55.40	"
1.476	55.43	"
1.491	55.65	"
1.635	56.89	$CaO_2H_2+Ca_2N_2O_7.2H_2O$
1.686	57.03	$Ca_2N_2O_7.2H_2O$
1.596	57.91	"
1.576	58.67	"
1.348	60.44	"
1.167	62.82	"
1.077	66.44	"
1.141	69.12	"
1.252	70.60	$Ca_2N_2O_7.2H_2O+Ca_2N_2O_7.\frac{1}{2}H_2O$
1.203	70.40	$Ca_2N_2O_7.\frac{1}{2}H_2O$
1.103	71.44	"
0.937	73.85	"
0.849	75.74	"
0.815	76.94	"
0.804	77.62	$Ca(NO_3)_2$
0.412	77.74	"
0	78.43	"

(Bassett and Taylor, Chem. Soc. 1914, **105.** 1926.)

Solubility of CaO in KCl and NaCl+Aq.

Curves are given which show that the solubility of lime in solutions of either NaCl or KCl is a maximum for all temps. when the solution contains about 60 g. of salt per l. It is a minimum at any fixed temp. when the solution is sat., the solubility then being much less than in pure H_2O of the same temp. A solution of NaCl dissolves more lime at all temps. and concentrations than a corresponding solution of KCl. In all cases the maximum solubility of lime occurs when the temp. is lowest. With solutions of all concentrations the solubility decreases regularly as the temp. increases. (Cabot, J. Soc. Chem. Ind. 1897, **16.** 417-419.)

Solubility in KCl+Aq increases with increased quantities of KCl and then diminishes, becoming less than the solubility in H_2O alone. (Kernot, Gazz. ch. it. 1908, **38.** (1) 532.)

KOH or NaOH+Aq containing 1 pt. KOH or NaOH in 100 pts. H_2O do not dissolve more than $^1/_{50000}$ pt. CaO_2H_2, but it is sol. in NH_4OH+Aq. (Pelouze, A. ch. (3) **33.** 11.)

Solubility in NaOH+Aq at t°.

G. NaOH per l	Solubility of CaO in g. per liter at			
	20°	50°	70°	100°
0	1.17	0.88	0.75	0.54
0.400	0.94	0.65	0.53	0.35
1.600	0.57	0.35	0.225	0.14
2.666	0.39	0.20	0.11	0.05
5.000	0.18	0.06	0.04	0.01
8.000	0.11	0.02	0.01	traces
20.000	0.02	traces	0	0

(d'Anselme, Bull. Soc. 1903, (3) **29.** 936.)

Solubility of CaO in NaCl+NaOH+Aq.

G. NaCl per l.	G. CaO per l. of solution containing		
	No NaOH	0.89 g. NaOH per l.	4.09 g. NaOH per l.
0	1.3	0.8	0.22
5	1.4	0.9	....
10	1.6	1.0	....
25	1.7	1.1	....
50	1.8	1.25	....
75	1.9	1.4	0.55
100	1.85	1.4	....
150	1.65	1.25	0.44
175	1.6	1.2	....
182	1.6	1.2	....
225	1.4	1.0	....
250	1.3	0.9	....
300	1.1	0.7	0.22

(Maigret, Bull. Soc. 1905, (3) **33.** 631.)

Solubility of CaO_2H_2 in $CaSO_4$+Aq at 25°.

G. per 100 cc. sat. solution		Solid phase
$CaSO_4$	CaO	
0	0.1166	CaO_2H_2
0.0391	0.1141	"
0.0666	0.1150	"
0.0955	0.1215	"
0.1214	0.1242	"
0.1588	0.1222	$CaO_2H_2+CaSO_4.2H_2O$
0.1634	0.0939	$CaSO_4.2H_2O$
0.1722	0.0611	"
0.1853	0.0349	"
0.1918	0.0176	"
0.2030	0.0062	"
0.2126	0	"

(Cameron and Bell, J. Am. Chem. Soc. 1906, **28.** 1220.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Alcohol dissolves traces.

Methyl alcohol forms colloidal solution containing 1.125 g. per l. (Neuberg and Rewald, Biochem. Z. 1908, **9.** 545.)

Insol. in ether.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Much more sol. in glycerine, or sugar+Aq than in H_2O.

Solubility of CaO in glycerine.

Wt. of glycerine in 100 ccm. of solution	Wt. CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to glycerine	
		CaO	Glycerine
10.00	0.370	3.6	96.4
5.00	0.240	4.6	95.4
2.86	0.196	6.4	93.6
2.50	0.192	7.1	92.9
2.00	0.186	8.5	91.5
1.00	0.165	14.2	85.8

(Berthelot, A. ch. (3) **46.** 176.)

1000 g. H_2O dissolve 1.251 g. CaO; 1000 g. H_2O+50 g. glycerine dissolve 1.865 g. CaO; 1000 g. H_2O+100 g. glycerine dissolve 2.583 g. CaO; 1000 g. H_2O+200 g. glycerine dissolve 4.040 g. CaO; 1000 g. H_2O+400 g. glycerine dissolve 6.569 g. CaO. (Carles, Arch. Pharm. (3) **4.** 558.)

Insol. in pure glycerine.

Solubility of CaO_2H_2 in glycerine+Aq at 25°.
G=g. glycerine in 100 g. glycerine+Aq.
$\frac{1}{2}Ca(OH_2)$=millimols sol. in 100 cc. glycerine+Aq.

G	$\frac{1}{2}CaO_2H_2$	Sp. gr.
0	4.3	1.0003
7.15	8.13	1.0244
20.44	14.9	1.0537
31.55	22.5	1.0842
40.95	40.1	1.1137
48.7	44.0	1.1356
69.2	95 8	1 2027

(Herz and Knoch, Z. anorg. 1905, **46.** 193.)

Solubility in glycerine+Aq at 25°.

Solution contains			Sp. gr.
% $Ca(OH)_2$	% glycerine	% H_2O	
0.117	0	...	
0.178	3.50	96.32	1.008
0.413	15 59	80.28	...
0.48	17 84	81.68	1 042
0.88	34.32	64.80	1.088
1.34	55.04	43.62	1 149

Solid phase in this system is CaO_2H_2. (Cameron and Patten, J. phys. Chem. 1911, **15.** 71.)

100 pts. sugar dissolved in H_2O dissolve 55.6 pts. CaO (Osann); 50 pts. CaO (Ure); 49.6 pts. CaO (Daniell); 29–30.6 pts. CaO (Hunton); 23 pts. CaO. (Soubeiran.)

Sugar solution at 100° takes up ¼ mol. CaO for each mol. sugar, at 0°, if it contains not less than 25% of sugar, it takes up 2 mols. CaO to 1 mol. sugar. (Dubrunfaut.)

Amount dissolved is proportional to the density and temperature of the solutions.

Solubility of CaO in sugar+Aq

Pts. sugar dissolved in 100 pts. H_2O	Relation of CaO to sugar	
	CaO	Sugar
40	21.0	79 8
37.5	20 8	79 2
35 0	20.5	79 5
32 5	20 3	79 7
30 0	20.1	79 9
27 5	19 9	80 1
25 0	19.8	80 2
22 5	19 3	80 7
20 0	18 8	81 2
17.5	18 7	81 3
15 0	18.5	81 5
12 5	18.3	81 7
10 0	18.1	81 9
7 5	16.9	83 1
5.0	15.3	84.7
2 5	13 8	86.2

(Peligot, C. R. **32.** 335.)

100 g. solution of sugar sat. with CaO between 10° and 54.4° contain 22.5 to 23.5% CaO. (Hunton, **1837.**)

Solubility of CaO in dil. sugar solutions.

Wt. of sugar in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to sugar	
		CaO	Sugar
4.850	1.031	17.5	82.5
2.401	0.484	16.8	83.2
2.000	0.433	17.8	82.2
1.660	0.364	18.0	82.0
1.386	0.326	19.0	81.0
1 200	0.316	20.8	79.2
1.058	0.281	21.0	79 0
0.960	0.264	21.6	78 4
0 400	0.194	32.7	67.3
0.191	0.172	47.4	52.6
0.096	0.154	61.6	78.4
0 000	0.148	.	...

(Berthelot, A. ch. (3) **46.** 176.)

Solubility in sugar+Aq at t°.

t°	G. sugar in 100 ccm. of solution	G. CaO dissolved per 100 g sugar
16–17°	0.7814	37.9
	0 9120	32.3
	1.4000	30.5
	1.6930	28.9
	4.754	27.7
	5 730	27.1
	10.159	27.5
	11.200	27.2
	12.500	27.3
	13.930	27.9
	14.487	27.5
	16.410	28.0
15°	0.625	71.6
	0 964	53.4
	2 084	36.0
	3.028	32.3
	3.451	31.7
	4.168	30.2
	4.880	28.7
	5.73	28.3
	6.12	27.4
	6.25	27.7
	6.51	27.5
	7 55	27.9
	8.20	27.3

(Weisberg, Bull. Soc. 1899, (3) **21.** 775.)

Solubility in sugar+Aq at 25°.

Solution contains			Sp. gr.
% $Ca(OH)_2$	% sugar	% H_2O	
0.117	0	...	0.983
0.188	0.62	99.19	1.000
0.730	4.82	94.50	1.021
1.355	7.50	91.12	1.037
2 31	9.87	87.85	1.051
3.21	11.90	84.89	1.067
4.57	15.10	80.33	1.092
5.38	17.42	76.93	1.109
6 07	19.86	73.07	1 123

The solid phase in this system consists of a series of solid solutions with $Ca(OH)_2$ a limiting case.

(Cameron and Patten, J. phys. Chem. 1911, **15.** 70.)

Solubility of CaO in sugar+Aq at 80°.

% sugar	% CaO	% Sugar	% CaO
4.90	0.117	19.50	0.358
9.90	0.189	24.60	0.458
14.75	0.230	29.70	1.017

Solid phase, CaO_2H_2.

(von Ginneken, Proc. Kon. Akad. v. Wetensch, Amsterdam, 1911, **14.** 457.)

Solubility of CaO in mannite+Aq.

Wt. of mannite in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to mannite	
		CaO	Mannite
9.60	0.753	7.3	92.7
4.80	0.372	7.2	92.8
2.40	0.255	9.6	90.4
1.92	0.225	10.5	89.5
1.60	0.207	11.4	88.6
1.37	0.194	12.5	87.5
1.20	0.193	13.9	86.1
1.07	0.190	15.1	84.9
0.96	0.186	16.2	86.8
0.192	0.155	44.6	55.4
0.096	0.154	61.6	38.4
0.000	0.148	...	...

(Berthelot, A. ch. (3) **46.** 176.)

Solutions of CaO in sugar, mannite, or glycerine afford an abundant ppt. on being heated, but this redissolves on cooling. (Berthelot.)

Sol. in sorbite+Aq (Pelouze); sl. sol. in quercite+Aq. Sol. in monobasic Ca saccharate+Aq. (Peligot.) Much more sol. in gelatine+Aq than in pure H_2O.

Calcium hydroxyhydrosulphide, $Ca(OH)SH+3H_2O$.

Easily sol. in H_2O with almost immediate decomposition. Insol. in alcohol, but slowly

decomp. thereby. (Divers and Shimidzu, Chem. Soc. **45.** 270.)

Calcium *sub***iodide,** CaI.

Decomp. by moisture. (Wöhler, Z. anorg. **1909, 61.** 76.)

Calcium iodide, CaI_2.

Deliquescent. 100 pts. H_2O dissolve—

at 0°	20°	40°	43°	92°	
192	204	228	286	435 pts. CaI_2.	

(Kremers, Pogg. **103.** 65.)

Sp. gr. of CaI_2+Aq at 19.5° containing:

5	10	15	20	25	30% CaI_2,
1.044	1.09	1.14	1.198	1.26	1.321
35	40	45	50	55	60% CaI_2.
1.398	1.477	1.567	1.665	1.78	1.91

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sol. in absolute alcohol. (Gay-Lussac, A. ch. **91.** 57.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)
Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
$+4H_2O$. (Kuznetzov, C. A. **1911.** 842.)
$+6H_2O$. Sat. aq. solution contains at:

−22°	+7°	10°	19°
61.6	65.0	65.1	66.3% salt.
51°	64°	130°	248°
69.4	75.9	81.3	87.1% salt.

(Étard, A. ch. 1894, (7) **2.** 543.)

$+7H_2O$. (Kuznetzov.)

Calcium *per***iodide,** CaI_3+15H_2O.

(Mosnier, A. ch. 1897, (7) **12.** 401.)
CaI_4. (Herz and Bulla, Z. anorg. 1911, **71.** 255.)

Calcium mercuric iodide, CaI_2,HgI_2+8H_2O.

Very deliquescent. Sol. in H_2O, alcohols, allyl iodide, aldehyde, acetic acid, ethyl oxalate and aniline. Sl. sol. in nitrobenzene. Completely insol. in $CHCl_3$, CCl_4, ethyl iodide, ethylene bromide, C_6H_6, monochlorbenzene and toluene. (Duboin, C. R. 1906, **142.** 573.)
$3CaI_2, 4HgI_2+24H_2O$. Sol. in H_2O with pptn. of red HgI_2.
Very sol. in alcohols, glycerine, ethyl acetate, methyl and isobutyl propionate, allyl iodide, aldehyde, acetone, aniline and ethyl oxalate. Insol. or sl. sol. in nitrobenzene. Insol. in $CHCl_3$, C_6H_6, ethyl iodide, monochlorbenzene, etc. (Duboin, C. R. 1906, **142.** 397.)
$CaI_2, 2HgI_2$.
Decomp. by H_2O. (Boullay.)
$CaI_2, 5HgI_2+8H_2O$. Decomp. by H_2O, alcohols, glycerine, aldehyde, and acetic acid; slowly by nitrobenzene and ethyl oxalate. Insol. in monochlorbenzene, toluene, $CHCl_3$ and ethylene bromide. (Duboin, *l. c.*)

Calcium silver iodide, $CdI_2, 2AgI+6H_2O$.

Immediately decomp. by H_2O. (Simpson, Roy. Soc. Proc. **27.** 120.)

Calcium zinc iodide, CaI_2, ZnI_2+8H_2O.

Very hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 384.)

Calcium iodide ammonia, $CaI_2, 6NH_3$.

(Isambert, C. R. **66.** 1259.)

Calcium nitride, Ca_3N_2.

Sol. in dil. acids; insol. in conc. (water free) acids. (Moissan, C. R. 1898, **127.** 499.)

Calcium oxide, CaO.

Decomp. by H_2O, with evolution of much heat, to form CaO_2H_2, which see for solubility in H_2O, etc.

Calcium *per***oxide,** CaO_2.

Very sl. sol. in H_2O; easily sol. in acids, and NH_4 salts+Aq. Insol. in NH_4OH+Aq. (Conroy, Chem. Soc. (2) **11,** 808.)
$+2H_2O$. True composition is $CaO_2H_2+H_2O_2$. (de Forcrand, C. R. 1900, **130.** 1390.)
$+8H_2O$. Efflorescent. Difficultly sol. in H_2O with gradual decomp. Insol. in alcohol or ether. (Gay-Lussac and Thénard, A. ch. (2) **8.** 313.)

Calcium oxybromide, $3CaO, CaBr_2+16H_2O$.

Decomp. by H_2O and alcohol. Very easily sol. in hydracids and dil. HNO_3. (Tassily, C. R. 1894, **119.** 372.)

Calcium oxychloride, $Ca_4O_3Cl_2+15H_2O = 3CaO, CaCl_2+15H_2O$.

Decomp. by H_2O or alcohol. (Rose.)
Formula is $Ca_2HO_2Cl+7H_2O$. (Grimshaw, C. N. **30.** 280.)
$+16H_2O$. Decomp. by H_2O into CaO_2H_2 and $CaCl_2$ until a maximum of 85 g. $CaCl_2$ are dissolved per litre. (Ditte, C. R. **91.** 576.)
$4CaO, CaCl_2+14H_2O$. (Schreinemakers and Figee, Chem. Weekbl. 1911, **8.** 685.)
$CaO,CaCl_2$. (Schreinemakers and Figee.)

Calcium lead oxychloride, $CaCl_2, CaO, 2PbO+4H_2O$.

Sol. in H_2O with decomp. (André, C. R. **104.** 359.)
$CaCl_2, 3PbO+3H_2O$. (André.)

Calcium mercuric oxychloride, $CaCl_2, 2HgO+4H_2O$.

Decomp. immediately by H_2O. (Klinger, B. **16.** 997.)

Calcium oxyiodide, $3CaO, CaI_2+16H_2O$.

Decomp. by H_2O, alcohol, and acids. Sol. in hydracids and in very dil. HNO_3. (Tassily, C. R. 1894, **119.** 372.)

Calcium oxysulphide, $Ca_4O_3S_4+12H_2O = 3CaO, CaS_4+12H_2O$.

Decomp. by H_2O. Not acted on by absolute alcohol. (Schöne, Pogg. **117.** 77.)

According to Geuther (A. **224.** 178) $=CaS_3$, $2CaO+10$, or $11H_2O$. Sol. in dil. $HCl+Aq$ with separation of S.

$Ca_5O_4S_4+18H_2O=4CaO, CaS_4+18H_2O$. Decomp. by H_2O, but not acted on by absolute alcohol. (Schöne, Pogg. **117.** 82.)

According to Geuther (A. **224.** 178) $=CaS_3$, $3CaO+14$, or $15H_2O$.

$Ca_6O_5S_5+20H_2O=5CaO, CaS_5+20H_2O$. (Rose, Pogg. **55.** 433.)

Sol. in 400 pts. cold, decomp. by boiling H_2O (Buchner); sl. sol. in cold, much more in hot H_2O, but it is not deposited on cooling. Aqueous solution sat. at 6°-7.2° has sp. gr. = 1.0105 (Herschel); sol. in alcohol (Gay-Lussac); insol. in alcohol (Gmelin).

Calcium phosphide, CaP.

Deliquescent. Decomp. in moist air or with H_2O. Not attacked by conc. HNO_3, but decomp. by dil. HNO_3+Aq. (Thénard, A. ch. (3) **14.** 14.)

Ca_3P_2. Crystallized.

Decomp. by H_2O.

Not attacked by conc. H_2SO_4. Violently attacked by dil. H_2SO_4.

Not attacked by abs. alcohol, ether, benzene or oil of turpentine. (Moissan, C. R. 1899, **128.** 792.)

Ca_2P_3. Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Calcium selenide, CaSe.

Sl. sol. in H_2O. Very easily decomp. (Fabre, C. R. **102.** 1469.)

Calcium silicide, $CaSi_2$.

Slowly decomp. by H_2O; sol. in conc. H_2SO_4 and dil. HNO_3 with evolution of H_2. With conc. HCl it gives H_2, Si and silicon hydride; with dil. HCl, H_2 and a yellow substance. Sol. in alkali+Aq or NH_3+Aq with evolution of H_2. (Moissan, C. R. 1902, **134.** 505.)

Two modifications:

(a) Only sl. sol. in HNO_3; decomp. H_2O to give an insol. ppt. on addition of HCl.

(b) Easily sol. in HNO_3 and acetic acid; decomp. HCl to give a ppt. which is sol. in KOH+Aq. (de Chalmot, Am. Ch. J. 1896, **18,** 320.)

Ca_3Si_2. Slowly decomp. by H_2O, rapidly by dil. acetic acid or by H_2SO_3+Aq without evolution of spontaneously inflammable gas. (Honigschmid, M. 1909, **30.** 497.)

Decomp. by dil. min. acids, with evolution of spontaneously inflammable gas. (Hackspill, Bull. Soc. 1908, (4) **3.** 619.)

Ca_6Si_{10}. Insol. in all solvents. Decomp. by boiling H_2O, by conc. HCl and by acetic acid. Sol. in dil. alkali and alkali carbonates +Aq. Hardly attacked by conc. H_2SO_4 or HNO_3. (Kolb, Z. anorg. 1909, **64.** 349.)

$Ca_{11}Si_{10}$. Easily decomp. by boiling with H_2O. Decomp. by dil. acetic acid, dil. or conc HCl. (Kolb, Z. anorg. 1909, **64.** 349 and 356.)

Calcium siliconitride, $CaSi_2N_2$.

(Kolb, Z. anorg. 1909, **64.** 363.)

$Ca_2Si_3N_4$. Slowly decomp. by boiling with H_2O, somewhat more rapidly with dil. NaOH +Aq. Slowly decomp. by conc. HCl. (Kolb, *l. c.*)

$Ca_{11}Si_{10}N_{16}$. Completely decomp. by HCl. (Kolb, *l. c.*)

Calcium sulphide, CaS.

500 pts. H_2O dissolve 1 pt. CaS completely; less H_2O dissolves out CaS_2H_2 and leaves CaO_2H_2. Very much H_2O decomposes completely into CaO_2H_2 and H_2S. (Béchamp, A. ch. (4) **16.** 222.)

Not decomp. by H_2O, and only sl. sol. therein at ordinary temp. (Pelouze.)

After 48 hours contact with CaS, 1 l. H_2O contains at:

10°	18°	40°	60°	90°
0.15	0.23	0.30	0.48	0.33 g. CaS.

After boiling for 2 hours, 0.27 g. CaS is dissolved; addition of NaCl diminishes solubility, but Na_2SO_4 increases it. Lime-water dissolves at 14° 0.18 g. CaS, the same amount which H_2O dissolves at 60°. Milk of lime dissolves 0.55 g. at 60°. H_2O containing 3 to 79 g. Na_2O per litre dissolves only traces of CaS at 10°, but at 40–60°, or by boiling, a large amount of Na_2S is formed. (Kolb, A. ch. (4) **7.** 126.)

Sol. in 12,500 pts. H_2O at 12.6°. (Scheurer-Kestner, Répert. chim. appl. **1862.** 331.)

Sat. Na_2CO_3+Aq has scarcely any action on CaS, but a dilute solution has more action. (Kolb.)

Sol. in H_2O and sulphur, forming CaS_4.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Insol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 81.)

Sol. in sugar+Aq. (Stolle, C. C. **1900,** I. 1044.)

Calcium ***tetra*****sulphide,** CaS_4.

Known only in solution.

Calcium *penta***sulphide,** CaS_5.

Sol. in H_2O and alcohol. (Berzelius.)

Exists only in aqueous solution. (Schöne, Pogg. **117.** 73.)

Calcium hydroxyl sulphide, $Ca(OH)SH + 3H_2O$.

Easily sol. in H_2O with immediate decomp. and separation of $Ca(OH)_2$. Insol. in alcohol, but slowly decomp. thereby. (Divers and Shimidzu, Chem. Soc. **45.** 270.)

Calcium stannic sulphide.

See **Sulphostannate, calcium.**

Calomel.

See **Mercurous chloride.**

Carbamic acid.

Ammonium carbamate acid carbonate (*commercial carbonate of ammonia*).

See **Carbonate carbamate, ammonium hydrogen.**

—— (*salts of hartshorn*), $2NH_4HCO_3$, NH_4CONH_2.

See **Carbonate carbamate, ammonium hydrogen.**

Carbazote silicon, C_2SiN.

Insol. in acids, even HF; also in boiling KOH+Aq. (Schützenberger and Colson, C. R. **92.** 1508.)

Carbon, C.

Insol. in all solvents.

Diamond is unacted upon by $KClO_3$+fum. HNO_3; graphite forms graphitic acid by $KClO_3$+fum. HNO_3; amorphous carbon is sol. in $KClO_3$+fum. HNO_3. (Berthelot, A. ch. (4) **19.** 399.)

Diamond is sol. in molten iron at 1160°. Amorphous carbon is insol. in molten iron at 1160°, but becomes sol. therein by heating to 1400°. (Hempel, B. **18.** 998.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Charcoal is insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

The quantity of carbon dissolved by iron diminishes by increasing phosphorus, falling by about 0.5% for each additional 2.0% of phosphorus. (Fettweis, Metallurgie, 1906, **3.** 60.)

Solubility in iron is reduced by the presence of tin and of sulphur. (Wüst, Metallurgie, 1906, **3.** 169.)

The solubility of C in iron is increased by the presence of chromium; 9.2% C dissolved when 62% Cr is present in the mixture. (Goerens, Metallurgie, 1907, **4.** 18.)

Carbon boride, CB_6.

Insol. in boiling HNO_3+Aq. (Joly, C. R. **97.** 456.)

Carbon *sub***oxide,** C_3O_2.

B.-pt. +7° at 761 mm.

Sol. in H_2O with formation of malonic acid.

Slowly decomp. on standing in a sealed tube. (Diels, B. 1906, **39.** 696.)

Carbon *mon***oxide,** CO.

Sol. in 50 vols. recently boiled H_2O. (Davy.)
Sol. in 16 vols. H_2O. (de Saussure.)
Sol. in 27 vols. H_2O. (Dalton.)
100 vols. H_2O dissolve 6.2 vols. CO at 18°. (de Saussure.)

Solubility of CO in H_2O: 1 vol. H_2O at t° dissolves V vols. CO reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0.03287	7	0.02796	14	0.02466
1	0.03207	8	0.02739	15	0.02432
2	0.03131	9	0.02686	16	0 02402
3	0.03057	10	0.02635	17	0.02374
4	0.02987	11	0.02588	18	0 02350
5	0.02920	12	0.02544	19	0.02329
6	0.02857	13	0.02504	20	0.02312

(Bunsen's Gasometry, pp. 287, 128, 146.)

Coefficient of absorption = $0.032874 - 0.00081632t + 0.000016421t^2$. (Bunsen and Pauli, A. **93.** 16.)

Solubility of CO in H_2O.

β = Vol. CO absorbed by 1 vol. H_2O at a partial pressure of 760 mm.

β^1 = Vol. CO (reduced to 0° and 760 mm.) absorbed by 1 vol. of H_2O under a total pressure of 760 mm.

q = g. CO dissolved by 100 g. H_2O at a total pressure of 760 mm.

t°	β	β^1	q
0	0.03537	0.03516	0.0044
5	0.03149	0.03122	0.0039
10	0.02816	0 02782	0.0035
15	0.02543	0.02501	0.0031
20	0.02319	0.02266	0.0028
25	0.02142	0.02076	0.0026
30	0.01998	0.01915	0.0024
40	0.01775	0.01647	0.0021
50	0.01615	0.01420	0.0018
60	0.01488	0.01197	0.0015
70	0.01440	0.00998	0.0013
80	0.01430	0.00762	0.0010
90	0.01420	0.00438	0.0006
100	0.01410	0.00000	0.0000

(Winkler, B. 1901, **34.** 1416.)

Solubility in H_2O at various pressures.
V = Volume of the absorbing liquid.
P = Hg pressure in metres.
λ = Coefficient of solubility.

V	t°	P	λ
30.830 ccm.	17.7	0.9202	0.02791
		1.1438	0.02787
		1.4624	0.02786
		1.7986	0.02783
		2.3659	0.02782
		2.8390	0.02776
		3.2622	0.02771
		4.0114	0.02770
		4.6017	0.02763
		5.1953	0.02761
		5.8717	0.02756
		6.5462	0.02744
		7.0983	0.02738
		7.6470	0.02723
		8.9184	0.02715
31.939 ccm.	19.0	0.9176	0.02716
		1.1506	0.02717
		1.3897	0.02715
		1.7044	0.02712
		2.1239	0.02708
		2.7173	0.02701
		3.2576	0.02693
		3.9311	0.02689
		4.4584	0.02680
		5.2470	0.02673
		6.0346	0.02665
		6.6303	0.02654
		7.1842	0.02636
		7.9542	0.02617

(Cassuto, Phys. Zeit. 1904, **5.** 236.)

Coefficient of absorption of CO in H_2O at 25° equals 0.0154. (Findlay and Creighton, Biochem. J. 1911, **5.** 294.)

Cuprous chloride in an hydrochloric acid or ammoniacal solution, and ammoniacal solutions of cuprous salts absorb large amounts of CO. (Leblanc, C. R. **30.** 488.)

Cuprous chloride dissolved in HCl+Aq absorbs 15-20 vols. CO. (Berthelot, A. ch. (3) **51.** 66.)

Absorbed by KOH, NaOH, $Ba(OH)_2$, and $Ca(OH)_2$+Aq; more readily by ether, alcohol, and wood spirit, with formation of formic acid. (Berthelot, A. ch. (3) **61.** 463.)

Sol. in HCN. (Böttinger, B. **10.** 1122.)

1 vol. alcohol absorbs 0.20443 vols. CO gas at all temperatures between 0° and 25°. (Carius, A. **94.** 135.)

100 vols. alcohol (0.84 sp. gr.) dissolve 14.5 vols. CO at 18°; 100 vols. rectified naphtha (0.784 sp. gr.), 20.0 vols. CO at 18°; 100 vols. oil of lavender (0.88 sp. gr.), 15.6 vols. CO at 18°; 100 vols. olive oil (0.915 sp. gr.), 14.2 vols. CO at 18°; 100 vols. sat. KCl+Aq (1.168 sp. gr.), 5.2 vols. CO at 18°. (de Saussure, **1814.**)

1 vol. oil of turpentine absorbs 0.16–0.20 vol. CO. (de Saussure.)

Sol. in ether. (Regnault.)

Insol. in caoutchine.

Solubility in alcohol+Aq.

% alcohol by weight	0.00	9.09	16.67	23.08
Solubility	2.41	1.87	1.75	1.68
% alcohol by weight	28.57	33.33	50.00	
Solubility	1.50	1.94	3.20	

(Lubarsch, W. Ann. 1889, **37.** 524.)

Solubility of CO in organic solvents.

Solvent	Solubility at 20° C.	Solubility at 25° C.
Glycerine	Not measurable	
Water	0.02404	0.02586
Aniline	0.05358	0.05055
Carbon bisulphide	0.08314	0.08112
Nitrobenzene	0.09366	0.09105
Benzene	0.1707	0.1645
Glacial acetic acid	0.1714	0.1689
Amyl alcohol	0.1714	0.1706
Xylene	0.1781	0.1744
Toluene	0.1808	0.1742
Ethyl alcohol (99.8%)	0.1921	0.1901
Chloroform	0.1954	0.1897
Methyl alcohol	0.1955	0.1830
Amyl acetate	0.2140	0.2108
Acetone	0.2225	0.2128
Isobutyl acetate	0.2365	0.2314
Ethyl acetate	0.2516	0.2419

(Just, Z. phys. Ch. 1901, **37.** 361.)

Solubility of CO in ether at 0° = 0.3618, and at 10° = 0.3842. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Solubility of CO in organic mixtures.

CO in benzene and naphthalene at 25°C.

Per cent by weight of naphthalene	Per cent by weight of benzene	* Solubility of CO
0	100	0.174
11.52	88.48	0.164
11.65	88.35	0.163
23.98	76.02	0.149
23.60	76.40	0.148
32.35	67.65	0.142
32.74	67.26	0.143
33.79	66.21	0.141

(Skirrow, Z. phys. Ch. 1902, **41.** 144.)

* *See under* **Oxygen.**

CO in benzene and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of benzene	Solubility of CO
0	100	0.174
10.48	89.52	0.144
10.48	89.52	0.144
19.22	80.78	0.132
18.99	81.01	0.133
27.04	72.96	0.128
27.39	72.61	0.127

(Skirrow.)

CO in benzene and α-naphthol at 25° C.

Per cent by weight of α-naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
3.48	96.52	0.149
6.75	93.25	0.145
6.59	93.41	0.144
12.10	87.90	0.139
11.81	88.19	0.139

(Skirrow.)

CO in benzene and β-naphthol at 25° C.

Per cent by weight of β naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
2.06	97.94	0.158
4.14	95.86	0.151
4.36	95.64	0.149

(Skirrow.)

CO in benzene and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of benzene	Solubility of CO
0	100	0.174
14.5	85.5	0.162
14.12	85.88	0.162
28.18	71.82	0.152
28.14	71.86	0.152
40.58	59.42	0.140
40.63	59.37	0.140
54.9	45.1	0.126
54.9	45.1	0.127
83.33	16.67	0.101
83.2	16.8	0.102
100	0	0.093

(Skirrow.)

CO in benzene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of benzene	Solubility of CO
0	100	0.174
12.69	87.31	0.156
12.03	87.97	0.158
19.57	80.43	0.145
19.43	80.57	0.144
28.43	71.57	0.131
28.26	71.74	0.131
57.68	42.32	0.0945
57.38	42.62	0.0953
78.90	21.10	0.0689
78.80	21.20	0.0684
100	0	0.053

(Skirrow.)

CO in toluene and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
7.13	92.87	0.169
7.10	92.9	0.171
15.10	84.9	0.161
15.13	84.87	0.161
22.75	77.25	0.153
22.58	77.42	0.154

(Skirrow.)

CO in toluene and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
5.59	94.41	0.170
5.58	94.42	0.171
11.16	88.84	0.161
11.20	88.8	0.161
21.62	78.38	0.147
21.93	78.07	0.147

(Skirrow.)

CO in toluene and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
8.86	91.14	0.168
8.87	91.13	0.168
18.27	81.73	0.160
18.19	81.81	0.161
26.82	73.18	0.151
26.76	73.24	0.151
49.14	50.86	0.131
49.02	50.98	0.131
76.31	23.69	0.108
76.31	23.69	0.108
100	0	0.093

(Skirrow.)

CO in toluene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of toluene	Solubility of CO
0	100	0.182
6.61	93.39	0.169
6.61	93.39	0.168
13.56	86.44	0.157
13.55	86.45	0.156
19.91	80.09	0.148
19.96	80.04	0.148
44.64	55.36	0.115
44.31	55.69	0.116
74.63	25.37	0.0768
75.03	24.97	0.0753
100	0	0.053

(Skirrow.)

CO in toluene and α-naphthol at 25° C.

Per cent by weight of α-naphthol	Per cent by weight of toluene	Solubility of CO
0	100	0.182
1.46	95.54	0.171
4.44	95.56	0.171
8 75	91.25	0 162
8.89	91 11	0.163

(Skirrow.)

CO in acetone and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13 31	86.69	212 4	0.199
27.40	72 60	196.6	0 187

(Skirrow.)

CO in acetone and phenanthrene at 25°C.

Percent by weight of phenanthrene	Percent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
12.77	87 23	218	0.205
25.04	74.96	207.5	0.183

(Skirrow.)

CO in acetone and β-naphthol at 25° C.

Per cent by weight of β-naphthol	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13 95	86.05	213	0.190
26 88	73 12	195	0.169

(Skirrow.)

CO in acetone and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
21.59	78.4	201	0.207
53.20	46.8	152	0.157
100	0	...	0.093

(Skirrow.)

CO in acetone and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
20.83	79.17	192	0.179
55.10	44.9	120	0.110
100	0	...	0.053

(Skirrow.)

CO in acetic acid and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
21.65	78.35	0.156
51.03	48.97	0.130
100	0	0.093

(Skirrow.)

CO in acetic acid and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
13.5	86.5	0.110
41.64	58.36	0.0699
60.77	39.23	0.0618
82.21	17.79	0.0580
100	0	0.053

(Skirrow.)

CO in methyl alcohol and glycerine at 25°C.

Per cent by weight of glycerine	Per cent by weight of methyl alcohol	Measured vapor pressure	Solubility of CO
0	100	122	0.196
39.6	60.4	106	0.0964
60.5	39.5	91	0.0515
77.1	22.9	63	0.0246
100	0	...	very small

(Skirrow.)

CO in acetone and chloroform at 25° C.

Per cent by weight of chloroform	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
33.38	66.62	202	0.226
53.2	46.8	179	0.219
65.03	34.97	167	0.220
73.46	26.54	162	0.212
79.83	20.17	163	0.204
87.3	12.7	168	0.207
94 4	5.6	178	0.205
100	0	188	0.207

(Skirrow.)

CO in acetone and carbon bisulphide at 25° C.

Per cent by weight of carbon bisulphide	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
8.18	91.82	306	0.236
18.02	81.98	367	0.236
49.46	50.54	443	0.227
62.6	37.4	457	0.210
74.05	25.95	457	0.187
85.51	14.49	433	0.144
96.42	3.58	382	0.114
100	0	356	0.0959

(Skirrow.)

CO in benzene and ethyl alcohol at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
15.43	84.56	125	0.179
52.34	47.66	119	0.181
100	0	59	0.192

(Skirrow.)

CO in chloroform and methyl alcohol at 25° C.

Per cent by weight of alcohol	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.207
13	87	233	0.202
100	0	122	0.196

(Skirrow.)

CO in acetic acid and benzene at 25° C.

Percent by weight of acetic acid	Percent by weight of benzene	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
19.17	80.83	87.5	0.190
33.54	66.46	82	0.198
67.51	32.49	64.5	0.199
100	0	14	0.172

(Skirrow.)

CO in acetic acid and toluene at 25° C.

Per cent by weight of acetic acid	Per cent by weight of toluene	Measured vapor pressure	Solubility of CO
0	100	9	0.182
20.48	79.52	31.6	0.190
56.89	43.11	28	0.195
74.71	25.29	25.6	0.191
100	0	14	0.172

(Skirrow.)

CO in acetic acid and chloroform at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.206
26.67	73.33	144.5	0.207
56.46	43.54	88.5	0.196
100	0	14	0.172

(Skirrow.)

CO in carbon bisulphide and ethylene dichloride at 25° C.

Per cent by volume of carbon bisulphide	Per cent by volume of ethylene dichloride	Measured vapor pressure	Solubility of CO
0	100	77	0.147
25	75	231	0.159
49	51	294	0.160
81.6	18.4	338	0.140
100	0	356.5	0.083

(Skirrow.)

Coefficient of absorption for petroleum = 0.123 at 20°, and 0.134 at 10°. (Gniewasz and Walfisz, Zeit. phys. Ch. **1.** 70.)

Carbon *di*oxide, CO_2.

Gas.—

H_2O dissolves about its own vol. CO_2 at the ordinary temperature (the solution obtained being of 1.0018 sp. gr.) and pressure, and an additional vol. for the pressure of each additional atmosphere to which it is subjected.

The power of H_2O to absorb CO_2 does not increase in precisely the same ratio as the pressure. (Soubeiran.)

5 vols. CO_2 dissolve in 1 vol. H_2O at 7 atmos. pressure, and much greater pressure is necessary in order to increase the amount of gas dissolved, but up to 4 or 5 atmospheres the amount of gas dissolved is very nearly proportional to the pressure. (Courbe, J. Pharm. **26.** 121.)

100 vols. H_2O at 12.78° absorb 116 vols. CO_2 (Cavendish); at 29.44°, 84 vols. CO_2 (Henry); at 15.56°, 106 vols. CO_2 (Saussure); at 15.56°, 108 vols. CO_2 (Henry); at 15.56°, 100 vols. CO_2 (Dalton).

100 vols. H_2O at t° C. absorb V vols. of CO_2 gas reduced to 60° F. and 30 in. pressure.

t°	V	t°	V
0	175.72	26.7	68.60
4.4	147.94	32.2	57.50
10	122.27	37.8	50.39
15.6	100.50	65.6	11.40
21.1	83.86	100	trace

(Rogers, Am. J. Sci. (2) **6.** 107.)

1 vol. H_2O at 5° absorbs somewhat more than 1 vol. CO_2; at 10° scarcely 1 vol., and still less at higher temp. CO_2+Aq sat. at 2° has 1.0015 sp. gr.; most of the CO_2 escapes upon exposing the solution to the air, the more quickly the higher the temperature. But as CO_2 diminishes, the remainder is more obstinately held, so that boiling for ½ hour is necessary to expel it completely. (Bergman.)

Solubility of CO_2 in H_2O. 1 vol. H_2O at t° and 760 mm. dissolves V vols. CO_2 gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	1.7967	7	1.3339	14	1.0321
1	1.7207	8	1.2809	15	1.0020
2	1.6481	9	1.2311	16	0.9753
3	1.5787	10	1.1847	17	0.9519
4	1.5126	11	1.1416	18	0.9318
5	1.4497	12	1.1018	19	0.9150
6	1.3901	13	1.0653	20	0.9014

(Bunsen's Gasometry, pp. 287, 128, 152.)

Coefficient of absorption = $1.7967 - 0.07761t + 0.0016424t^2$. (Bunsen.)

Solubility in H_2O at various pressures: P = pressure in atmospheres.

P	Vol. gas in 1 ccm. H_2O at 0°	Vol. gas in 1 ccm. H_2O at 12.43°	P	Vol. gas in 1 ccm. H_2O at 0°	Vol. gas in 1 ccm. H_2O at 12.43°
1	1.797	1.086	20	26.65	17 11
5	8.65	5.15	25	30 55	20.31
10	16.03	9.65	30	33.74	23.35
15	21 95	13.63	..	–.	...

(Wroblewski, C. R. **94.** 1355.)

Absorption of CO_2 in H_2O at various pressures: P = pressure in mm.; V = vols. CO_2, reduced to 0° and 760° mm., absorbed by 1 vol. H_2O.

P	V	P	V
697.71	0.9441	2188.65	3 1764
809.03	1.1619	2369.02	3.4857
1289.41	1.8647	2554.00	3.7152
1469.95	2.1623	2738.33	4.0031
2002.06	2.9067	3109 51	4.5006

(Khanikoff and Longuinine, A. ch. (4) **11.** 412.)

C = coefficient of absorption in H_2O at t° and 760 mm.

t°	C	t°	C	t°	C
15.2	1.009	18.38	0.896	21	0 838
17 6	0 930	18 3	0 885	23	0.798

(Setschenow, Mém. Acad. St. Petersb. **22.** Nos. 6, 7.)

Absorption coefficient of CO_2 in H_2O at 0° = 1.7308. (Prytz and Holst, W. Ann. 1895, **54.** 136.)

Absorption of CO_2 by H_2O at t°.
α = coefficient of absorption.

t°	α	t°	α
0	1 713	19	0 902
1	1.646	20	0.878
2	1.584	21	0.854
3	1.527	22	0.829
4	1 473	23	0.804
5	1.424	24	0.781
6	1.377	25	0.759
7	1.331	26	0.738
8	1.282	27	0.718
9	1.237	28	0 699
10	1 194	29	0 682
11	1.154	30	0.665
12	1.117	35	0.592
13	1.083	40	0.530
14	1.050	45	0.479
15	1.019	50	0.436
16	0.985	55	0.394
17	0.956	60	0.359
18	0.928	..	...

(Bohr, W. Ann. 1899, **68.** 504.)

Solubility in H_2O at 25° = 0.8255; at 15° = 1.070. (Geffcken, Z. phys. Ch. 1904, **49.** 273.)

75 cc. H_2O absorb 0.1381 g. CO_2 at 15.5° and 720 mm. (Christoff, Z. phys. Ch. 1905, **53.** 329.)

Absorption-coefficient of CO_2 in H_2O at 20° = 0 877, or 1000 g. H_2O dissolve 878 cc. CO_2. (Usher, Chem. Soc. 1910, **97.** 72.)

Solubility of CO_2 in H_2O = 1.158 at 12° and 0.825 at 25°. (Findlay and Shenu, Chem. Soc. 1911, **99.** 1315.)

Absorption of CO_2 by H_2O at high pressure.

Amount of H_2O used { a = 0.210 ccm. b = 0.102 ccm.

V = ccm. of CO_2 absorbed by H_2O at t°, reduced to a pressure of 1 kg. per sq. cm.

V_1 = ccm. of CO_2 absorbed by 1 ccm. of H_2O.

Pressure kg/sq. cm.	t°	V_1 a	V_1 b
25	20°	....	17.77
30		....	19.77
40			21.52
50		.	28.09
55		... .	29.75
30	35°	11.77	13.57
40		14.82	20.00
50		18.96	24.64
60		22 90	22.50
70		27.18	27.62
80		...	32.85
40	60°	10.88	9.798
50		12.24	13 72
60		14.46	15.28
70		16.80	17.46
80		19.74	22.67
90		22.74	21.16
100		26 21	27.85
110		28.92	28.79
120		30.20	33.90
60	100°	8.965	....
70		10.11	6.395
80		11.05	9.591
90		12 63	10.85
100		13.63	12.40
110		14.88	16.31
120		16.40	15.78
130		17.93	16.89
140		19 56	17.71
150		20.58	17.49
160		22.07	....
170		22.78	....

(Sander, Z. phys. Ch. 1912, **78.** 537.)

Solubility of carbon dioxide in water at 25°.

P. = Pressure in mm. Hg.

S. = Solubility calculated according to formula for which see the original article. (Findlay, Chem. Soc. 1910, 97. 538.)

P	S	P	S
743	0.816	1059	0.817
752	0.817	1064	0.819
800	0.815	1153	0.818
841	0.817	1243	0.819
955	0.816	1351	0.820
955	0.817	1351	0.820

(Findlay and Creighton, Chem. Soc. 1910, **97.** 538.)

Solubility of carbon dioxide in water at 25°.

P. = Pressure in mm. Hg.

S. = Solubility. See above.

P	S	P	S
755	0.826	1069	0.823
759	0.825	1084	0.825
836	0.825	1210	0.825
841	0.826	1211	0.825
927	0.826	1350	0.824
934	0.824	1350	0.826

(Findlay and Creighton, Chem. Soc. 1912, **101.** 1460.)

Solubility of carbon dioxide in water at 25°.

P = Pressure in mm. Hg.

S = Solubility. See above.

P	S	P	S
263	0.817	495	0.816
271	0.816	651	0.816
382	0.814	667	0.817
392	0.811	752	0.818
479	0.816	768	0.817

(Findlay and Creighton, Chem. Soc. 1913, **103.** 638.)

Sl. sol. in HCl+Aq.

100 vols. H_2SO_4 of 1.840 sp. gr. absorb 45 vols. CO_2. (de Saussure.)

H_2SO_4 of ordinary density at 15.56° and common pressure absorbs 94% of its vol. of CO_2; fuming H_2SO_4, 125%; the absorption for pure H_2O under the same conditions being 98%. (Rogers, Am. J. Sci. (2) **5.** 115.)

H_2SO_4 absorbs 7–10% CO_2. (Hlasiwetz, W. A. B. **20.** 193.)

Coefficient of absorption by conc. H_2SO_4 = 0.932, which is the same as that by H_2O; but this diminishes on diluting, and is at its lowest limit 0.666, when the composition of the solution is H_2SO_4, H_2O; upon further dilution the coefficient of solubility gradually increases, and when 58 H_2O are present to 1 H_2SO_4, the coefficient of absorption is 0.857. (Setschenow, J. B. **1876.** 46.)

Absorption of CO_2 by H_2SO_4+Aq.

Solution	Grams CO_2 absorbed by 75 cc. at 15.5° and 720 mm.
½-N H_2SO_4	0.1273
1-N H_2SO_4	0.1179
2-N H_2SO_4	0.1092
4-N H_2SO_4	0.1003

(Christoff, Z. phys. Ch. 1905, **53.** 329.)

Solution	Grams CO_2 absorbed by 75 cc. at 15.5° and 720 mm.
2.5% H_2SO_4	0.1282
5% "	0.1179
10% "	0.0833
20% "	0.0755
30% "	0.0751
40% "	0.0713
45% "	0.0725
70% "	0.0918
90% "	0.1433

(Christoff, *l. c.*)

Coefficient of absorption for 96% H_2SO_4 = 0.926 at 20.2°. (Bohr, Z. phys. Ch. 1910, **71.** 48.)

Absorption of CO_2 by acids.

M = Content in gram-equivalents per liter.

S = Solubility (see under oxygen).

Absorption of CO_2 by HNO_3+Aq.

M	$S_{25°}$	$S_{15°}$
0.472	0.8382	1.073
0.475	0.8366	1.075
0.557	0.8387	1.069
0.704	0.8447	1.080
1.382	0.8620	1.093
1.387	0.8622	1.093
1.860	0.8752	1.105
2.519	0.8839	1.109
2.539	0.8865	1.111

(Geffcken, Z. phys. Ch. 1904, **49.** 273.)

Absorption of CO by HCl+Aq.

M	$S_{25°}$	$S_{15°}$
0.499	0.8047	1.041
0.511	0.8074	1.042
1.212	0.7973	1.020
1.249	0.7984	1.023
2.080	0.7951	0.9864
2.180	0.7951	1.009

(Geffcken.)

Absorption of CO_2 by $\frac{H_2SO_4}{2}$+Aq.

M	$s_{25°}$	$s_{15°}$
0.512	0.7923	1.016
0.517	0.7936	1.016
0.995	0.7693	0.9772
1.039	0.7685	0.9775
1.067	0.7672	0.9756
1.956	0.7302	0.9175
2.088	0.7273	0.9143
3.790	0.6736	0.8354
3.800	0.6747	0.8385

(Geffcken.)

In collecting CO_2 gas in pneumatic operations, a saturated solution of common salt is better than H_2O for filling the trough. This solution will only absorb about 1/3 of the amount of CO_2 absorbed by pure H_2O. (de Saussure, *l. c.*)

100 vols. of the following solutions at 18° and ordinary pressure absorb vols. CO_2—

	Sp. gr.	Vols. CO_2
Sat. NaCl+Aq (containing 29% of NaCl)	1.212	32.9
Sat. NH_4Cl+Aq (containing 27.53% of NH_4Cl)	1.078	75
Sat. KCl+Aq (containing 26% of KCl)	1.168	61
Sat. $CaCl_2$+Aq (containing 40.2% of $CaCl_2$)	1.402	26.1
Sat. K_2SO_4+Aq (containing 9.42% of K_2SO_4)	1.077	62
Sat. Na_2SO_4+Aq (containing 11.14% of Na_2SO_4)	1.105	58
Sat. $K_2Al_2(SO_4)_4$+Aq (containing 9.14% of $K_2Al_2(SO_4)_4+24H_2O$)	1.047	70
Sat. KNO_3+Aq (containing 20.6% of KNO_3)	1.139	57
Sat. $NaNO_3$+Aq (containing 26.4% of $NaNO_3$)	1.206	45
Sat. $H_2C_4H_4O_6$+Aq (containing 53.37% of $H_2C_4H_4O_6$	1.288	41

(de Saussure, Gilbert's Ann. Phys. **47.** 167.)

About half as sol. in NaCl+Aq (15% NaCl) as in H_2O.

Much more sol. in Na_2HPO_4+Aq or Na_2CO_3+Aq than in H_2O, the quantity dissolved increasing with the amount of salt in the solution. The solubility in these solutions depends on the coefficient of solubility in H_2O plus the product of a constant coefficient multiplied by the amount of salt in the solution; this constant equals 0.069 for Na_2HPO_4, and 0.088 for Na_2CO_3. (Fernet, A. ch. (3) **47.** 307.)

Fernet's determinations are not accurate. (L. Meyer, A. Suppl. **2.** 157.)

1 mol. Na_2HPO_4 in dil. Na_2HPO_4+Aq absorbs 2 mols. CO_2. (Setschenow.)

Solutions of salts of similar constitution are equivalent in regard to their power of absorption of CO_2, when they contain the same percentage of crystal water. Experiments were made with solutions of alum, $MgSO_4$, $7H_2O$, and $ZnSO_4$, $7H_2O$, containing 10% of the salts. The $MgSO_4$ solution absorbed the greatest proportional amount of CO_2, and the alum the least. The further rule was deduced that with salts of similar constitution and the same amount of crystal water, the absorptiometric equivalents are identical with the chemical equivalents. (Setschenow, B. **6.** 1461.)

Salts can be divided into two classes, according as CO_2 has chemical action on the salt or not. In the first case, *i. e.*, when there is chemical combination or action of CO_2 on the salt in solution, the amount of CO_2 absorbed increases with increasing concentration of the solution; in the second case, however, the amount of CO_2 decreases with the strength of the solution. Several salts can be arranged in a series as regards their power of absorption, beginning with that which has the greatest, as follows: Na_2CO_3, $Na_2B_4O_7$, Na_2HPO_4, $NaC_2H_3O_2$, $Na_3C_6H_5O_7$, $Na_2C_2O_4$, $NaC_3H_5O_3$, MNO_3, MCl, M_2SO_4. The division between the two classes occurs in this series at $Na_2C_2O_4$.

The matter is discussed at length in the original papers. (Setschenow, Mémoires Acad. St. Petersb. **22.** No. 6. Also further, Setschenow, *ib.* **34.** No. 3, and **35.** No. 7. See also Ostwald, Allgemeine Chemie, 2te Aufl. vol. 1, p. 629.)

Solubility of CO_2 in salts+Aq at 15.2°.

CO_2 = cc. CO_2 (at 0° and 760 mm.) dissolved per cc. of salt solution.

Salt	g. salt per l.	CO_2
NH_4Cl	1	1.005
"	10	0.985
"	51.6	0.941
"	172	0.819
"	258	0.770
NH_4NO_3	2.8	1.013
"	11.2	1.002
"	55	0.989
"	101	0.962
"	202.1	0.911
"	404.3	0.807
"	810.4	0.612
$(NH_4)_2SO_4$	72.2	0.712
"	144.4	0.575
$Ba(NO_3)_2$	62.7	0.922
$Ca(NO_3)_2$	41.	0.923
LiCl	16.72	1.035
"	50.15	0.808
"	125.4	0.596
"	250.8	0.497
"	501.5	0.120
$MgSO_4$	26.5	0.901
"	79.5	0.669
"	159.	0.441
"	318.	0.188
KBr	83.9	0.908
"	167.7	0.819
"	251.5	0.748
"	503.1	0.579
KI	319.1	0.777
"	478.6	0.688
"	957.3	0.506
KSCN	326	0.691
"	489	0.590

Solubility of CO_2 in salts+Aq at 15.2°—*Cont.*

Salt	g. salt per l.	CO_2
KSCN	978	0.387
KNO_3	58.8	0.959
"	117.5	0.890
"	235.1	0.781
NaCl	12.9	0.978
"	64	0.760
"	128	0.580
"	192	0.466
NaBr	115.1	0.775
"	460.3	0.364
"	690.4	0.221
$NaNO_3$	89.3	0.835
"	125	0.762
"	208.4	0.621
"	416.8	0.385
"	625.2	0.244
$NaClO_3$	233.3	0.625
"	349.9	0.506
"	699.8	0.257
Na_2SO_4	14.2	0.950
"	94.8	0.620
"	284.4	0.234
$ZnSO_4$	38.3	0.903
"	76.7	0.783
"	230	0.474
"	460	0.209

(Setschenow, A. ch. 1892, (6) **25.** 226.)

CO_2 is not disengaged at ordinary temp. from H_2O, in which $^1/_{1000}$ pt. of $CaCO_3$ or $MgCO_3$ is held in solution thereby. These solutions have a great power of retaining CO_2 even at a boiling temp. or with diminished pressure, and they also absorb CO_2 from the air in much larger quantity than pure H_2O. (Bineau.)

$BaCO_3$ in H_2O also retains CO_2 even after long boiling. (Storer.)

CO_2 is also absorbed from the air by Na_2CO_3, or K_2CO_3+Aq, especially if dilute.

Absorption of CO_2 by NaCl+Aq at t°.

α=Coefficient of absorption for a 6.52% NaCl solution.

α_1=Coefficient of absorption for a 17.62% NaCl solution.

t°	α	α_1
0	1.234	0.678
5	1.024	0.577
10	0.875	0.503
15	0.755	0.442
20	0.664	0.393
25	0.583	0.352
30	0.517	0.319
35	0.460	0.288
40	0.414	0.263
45	0.370	0.235
50	0.335	0.215
55	0.305	0.198
60	...	0.183

(Bohr, W. Ann. 1899, **68.** 504.)

Absorption of CO_2 by CsCl+Aq.

M=Content in g. equiv. per l.
S=Solubility. (See under Oxygen.)

M	$S_{25°}$	$S_{15°}$
0.552	0.7771	1.001
0.554	0.7769	0.9995

(Geffcken, Z. phys. Ch. 1904, **49.** 273.)

Absorption of CO_2 by KNO_3+Aq.

M	$S_{25°}$	$S_{15°}$
0.536	0.7832	1.002
0.537	0.7818	0.9997
1.022	0.7452	0.9439
1.033	0.7447	0.9421

(Geffcken.)

Absorption of CO_2 by KI+Aq.

M	$S_{25°}$	$S_{15°}$
0.559	0.7678	0.9809
0.573	0.7676	0.9835
1.043	0.7236	0.9144
1.119	0.7166	0.9090

(Geffcken.)

Absorption of CO_2 by RbCl+Aq.

M	$S_{25°}$	$S_{15°}$
0.479	0.7705	0.9908
0.481	0.7698	0.9910
1.007	0.7190	0.921[illegible]
1.012	0.7157	0.9200

(Geffcken.)

Absorption of CO_2 by KBr+Aq.

M	$S_{25°}$	$S_{15°}$
0.550	0.7621	0.9783
0.565	0.7619	0.9766
1.056	0.7030	0.9100
1.064	0.7068	0.9065

(Geffcken.)

Absorption of CO_2 by KCl+Aq.

M	$S_{25°}$	$S_{15°}$
0.423	0.7695	0.9892
0.432	0.7667	0.9865
1.045	0.6920	0.8875
1.058	0.6961	0.8910

(Geffcken.)

Absorption of CO_2 by salts+Aq.

Salt	Grams CO_2 absorbed by 75 cc. of salt solution at 15.5° and 720 mm.
1-N KBr	0.1280
1-N KNO_3	0.1231
1-N KCl	0.1213
1-N KI	0.1204
1-N LiCl	0.1087
1-N NaCl	0.1050
1-N $(NH_4)_2SO_4$	0.1093
1-N $(NH_4)_2SO_4$, $Fe_2(SO_4)_3+24H_2O$	0.0991
1-N K_2SO_4	0.1002
1-N K_2SO_4, $Al_2(SO_4)_3+24H_2O$	0.1054
$^2/_3$-N K_2SO_4	0.1140
$^1/_2$-N $MgSO_4$	0.1209
1-N $MgSO_4$	0.1047
2-N $MgSO_4$	0.0656
4-N $MgSO_4$	0.0527
2-N $CuSO_4$	0.0751
2-N $ZnSO_4$	0.0720
$^2/_3$-N $KHSO_3$	0.1017
2-N $KHSO_4$	0.0999
1-N KH_2AsO_4	0.0808
1-N KH_2PO_4	0.0852
$^1/_2$-N K_2HAsO_4	0.1111
$^1/_2$-N K_2HPO_4	0.4989
$^1/_{40}$-N $Na_2B_4O_7$	0.2205
$^1/_8$-N $Na_2B_4O_7$	0.5317
$^1/_4$-N $Na_2B_4O_7$	0.8511
$^1/_4$-N $NaBO_3$	0.8124
$^1/_4$-N $NH_4HB_2O_4$	0.7672
N-$Na_2PO_4+12H_2O$	0.5828
N-$Na_4P_2O_7+10H_2O$	0.8457
N-$NaPO_3$	0.2081
N-KPO_3	0.2618

(Christoff, Z. phys. Ch. 1905, **53.** 338–340.)

Solubility of CO_2 in KCl+Aq at 25°.

Concentration, 7.45 g. in 100 cc. of solution, sp. gr. = 1.043.

Pressure	756	850	953	1116	1249	1362
Solubility	0.694	0.693	0.688	0.700	0.709	0.710

Concentration, 5 g. in 100 cc. of solution, sp. gr. = 1.031.

Pressure	756	832	901	1050	1150	1223
Solubility	0.731	0.727	0.724	0.726	0.735	0.736

Concentration, 2.56 g. in 100 cc. of solution, Sp. gr. = 1.016.

Pressure	756	852	981	1079	1190	1362
Solubility	0.767	0.761	0.761	0.762	0.768	0.766

(Findlay and Creighton, Chem. Soc. 1910, **97.** 557.)

Solubility of CO_2 in NH_4Cl+Aq at 25°.

Concentration (C) denotes number of grams of solute in 100 cc. of solution.

Density (D) equals the specific gravity of the solution.

Solubility (S) calculated by formula given in the original article.

C	D	S
2.35	1.005	0.791
5.05	1.013	0.754
8.24	1.022	0.732
10.02	1.027	0.712
17.09	1.045	0.665

(Findlay and Shenn, Chem. Soc. 1912, **101.** 1461.)

Solubility of CO_2 in KCl+Aq at 25°.

C	D	S
1.84	1.008	0.792
3.05	1.017	0.764
4.58	1.026	0.749
7.46	1.044	0.701

(Findlay and Shenn.)

Solubility of CO_2 in $BaCl_2$+Aq at 25°.

C	D	S
2.80	1.018	0.789
5.81	1.040	0.741
8.15	1.054	0.710
9.97	1.070	0.676

(Findlay and Shenn.)

Solubility of CO_2 in $(NH_4)_2Fe(SO_4)_2$+Aq at 25°.

C	D	S
9.51	1.052	0.641
10.26	1.057	0.629
22.47	1.124	0.460

(Findlay and Shenn.)

Solubility of CO_2 in solutions of sucrose at 25°.

C	D	S
2.63	1.009	0.813
5.16	1.018	0.798
9.68	1.038	0.767
12.33	1.051	0.744

(Findlay and Shenn.)

Solubility of CO_2 in solutions of chloral hydrate at 25°.

C	D	S
5.08	1.019	0.815
10.12	1.041	0.795

(Findlay and Shenn.)

100 vols. alcohol (0.803 sp. gr.) at 18° absorb 260 vols. CO_2.

100 vols. alcohol (0.840 sp. gr.) at 18° absorb 186 vols. CO_2. (de Saussure, *l. c.*)

Solubility of CO_2 in alcohol. 1 vol. alcohol at t° and 760 mm. dissolves V vols. CO_2 gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4.3295	9	3.5844	18	3.0402
1	4.2368	10	3.5140	19	2.9921
2	4.1466	11	3.4461	20	2.9465
3	4.[illegible]89	12	3.3807	21	2.9034
4	3.9736	13	3.3178	22	2.8628
5	3.8908	14	3.2573	23	2.8247
6	3.8105	15	3.1993	24	2.7890
7	3.7327	16	3.1438	..	...
8	3.6573	17	3.0908	..	....

(Bunsen's Gasometry, pp. 287, 128, 153.)

Coefficient of absorption $= 4.32955 - 0.09395t + 0.00124t^2$. (Bunsen.)

Much less sol. in 30% alcohol than in pure alcohol or pure H_2O. (Müller, W. Ann. **37.** 24.)

Solubility of CO_2 in 99% alcohol at t°.

α = Coefficient of absorption, *i. e.*, the no. of ccm. of CO_2 measured at 0° and 760 mm. which are absorbed at the given temp. and at an absorption pressure of 760 mm. by 1 ccm. alcohol.

α_1 = Coefficient of absorption corrected for increase in the volume of the alcohol used due to absorption of CO_2.

t°	α	α_1
—65	38.41	35 93
—25	8.75	8.61
—20	7.51	7.41
—15	6.59	6.51
—10	5.75	5.69
—5	5.01	4.96
0	4.44	4.40
+5	3.96	3.93
10	3.57	3.55
15	3.25	3.23
20	2.98	2.96
25	2.76	2 74
30	2.57	2.56
35	2.41	2.39
40	2.20	2.19
45	2.01	2.00

(Bohr, W. Ann. 1900, (4) **1.** 249.)

Solubility in 98.7% alcohol at t°.

α = Coefficient of absorption.

α_1 = Coefficient of absorption corrected for increase in volume of the alcohol used due to absorption of CO_2.

t°	α	α_1
0	4.35	4.31
—10	5.43	5.38
—20	7.25	7.16
—30	9.97	9.79
—40	14.25	13.89
—50	21.28	20.49
—60	31.25	29 59
—65	39.89	37.22
—67	44.07	40.83

(Bohr, W. Ann. 1900, (4) **1.** 253.)

Solubility in alcohol+Aq at t°.

t°	% by wt. of alcohol in the solvent	Solubility of CO_2 in alcohol+Aq	Solubility of CO_2 in H_2O
1.4	6.325	1.5864	1.6916
3.2	4.464	1.4878	1.5652
9.2	7.276	1.1829	1.2216
13.8	2.870	1 0268	1.0385

(Langer, C. C. **1904,** I, 1583.)

Solubility of CO_2 in ethyl alcohol at 25°.

Concentration. 2.95 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99308.

Pressure	737	836	929	1073	1213	1338
Solubility	0.812	0.813	0.812	0.811	0.813	0.811

Concentration. 3.01 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99295.

Pressure	745	823	937	1083	1226	1357
Solubility	0.814	0.812	0.815	0.813	0.812	0.812

Concentration. 8.83 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.98342.

Pressure	747	846	942	1090	1231	1360
Solubility	0.786	0.786	0.784	0.785	0.786	0.788

(Findlay and Shenn, Chem. Soc. 1911, **99.** 1315.)

Solubility of CO_2 in organic solvents at low temperatures.

Solvent. Ethyl alcohol.

t = —78°; sp. gr. = 0.872		
Pressure	Coefficient of absorption	Solubility
100	111.8	68.4
200	115.7	69.5
400	123.8	71.4
700	138.6	74.7

Solubility of CO_2 in organic solvents at low temperatures.—*Continued*

t = —59°; sp. gr. = 0.856

Pressure	Coefficient of absorption	Solubility
100	40.85	27.27
200	41.00	27.16
400	42.35	27.65
700	44.15	28.10

Solvent. Methyl alcohol.

t = —78°; Sp. gr. = 0.884

Pressure	Coefficient of absorption	Solubility
[illegible]	194.0	120.5
100	195.0	119.6
200	202.9	120.1
400	221.5	122.2
500	226.4	..
740	260.0	126.8

t° = —59°; sp. gr. = 0.866

Pressure	Coefficient of absorption	Solubility
100	63.0	42.5
200	64.2	42.7
400	66.3	43.1
700	69.0	43.3

Solvent. Acetone.

t = —78°; sp. gr. = 0.900

Pressure	Coefficient of absorption	Solubility
50	311	196.6
100	322	198.1
200	344.5	201.5
400	400	208.8
640	487	215.7
700	545.5	...

t = —59°; sp. gr. = 0.879

Pressure	Coefficient of absorption	Solubility
100	97.8	67.2
200	101.2	68.0
460	106.6	72.8
700	118.8	72.8

Solvent.—Ethyl acetate.

t = —78°; sp. gr. = 1.017

Pressure	Coefficient of absorption	Solubility
50	250.2	177.5
100	255.6	177.1
200	271.8	179.2
400	310.9	183.2
650	386.9	191.2

Solubility of Co_2 in organic solvents at low temperatures.—*Continued*

t = —59°; sp. gr. = 0.994

Pressure	Coefficient of absorption	Solubility
100	85.3	65.6
200	86.3	65.3
400	91.6	66.7
700	101.5	69.7

Solvent. Methyl acetate.

t = —78°; sp. gr. = 1.056

Pressure	Coefficient of absorption	Solubility
50	304.9	224.1
100	315.0	224.3
200	337.4	223.1
400	389.3	225.6
650	498.1	231.2

t = —59°; sp. gr. = 1.032

Pressure	Coefficient of absorption	Solubility
100	94.3	75.8
200	98.45	77.1
400	103.6	77.6
700	112.9	79.0

(Stern, Z. phys. Ch. 1912, **81.** 468.)

Solubility of CO_2 in ether at 0° = 7.33; at 10° = 6.044; at 15° = 5.46. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Coefficient of absorption in chloroform is 0.20376 at 36.57 mm., and 4.43757 at 762 mm. pressure. (Woukoloff, C. R. **109.** 62.)

100 vols. of following liquids absorb vols. CO_2 at 18°—

	Sp. gr.	Vols. CO_2
Ether	0.727	217
Rectified naphtha	0.784	169
Oil of turpentine	0.860	166
Oil of lavender (freshly distilled)	0.880	191
Oil of thyme	0.890	188
Linseed oil	0.940	156
Olive oil	0.915	151
Gum-arabic + Aq (containing 25% of the gum)	1.092	75
Cane-sugar + Aq (containing 25% of sugar)	1.104	72

(de Saussure, *l. c.*)

1 vol. oil of turpentine absorbs 1.7–1.9 vols. CO_2 (Saussure.)

1 vol. spirit at 10° absorbs 2 vols. CO_2. (de Saussure.)

1 vol. olive oil at 10° absorbs 1 + vol. CO_2. (de Saussure.)

1 vol. oil of turpentine at 10° absorbs 2 vols. CO_2. (Bergman.)

1 vol. caoutchine absorbs 11 vols. CO_2. (Bergman.)

Coefficient of absorption for petroleum is 1.17 at 20° and 1.31 at 10°. (Gniewasz and Walfisz, Zeit. phys. Ch. **1.** 70.)

100 vols. petroleum absorb 70 vols. CO_2 at 10°. (Robinet, C. R. **58.** 608.)

Solubility of CO_2 in $\frac{N}{2}$ solutions of various organic substances at 20°.

Substance	Sp. gr. of $\frac{N}{2}$ solution	Coeff. of absorption	cc. CO_2 dissolved in 1000 g. H_2O
Dextrose	1.0328	0.792	841
Mannite	1.03031	0.782	833
Glycerine	1.01413	0.843	864
Pyrogallol	1.01718	0.853	894
Hydrochinon	1.00946	0 887	928
Resorcin	1.00958	0.901	945
Pyrocatechin	1.0107	0.868	908
Urethane	1.0037	0.869	907
Carbamide	1 00715	0.864	884
Thiocarbamide	1.00917	0.859	885
Antipyrine	1.01339	0.859	935
Acetamide	1.005	0.879	906
Acetic acid	1.0026	0.868	893
N. Propylic acid	0.9939	0.869	902

(Usher, Chem. Soc. 1910, **97**. 73.)

Absorption of CO_2 by ethyl alcohol.

Amount of alcohol used $=0.093$ ccm.

V = ccm. of CO_2 absorbed by the solvent at t°, reduced to a pressure of 1 kg. per sq. cm.

V_1 = ccm. of CO_2 absorbed by 1 ccm. of the solvent.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
30	20°	57.31	9.462	104.8
40			15.15	149.7
50			23.04	188.8
30	35°	60.05	7.114	77.87
40			10.52	113.1
50			14.73	144.5
60			19.63	173.0
70			27.39	210.8
40	60°	64.44	6.429	72.82
50			9.023	97.09
60			12.27	122.5
70			15.64	145.2
80			19.11	167.9
90			20.64	180.7
100			23.88	195.7
50	100°	72.19	3.809	42.49
60			6.034	66.05
70			8.374	88.67
80			10.76	111.2
90			13.06	129.0
100			14.90	145.7
110			16.22	155.0
120			18.93	174.6
130			20.48	182.6
140			20.61	186.0

(Sander, Z. phys. Ch. 1912, **78**. 524.)

Absorption of CO_2 by propyl alcohol.

Amount of alcohol used $=0.103$ ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
20	20°	60.59	4.867	56.16
30			8.472	86.62
40			13.46	122.1
50			21.62	174.6
20	35°	62.96	3.493	40.00
30			6.307	64.08
40			9.296	98.16
50			13.99	122.8
60			18.90	159.9
70			35.03	228.2
80			49.23	269.6
20	60°	68.08	2.602	24.73
30			4.722	47.68
40			6.723	64.65
50			9.810	88.54
60			13.05	111.5
70			17 15	144.4
80			19 61	159.2
90			24.75	184.3
100			30 19	213 9
40	100°	76 27	2 592	26 50
50			5.669	54.19
60			8.025	74.51
70			10.44	92.17
80			13.13	107.7
90			15.72	132.3
100			17.10	144.7
110			20.95	163.5
120			23.55	175.4

(Sander.)

Absorption of CO_2 by ether.

Amount of ether used $=0.131$ ccm.

V and V_1. See under absorption of CO_2 by alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
45	35°	62.06	42.62	205.6
50			46.81	217.3
60			57.83	241.6
50	60°	67.11	28.49	171.6
60			35.24	195.4
70			42.01	210.0
80			46.64	221.4
90			50.72	235.0
100			56.63	248.7
60	100°	71.03	12.57	101.0
70			20.00	134.6
80			26.34	142.8
90			32.16	166.4
100			35.70	175.4

(Sander.)

Absorption of CO_2 by benzene.

Amount of benzene used = 0.080 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
15	20°	55.14	2.728	46.89
20			4.845	71.16
30			9.618	125.3
40			18.70	192.4
50			30.10	264.3
15	35°	58.17	2.225	39.94
20			3.373	48.65
30			6.879	94.59
40			11.56	138.3
50			17.09	186.6
60			25.73	243.1
70			35.80	269.0
20	60°	61.86	2.140	34.57
30			3.880	55.97
40			6.699	88.71
50			10.28	128.5
60			13.57	156.6
70			17.71	184.6
80			22.50	215.0
90			28.09	246.6
100			33.76	284.4
40	100°	73.75	2.822	46.52
50			3.981	58.46
60			6.440	91.27
70			8.398	119.0
80			11.96	155.8
90			14.57	182.5
100			17.79	212.9
110			20.60	237.7
120			23.98	258.2

(Sander.)

Absorption of CO_2 by chlorbenzene.

Amount of chlorbenzene used = 0.106 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
20	20°	61.03	5.813	62.61
30			10.25	95.22
40			17.17	137.3
50			26.59	187.5
20	35°	64.16	4.650	46.66
30			7.705	72.73
40			11.81	101.5
50			16.83	137.3
60			22.82	168.3
70			32.83	205.5
20	60°	69.38	3.685	35.86
30			5.510	53.94
40			7.982	73.69
50			11.16	99.06
60			13.74	118.1
70			16.65	134.5
80			19.50	149.3
90			22.23	165.5
110			31.64	204.4
30	100°	77.73	3.562	33.65
40			5.008	48.16
50			7.106	63.78
60			8.701	77.24
70			10.37	91.02
80			12.05	103.00
90			13.88	121.2
100			14.89	121.5
110			16.35	130.7
120			17.77	140.7
130			18.54	146.8

(Sander.)

Absorption of CO_2 by brombenzene.

Amount of brombenzene used = 0.113 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
20	20°	60.84	4.531	50.83
30			7.793	82.29
40			12.22	121.1
50			17.37	160.0
20	35°	63.96	3.947	43.38
30			5.782	62.69
40			8.508	90.43
50			11.96	116.4
60			16.00	146.0
70			22.56	184.1
80			41.26	233.9
20	60°	69.16	2.650	30.58
30			3.714	46.15
40			5.971	62.64
50			7.406	77.19
60			9.718	98.73
70			10.27	108.4
80			13.99	131.4
90			16.70	144.3
100			20.06	169.7
110			23.13	190.6
30	100°	77.48	2.970	30.56
40			4.032	41.49
50			5.833	59.64
60			7.239	72.64
70			8.330	82.56
80			9.714	92.86
90			11.14	107.1
100			12.79	118.0
110			13.80	125.3
120			15.50	140.7

(Sander.)

Absorption of CO_2 by nitrobenzene.

Amount of nitrobenzene used = 0.164 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
15	20°	57.65	5.459	41.60
20			7.354	57.12
30			12.14	92.50
40			15.93	115.9
50			21.71	155.9
20	35°	59.86	5.644	44.48
30			8.658	68.23
40			11.98	94.39
50			15.59	113.4
60			19.94	145.1
70			25.57	179.6
80			34.95	227.0
20	60°	64.73	3.787	31.38
30			4.519	38.23
40			6.308	52.26
50			7.750	64.21
60			8.887	72.15
70			10.15	82.40
80			10.80	85.03
20	100°	75.52	2.749	24.67
30			4.162	41.00
40			5.393	50.36
50			6.832	63.80
60			7.763	70.85
70			9.048	75.75
80			10.65	86.86

(Sander.)

Absorption of CO_2 by toluene.

Amount of toluene used = 0.114 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
20	20°	59.97	7.420	57.91
30			13.31	103.3
40			23.25	155.9
50			45.10	235.8
20	35°	63.05	6.018	49.60
30			10.13	82.63
40			16.03	118.8
50			23.34	155.8
60			31.39	192.1
70			44.17	225.8
30	60°	68.17	6.735	54.67
40			9.885	78.67
50			13.98	104.6
60			18.00	128.1
70			22.66	150.1
80			26.60	171.9
90			31.66	191.5
100			38.86	210.0

Absorption of CO_2 by toluene.—*Continued*

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
30	100°	76.37	3.356	28.68
40			5.945	49.25
50			8.703	67.93
60			11.18	85.98
70			13.72	101.7
80			16.30	117.6
90			18.88	132.6
100			21.85	149.0
110			24.86	161.9
120			26.80	171.8
130			28.21	178.7

(Sander.)

Absorption of CO_2 by ethyl acetate.

Amount of ethyl acetate used = 0.155 ccm.

V and V_1. See under absorption of CO_2 by ethyl alcohol.

Pressure kg/sq.cm.	t°	Gas volume ccm.	V	V_1
25	20°	60.30	29.43	158.6
30			37.91	188.2
40			51.26	227.9
30	35°	63.40	26.54	145.2
40			38.69	188.4
50			48.35	213.9
60			51.88	219.8
30	60°	68.55	18.12	108.0
40			25.67	140.5
50			33.21	165.2
60			40.12	186.7
70			45.47	201.1
80			49.16	223.4
40	100°	76.80	12.76	80.70
50			18.80	110.1
60			24.12	132.0
70			28.99	152.0
80			32.96	162.3
90			36.92	172.1
100			42.75	191.5

(Sander.)

Absorption of CO_2 by $CH_3COOH + CCl_4$.

Solvent	cc. CO_2 absorbed
1 mol. CH_3COOH	58.8
0.8 " CH_3COOH + 0.2 " CCl_4	61.0
0.5 " CH_3COOH + 0.5 " CCl_4	62.4
0.2 " CH_3COOH + 0.8 " CCl_4	60.2
1 " CCl_4	57.6

(Christoff, J. phys. Ch. 1905, **53.** 382.)

Absorption of CO_2 by $C_2H_4Cl_2+CS_2$.

Solvent	cc. CO_2 absorbed
1 mol. $C_2H_4Cl_2$	209.7
0.8 " $C_2H_4Cl_2+$ 0.2 " CS_2	173.4
0.5 " $C_2H_4Cl_2+$ 0.5 " CS_2	140.0
0.2 " $C_2H_4Cl_2+$ 0.8 " CS_2	71.9
1 " CS_2	19.9

(Christoff.)

Solubility of CO_2 in organic solvents

$\frac{ds}{dt}$ - change of solubility for 1° increase in temp.

Solvent	Solubility at 25° C.	Solubility at 20° C.	Solubility at 15° C.	$\frac{ds}{dt}$
Glycerine	0.0302	...	....	.....
Water	0.8256			
Carbon bisulphide	0.8699	0.8888	0.9446	—0.00747
Iodobenzene	1.301	1.371	1.440	—0.0139
Aniline	1.324	1.434	1.531	—0.0207
o-Toluidine	1.381	1.473	1.539	—0.0158
m-Toluidine	1.436	1.581	1.730	—0.0244
Eugenol	1.539	1.653	1.762	—0.0223
Benzotrichloride	1.643	....		....
Cumene	1.782	1.879	1.978	—0.0196
Carvene	1.802	1.921	2.034	—0.0232
Dichlorhydrin	1.810	1.917	2.020	—0.0210
Amyl alcohol	1.831	1.941	2.058	—0.0227
Brombenzene	1.842	1.964	2.092	—0.0250
Isobutyl alcohol	1.849	1.964	2.088	—0.0239
Benzyl chloride	1.938	2.072	2.180	—0.0242
m-Xylene	2.090	2.216	2.346	—0.0256
Ethylene bromide	2.157	2.294	2.424	—0.0267
Chlorobenzene	2.265	2.420	2.581	—0.0316
Carbon tetrachloride	2.294	2.502	2.603	—0.0309
Propylene bromide	2.301	2.453	2.586	—0.0281
Toluene	2.305	2.426	2.557	—0.0256
Benzene	2.425	2.540	2.710	—0.0285
Amyl bromide	2.455	2.638	2.803	—0.0348
Nitrobenzene	2.456	2.655	2.845	—0.0389
Propyl alcohol	2.498	....	....	.....
Carvol	2.498	2.690	2.914	—0.0416
Ethyl alcohol (97%)	2.706	2.923	3.130	—0.0424
Benzaldehyde	2.841	3.057	3.304	—0.0463
Amyl chloride	2.910	3.127	3.363	—0.0455
Isobutyl chloride	3.105	3.388	3.659	—0.0554
Chloroform	3.430	3.681	3.956	—0.0526
Butyric acid	3.478	3.767	4.084	—0.0606
Ethylene chloride	3.525	3.795	4.061	—0.0536
Pyridine	3.656	3.862	4.291	—0.0635
Methyl alcohol	3.837	4.205	4.606	—0.0769
Amyl formate	4.026	4.329	4.646	—0.0620
Propionic acid	4.078	4.417	4.787	—0.0709
Amyl acetate	4.119	4.411	4.850	—0.0731
Glacial acetic acid	4.679	5.120	5.614	—0.0935
Isobutyl acetate	4.691	4.968	....	—0.0554
Acetic anhydride	5.206	5.720	6.218	—0.1012
Acetone	6.295	6.921	....	—0.1252
Methyl acetate	6.494	....	....	.....

(Just, Z. phys. Ch. 1901. **37**. 354.)

Absorption of CO_2 by organic substances+Aq at 15°.

P = % of the organic substance in the solvent.

$\beta_{15}°$ = Coefficient of absorption at 15°.

$S_{15}°$ = Solubility at 15°.

Organic substance used	P	$\beta_{15}°$	$S_{15}°$
Chloral hydrate	0	0.996	...
	0	0.992	1.056
	0	1.012	....
	17.7	0.885	0.935
	21.8	0.860	0.908
	31.6	0.803	0.848
	37.0	0.790	0.834
	38.3	0.781	0.825
	49.8	0.760	0.802
	51.1	0.769	0.812
	52.6	0.764	0.807
	57.1	0.765	0.808
	61.1	0.780	0.824
	68.8	0.797	0.842
	71.0	0.812	0.857
	74.6	0.848	0.895
	79.4	0.903	0.953
Glycerine	0	1.003	1.064
	0	1.013	....
	26.11	0.785	0.829
	27.69	0.800	0.845
	43.72	0.639	0.675
	46.59	0.620	0.655
	62.14	0.511	0.540
	73.36	0.449	0.474
	77.75	0.430	0.454
	87.74	0.422	0.446
	90.75	0.404	0.427
	96.64	0.415	0.438
	99.26	0.410	0.438

(Hammel, Z. phys. Ch. 1915, **90**. 123.)

Solubility of carbon dioxide in solutions of aniline at 25°.

I. Concentration, 0.206 g. aniline in 100 c. c. of solution.

P = Pressure.

S = Solubility calc. according to formula given in original article.

P	S	P	S
748	0.865	1053	0.855
808	0.855	1159	0.862
920	0.857	1243	0.860

II. Concentration, 0.425 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.909	1150	0.897
816	0.897	1236	0.902
921	0.897	1380	0.908

Solubility of carbon dioxide in solutions of aniline at 25°.—*Continued*

III. Concentration, 0.566 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.935	1082	0.923
823	0.929	1223	0.924
941	0.925	1341	0.930

IV. Concentration, 0.743 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.953	1063	0.940
895	0.941	1223	0.940
983	0.940	1302	0.942

(Findlay and Creighton, Chem. Soc. 1910, **97.** 555.)

Solubility of CO_2 in CS_2 increases approx. proportionally with the pressure. The absorption is greater at lower temp. and less at higher temp. than is required by Dalton's law. (Woukoloff, C. R. 1889, **108.** 674.)

Absorption of CO_2 by sugar+Aq.

Sugar+Aq	Grams CO_2 absorbed by 75 cc. of solution at 15.5° and 720 mm.
1/10-N sugar solution	0.1225
1/2-N " "	0.1089
1-N " "	0.0931

(Christoff, Z. phys. Ch. 1905, **53.** 329.)

Absorption of CO_2 in sugar+Aq at 20°.

Conc. of solution	Sp. gr.	Coefficient of absorption
1/8 mol. per l.	1.01518	0.846
1/4 " " "	1.03125	0.815
1/2 " " "	1.06372	0.756
1 " " "	1.12809	0.649

(Usher, Chem. Soc. 1910, **97.** 72.)

Liquid.—Not miscible with H_2O, though slightly sol. therein, or with fatty oils; miscible with alcohol, ether, CS_2, and the essential oils. (Thilorier, Mitchell.)

Unacted upon by H_2O; sol. in alcohol, ethers, petroleum, oil of turpentine, and CS_2. (Mareska and Donny.)

Petroleum dissolves 5 to 6 vols. liquid CO_2. (Cailletet, C. R. **75.** 1271.)

Sl. sol. in CS_2. (Cailletet.)

Solid.—When immersed in H_2O, rapidly volatilizes and dissolves. With alcohol or ether it forms a semi-fluid mixture. (Channing, Am. J. Sci. (2) **5.** 186.)

Only slightly sol. in anhydrous ether, but may be mixed therewith to a paste. (Thilorier.)

Sol. in methyl chloride below —65° to the point of sat. without decomp. (Villard, C. R. 1895, **120.** 1413.)

$+6H_2O$. (Villard, C. R. 1894, **119.** 369.)

Carbon selenide, C_4Se.

Sol. only in hot conc. H_2SO_4. (v. Bartal, Ch. Z. 1906, **30.** 810.)

C_6Se. Insol. in H_2O, CS_2, and ether. Easily sol. in hot conc. H_2SO_4; sol. in conc. NaOH+Aq from which it is pptd. by HCl. (v. Bartal.)

Carbon silicide CSi.

(*Carborundum.*) Not attacked by any acids, even HF; sl. attacked by caustic alkalies or carbonates. (Acheson, C. N. **68.** 179.)

Not attacked by KOH+Aq. (Schützenberger, C. R. **114.** 1089.)

Carbon *mono*sulphide, CS.

Insol. in H_2O, alcohol, oil of turpentine, or benzene; somewhat sol. in CS_2 or ether; sol. in warm HNO_3; sol. in conc. KOH+Aq. (Sidot, C. R. **81.** 32.)

Readily absorbed by alcohol and aniline. (Deninger, J. pr. 1895, (2) **51.** 349.)

Carbon *di*sulphide, CS_2.

Very sl. sol. in H_2O.

1 l. H_2O dissolves 2–3 g. CS_2 (Ckiandi, Bull. Soc. **43.** 562); 3.5–4.52 g. (Peligot, *ib.* **43.** 563).

30 ccm. CS_2 shaken with 8690 ccm. H_2O at 20–23° for 18 days decreased 11 ccm. in 9 days and 1.4 ccm. in the next 3 days by diffused light, and 0.6 ccm. in the last 5 days (no light). Part of the CS_2 was decomp. and 7.85 ccm. were dissolved, therefore H_2O dissolves 1/1000 of its weight CS_2. (Sestini, Gazz. ch. it. **1.** 473.)

Solubility of CS_2 in H_2O.

100 pts. H_2O dissolve 0.203 pts. CS_2 at 12–13°
" " 0.191 " " 15–16°
" " 0.168 " " 25–27°
" " 0.145 " " 30–33°.

(Page, C. N. **41.** 195.)

Solubility of CS_2 in H_2O. a = g. CS_2 in 1000 ccm. solution at t°.

a	t°	a	t°	a	t°
2.04	0	1.79	20	1.11	40
1.99	5	1.69	25	0.70	45
1.94	10	1.55	30	0.14	49
1.87	15	1.37	35		

(Chancel and Parmentier, C. R. **100.** 773.)

100 g. H_2O dissolve at t°:

t°	0	10	20	30
	0.258	0.239	0.201	0.195 g. CS_2.

(Rex, Z. phys. Ch. 1906, **55.** 365.)

Absorption of CS_2 vapor by H_2O at t°.

t°	Coefficient of absorption
0	3.573
10	2.189
20	1.346
30	0.799

Calc. from data of Chancel and Parmentier, C. R. **100.** 733.)
(Winkler, Z. phys. Ch. 1906, **55.** 352.)

Vapors of CS_2 are most easily absorbed by alcoholic solution of KOH. Sl. absorbed by KOH+Aq, and very slowly by $CuSO_4$, $Pb(C_2H_3O_2)_2$+Aq, conc. H_2SO_4, or $CaCl_2$ in HCl+Aq. (Berthelot, A. ch. (3) **51.** 74.)

Solubility in alcohol. S = strength of alcohol in per cent by weight; P = pts. CS_2 which dissolve in 10 ccm. alcohol at 17°.

S	P	S	P
100	∞	91.37	5.00
98.5	18.20	84.12	3.00
98.15	13.20	76.02	2.00
96.95	10.00	48.40	0.20
93.54	7.00	47.90	0.00

(Tuchschmidt and Follenius, B. **4.** 583.)

Miscible with absolute alcohol, ether, ethereal and fatty oils, and liquid CO_2.

*Tri*carbon *di*sulphide, C_3S_2.

Insol. in H_2O; easily sol. in alcohol, ether, chloroform, benzene, and CS_2. The alcoholic and ethereal solutions decomp. on standing. (Lengyel, B. **26.** 2960.)

Sol. in alcohol with decomp. Sol. in CS_2 and in benzene. (Stock, B. 1912, **45.** 3575.)

Solid modification. Insol. in H_2O and ordinary solvents. Sol. in KOH+Aq. (Lengyel.)

Carbon sulphoselenide, CSSe.

Mpt. —85°, bpt. +84°.

Decomp. by light. Not attacked by H_2O. Sol. in hot conc. HNO_3. Decomp. by Br_2 to an oil. Sol. in alcohol with decomp. Miscible with CS_2. (Stock, B. 1914, **47.** 150.)

Carbon sulphotelluride, CSTe.

Mpt. —54°. Very unstable.

Miscible with CS_2 and benzene without decomp. (Stock, B. 1914, **47.** 142.)

Carbonatochloroplatin*di*amine carbonate chloroplatin*di*amine nitrate.

$\begin{matrix}CO_3\\Cl_2\end{matrix}\left[Pt\begin{matrix}N_2H_6\\N_2H_6\end{matrix}\right]_2(CO_3)_2$, $Cl_2Pt(N_2H_6NO_3)_2$.

Precipitate. (Cleve, J. B. **1867.** 321.)

Carbonatonitratoplatin*di*amine carbonate, $\begin{matrix}CO_3\\(NO_3)_2\end{matrix}[Pt(N_2H_6)_2]_2(CO_3)_2$.

Sol. in boiling H_2O. (Cleve.)

Carbonatotetramine cobaltic bromide, $Co(NH_3)_4CO_3Br$.

Much less sol. than chloride. (Jörgensen, Z. anorg. **2.** 279.)

—— **carbonate,** $[Co(NH_3)_4CO_3]_2CO_3+3H_2O$.

Very sol. in H_2O. (Jörgensen.)

—— **chloraurate,** $[Co(NH_3)_4CO_3]_2AuCl_4+\frac{1}{2}H_2O$.

Somewhat sol. in H_2O; nearly absolutely insol. in alcohol. (Jörgensen.)

—— **chloride,** $Co(NH_3)_4CO_3Cl$.

Easily sol. in H_2O; insol. in alcohol. (Jörgensen.)

—— **chloroplatinate,** $[Co(NH_3)_4CO_3]_2PtCl_6+2H_2O$.

Nearly insol. in H_2O and alcohol. (Jörgensen.)

—— **chloroplatinite,** $[Co(NH_3)_4CO_3]_2PtCl_4$.

Nearly insol. in H_2O; wholly in alcohol. (Jörgensen.)

—— **dithionate,** $[Co(NH_3)_4CO_3]_2S_2O_6$.

Ppt. (Jörgensen.)

—— **iodide,** $Co(NH_3)_4CO_3I$.

Much less sol. than bromide or chloride. (Jörgensen.)

—— **nitrate,** $Co(NH_3)_4CO_3NO_3+\frac{1}{2}H_2O$.

Sol. in about 15 pts. cold H_2O; insol. in alcohol. (Jörgensen.)

—— **sulphate,** $[Co(NH_3)_4CO_3]_2SO_4+3H_2O$.

Considerably less sol. in H_2O than the nitrate. (Jörgensen.)

Carbonic acid, H_2CO_3

See **Carbon dioxide.**

Carbonates.

Carbonates of Na, K, Rb, and Cs are easily sol. in H_2O; carbonates of Li and Tl are much less sol.; other carbonates are nearly or quite insol. All carbonates are sol. to some extent in H_2O containing CO_2. All carbonates, except those of NH_4, Rb, and Cs, are insol. in alcohol.

Sol. in those acids which are themselves sol. in H_2O, except HCN and H_3BO_3.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 824.)

Aluminum carbonate, basic.

$5Al_2O_3$, $6CO_2+37H_2O=3Al(OH)_3$, $Al_2(CO_3)_3+14H_2O$. (Seubert, Z. anorg. 1893, **4.** 67.)

Al_2O_3, CO_2. (Parkmann, Sill. Am. J. (2) **34.** 324.)

$3Al_2O_3$, $2CO_2+16H_2O$. (Muspratt and Danson, A. **72.** 120.)

$3Al_2O_3$, $2CO_2+9H_2O$. (Wallace, Chem. Gaz. **1858.** 410.)

$5Al_2O_3$, $3CO_2+18H_2O$. (Bley, J. pr. **39.** 11.)

$2Al_2O_3$, $CO_2+6H_2O.=10Al(OH)_3$, $Al_2(CO_3)_3+3H_2O$. Sol. in cold dil. acids. (Schlumberger, Bull. Soc. 1895, (3) **13.** 46.)

$+8H_2O$. (Urbain and Renoul, J. Pharm. (4) **30.** 340.) $=10Al(OH)_3$, $Al_2(CO_3)_3+9H_2O$. (Seubert, Z. anorg. 1893. **4.** 67.)

$8Al_2O_3$, $3CO_2+40H_2O$. (Langlois, A. ch. (3) **18.** 505.)

All are precipitates, insol. in H_2O, sol. in acids, and give off CO_2 at slight heat.

There are no definite carbonates of aluminum. (Cameron, J. phys. Chem. 1908, **12.** 572.)

Aluminum ammonium carbonate, Al_2O_3, CO_2, $(NH_4)_2CO_3+4H_2O$.

Precipitate. (Rose, Pogg. **91.** 460.)

Aluminum sodium carbonate, Al_2O_3, CO_2, $2Na_2CO_3+24H_2O$.

Precipitate. Sol. in cold dil. acids. (Bley, J. pr. **39.** 22.)

Ammonium carbonate, $(NH_4)_2CO_3+H_2O$.

Sol. at 15° in its own weight H_2O. Solution in H_2O gives off gas at 70–75°, and boils at 75–80°. Sl. sol. in cold dil. NH_4OH+Aq, more sol. at ordinary temp. Insol. in conc. NH_4OH+Aq. (Divers, Chem. Soc. (2) **8.** 171, 259, and 364.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Insol. in alcohol.

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

100 g. pure glycerine dissolve 20 g. $(NH_4)_2CO_3$ at 15°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Ammonium hydrogen carbonate, NH_4HCO_3.

Sol. at 15° in about 8 pts. H_2O. (Berthollet, J. Phys. **66.** 168.)

Sol. at 12.8° in about 6 pts. H_2O. (J. Davy, N. Edinb. J. **16.** 245.)

Solution decomp. on air or by gentle heat or by addition of the solid salt. (Berthollet.)

100 pts. H_2O dissolve at 0°, 11.9 pts.; at 10°, 15.85 pts.; at 20°, 21 pts.; at 30°, 27 pts. NH_4HCO_3. (Dibbits, J. pr. (2) **10.** 417.)

Solubility of NH_4HCO_3 in NH_4Cl+Aq, sat. with CO_2, at t°.

t°	g. per 100 g. H_2O		Sp. gr. of sat. solution
	NH_4Cl	NH_4HCO_3	
0°	0	11.9	...
	29.08	3.6	1.077
15°	0	18.64	1.064
	2.99	16.29	1.063
	6.06	14.22	1.062
	8.51	12.69	1.062
	11.68	11.68	1.065
	18.30	9.33	1.069
	26.93	7.73	1.076
	33.25	6.64	1.085
	34.35	6.42	1.085
30°	0	27.0	.
	39.7	9.1	..

(Fedotieff, Z. phys. Ch. 1904, **49.** 168.)

Solubility of NH_4HCO_3 in $NaHCO_3+Aq$, sat. with CO_2 at t°.

t°	g. per 100 g. H_2O		Sp. gr. of sat. solution
	$NaHCO_3$	NH_4HCO_3	
0°	0	11.90	.
	4.82	10.94	1.072
15°	0	18.64	1.064
	5.92	17.06	1.090
30°	0	27.0	.
	7.0	23.0	..

(Fedotieff, Z. phys. Ch. 1904, **49.** 168.)

Solubility of NH_4HCO_3 in NH_4NO_3+Aq at t°.

t°	g. per 100 g. H_2O		Sp. gr. of sat. solution
	NH_4NO_3	NH_4HCO_3	
0°	0	11.90	...
	118	4.52	1.2625
15°	0	18.64	1.064
	23.26	12.91	1.113
	49.82	10.33	1.164
	103.4	8.25	1.242
	128.9	7.79	1.269
	166.9	7.49	1.302
30°	0	26.96	..
	231.9	12.57	...

(Fedotieff and Koltunoff, Z. anorg. 1914, **85.** 251.)

Insol. in alcohol. (J. Davy.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Ammonium dihydrogen carbonate, $(NH_4)_4H_2(CO_3)_3+H_2O$.

Sol. in 5 pts. H_2O at 15°; decomp. by more H_2O or by heat. (Divers, Chem. Soc. (2) **8.** 171, 359, and 364.)

Sl. sol. in alcohol.

Ammonium hydrogen carbonate carbamate, $2NH_4HCO_3$, NH_4CONH_2. (*Salts of hartshorn.*)

1 pt. salt dissolves at:

13°	in 4	pts. H_2O.
16.7°	" 3.3	"
32.2°	" 2.7	"
40.6°	" 2.4	"
49°	" 2	"

(J. Davy, N. Edinb. J. **16.** 245.)

Strong alcohol dissolves out carbamate, and the carbonate remains undissolved.

NH_4HCO_3, $NH_4CO_2NH_2$. (*Commercial carbonate of ammonia.*)

Sol. at 15° in 4 pts. H_2O, at 65° in 1½ pts. H_2O. (Divers.)

30 pts. salt+100 pts. H_2O lower temp. from 15.3° to 3.2°. (Rüdorff, B. **2.** 68.)

Sol. in 1.667 pts. cold, and 0.833 pt. hot H_2O. (Fourcroy.)

100 pts. H_2O at	13°	dissolve	25 pts.
"	17°	"	30 "
"	37°	"	37 "
"	41°	"	40 "
"	49°	"	50 "

(Berzelius.)

100 pts. H_2O at 15.5° dissolve 33 pts.; at 100°, 100 pts. (Ure's Dict.)

Sol. in 2 pts. H_2O at 15.5°, and in less than 1 pt. boiling H_2O; sat. solution at 15.5° contains 33.3%, and sat. boiling solution 50%. (Abl.)

Sat. aqueous solution at 10° contains 15.7%. (Eller.)

Sat. aqueous solution at (?) contains 6.1%. (Mussembroek.)

Sat. solution in the cold contains 37.5%. (Fourcroy.)

Does not dissolve as such in H_2O; $(NH_4)_2CO_3$ dissolves out first, and NH_4HCO_3 later. (Scanlan.)

Sp. gr. of carbonate of ammonia+Aq at 12°.

Deg. Tw.	Sp. gr. at 12°.	% Carb. ammon.	Change of sp. gr. for 1° C.
1	1.005	1.66	0.0002
2	1.010	3.18	0.0002
3	1.015	4.66	0.0003
4	1.020	6.04	0.0003
5	1.025	7.49	0.0003
6	1.030	8.93	0.0004
7	1.035	10.35	0.0004
8	1.040	11.86	0.0004
9	1.045	13.36	0.0005
10	1.050	14.83	0.0005
11	1.055	16.16	0.0005
12	1.060	17.70	0.0005
13	1.065	19.18	0.0005
14	1.070	20.70	0.0005
15	1.075	22.25	0.0006
16	1.080	23.78	0.0006
17	1.085	25.31	0.0006
18	1.090	26.82	0.0007
19	1.095	28.33	0.0007
20	1.100	29.93	0.0007
21	1.105	31.77	0.0007
22	1.110	33.45	0.0007
23	1.115	35.08	0.0007
24	1.120	36.83	0.0007
25	1.125	38.71	0.0007
26	1.130	40.34	0.0007
27	1.135	42.20	0.0007
28	1.140	44.29	0.0007
29	1.144	44.90	0.0007

(Lunge, Chem. Ind. **1883.** 2.)

Sp. gr. of aqueous solution of salt with composition 31.3% NH_3, 56.6% CO_2, 12.1% H_2O. 100 pts. of solution contain—

6.58	9.96	14.75	19.83	25.71	pts. salt
1.0219	1.0337	1.0497	1.0672	1.0863	sp. gr.

29.74	35.85	40.23	44.90	pts. salt.
1.0995	1.1174	1.1297	1.1414	sp. gr.

(J. H. Smith, Chem. Ind. **1883. 3.**)

Conc. alcohol dissolves out carbamate and leaves carbonate. (Hünefeld, J. pr. **7.** 25.)

Insol. in acetone. (Naumann, B. **1904, 37.** 4328.)

Ammonium cerous carbonate, $(NH_4)_2CO_3$, $Ce_2(CO_3)_3+6H_2O$.

Ppt. Very sl. sol. in conc. $(NH_4)_2CO_3$+Aq. (Meyer, Z. anorg. 1904, **41.** 104.)

Ammonium chromous carbonate, $(NH_4)_2CO_3$, $CrCO_3+H_2O$.

Decomp. by moist air; sol. in dil. HCl and H_2SO_4. (Baugé, C. R. 1896, **122.** 476.)

Ammonium cobaltous carbonate, $(NH_4)_2CO_3$, $CoCO_3+4H_2O$.

Permanent. Sol. in H_2O. (Deville, A. ch. (3) **35.** 460.)

$(NH_4)_2O$, $2CoO$, $4CO_2+9H_2O$. Quickly decomp. on air; sol. in H_2O. (Deville.)

$+12H_2O$. Sol. in H_2O.

Ammonium didymium carbonate, $(NH_4)_2CO_3$, $Di_2(CO_3)_3+3H_2O$.

Insol. in H_2O. (Cleve.)

Ammonium dysprosium carbonate, $NH_4Dy(CO_3)_2+H_2O$.

Only sl. sol. in H_2O. (Jantsch, B. 1911, **44.** 1277.)

Ammonium glucinum carbonate, $2(NH_4)_2CO_3$, $3GlCO_3$(?).

Very sol. in cold, decomp. by hot H_2O. Nearly insol. in alcohol. (Debray.)

Composition is $(NH_4)_2CO_3$, $2GlCO_3$, $Gl(OH)_2+2H_2O$. (Humpidge, Royal Soc. Proc. **39.** 1.)

Ammonium lanthanum carbonate, $La_2(CO_3)_3$, $(NH_4)_2CO_3+4H_2O$.

Ppt. (Meyer, Z. anorg. 1904, **41.** 102.)

Ammonium magnesium carbonate, $(NH_4)_2Mg(CO_3)_2+4H_2O$.

Sol. in 71 pts. H_2O with decomp.; more sol. in NH_4Cl+Aq. (Divers, Chem. Soc. **51.** 196.)

H_2O containing $(NH_4)_2CO_3$ dissolves very slightly; more sol. in H_2O containing NH_4Cl. (Favre, A. ch. (3) **10.** 473.)

Ammonium magnesium hydrogen carbonate, $(NH_4)_2Mg_2H_2(CO_3)_4+8H_2O$, or $12H_2O$.

Decomp. on air. (Deville, A. ch. (3) **35.** 454.)

Ammonium neodymium carbonate, $(NH_4)_2CO_3$, $Nd_2(CO_3)_3+4H_2O$.

Ppt. Sl. sol. in conc. $(NH_4)_2CO_3$+Aq. (Meyer, Z. anorg. 1904, **41.** 106.)

Ammonium nickel carbonate, NH_4HCO_3, $NiCO_3+4H_2O$.

Insol. in H_2O. (Deville, A. ch. (3) **35.** 452.)

Ammonium praseodymium carbonate, $(NH_4)_2CO_3$, $Pr_2(CO_3)_3+4H_2O$.

Ppt. Insol. in $(NH_4)_2CO_3$+Aq. (Meyer, Z. anorg. 1904, **41.** 105.)

Ammonium samarium carbonate, $(NH_4)_2CO_3$, $Sm_2(CO_3)_3+4H_2O$.

Ppt.

Ammonium scandium carbonate, $(NH_4)_2CO_3$, $2Sc_2(CO_3)_3+6H_2O$.

Difficultly sol. in H_2O. Sol. in cold alkali-carbonate+Aq, less sol. in hot. (R. Meyer, Z. anorg. 1910, **67.** 410.)

Ammonium tin (stannous) carbonate, $(NH_4)_2CO_3$, $2SnCO_3+3H_2O$.

Decomp. by cold H_2O. (Deville, A. ch. (3) **35.** 456.)

Ammonium uranyl carbonate, $2(NH_4)_2CO_3$, UO_2CO_3.

Sol. at 15° in 20 pts. H_2O, more abundantly in H_2O containing $(NH_4)_2CO_3$. (Ebelmen.)

Insol. in pure H_2O; sol. in H_2O containing $(NH_4)_2CO_3$. Solution is decomp. by boiling. (Berzelius.)

Sol. in SO_2+Aq. (Berthier, A. ch. (3) **7.** 76.)

$3(NH_4)_2CO_3$, $2(UO_2)CO_3+4H_2O$. Sol. in H_2O. (Giolitti C. C. **1905,** II. 227.)

Ammonium vanadyl carbonate, $3(NH_4)_2O$, $7VO_2$, $5CO_2+16H_2O$.

Sl. sol. in H_2O.

Sol. in acids and alkalies. (Koppel, Z. anorg. 1905, **45.** 350.)

Ammonium yttrium carbonate, $(NH_4)_2CO_3$, $Y_2(CO_3)_3+2H_2O$.

Insol. in $(NH_4)_2CO_3$+Aq. (Mosander.)

Ammonium zinc carbonate, basic, $3ZnO$, NH_4OH, $2CO_2+H_2O$.

Insol. in H_2O. (Kassner, Arch. Pharm. (3) **27.** 673.)

Ammonium zinc carbonate, $(NH_4)_2CO_3$, $ZnCO_3$.

Insol. in H_2O. (Deville.)

Quite sol. in H_2O; more sol. than $(NH_4)_2CO_3$, $MgCO_3$. Tolerably permanent in the air. Slowly decomp. by cold, rapidly by hot H_2O.

Very sol. in $(NH_4)_2CO_3$+Aq. Not attacked by alcohol. (Favre, A. ch. (3) **10.** 481.)

Barium carbonate, $BaCO_3$.

Sol. in 4304 pts. cold, and 2304 pts. boiling H_2O. (Fourcroy.)

Sol. in 47,620 pts. H_2O. (Bineau, A. ch. (3) **51.** 290.)

Sol. in 14,137 pts. H_2O at 16–20°, and 15,421 pts. at 100°. (Fresenius.)

Sol. in 12,027 pts. H_2O at 15°. (Kremers, Pogg. **85.** 247.)

Calculated from electrical conductivity of solution, 1 pt. $BaCO_3$ is sol. in 64,070 pts. H_2O at 8.8° and 45,566 pts. at 24.2°. (Hollemann, Z. phys. Ch. **12.** 125.)

Solubility in H_2O at t°.

t°	g. sol. in 100 g. H_2O
14	4.32×10^{-4}
18	4.57×10^{-4}
23	4.89×10^{-4}
27	5.22×10^{-4}
32	5.69×10^{-4}
38	6.27×10^{-4}

(Weissenberger, Z. phys. Ch. 1914, **88.** 266.)

"Solubility product" = 8.1×10^{-9} mol. l. (McCoy and Smith, J. Am. Chem. Soc. 1911, **33.** 473.)

Sol. in H_2CO_3+Aq. (See *barium hydrogen carbonate.*)

Easily sol. in dil. acids. Not acted upon by conc. HNO_3+Aq.

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol. Slowly decomp. by 1 pt.

HNO_3+6 pts. absolute alcohol. Slowly decomp. by 1 pt. $H_2C_2O_4$+6 pts. absolute alcohol.

Not decomp. by absolute alcoholic solutions of racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, **1816**.)

Almost completely insol. in H_2O containing NH_4OH and $(NH_4)_2CO_3$, when digested in such a solution and allowed to stand. 1 pt. $BaCO_3$ dissolves in 141,000 pts. of such a solution. (Fresenius.)

Not more sol. in NaCl+Aq than in H_2O. (Karsten.)

Sol. in cold NH_4Cl, NH_4NO_3, or NH_4 succinate+Aq. (Vogel, J. pr. **7.** 453.)

2 mols. NH_4Cl dissolved in H_2O dissolve 1 mol. $BaCO_3$ by continued boiling. (Smith, Phil. Mag. J. **9.** 540.)

Solubility in H_2O increases by addition of NH_4Cl, at first strongly, then less strongly and finally strongly again. (D'Agustino and Pellegrino, Gazz. ch. it. 1908, **38** (1) 532.)

Somewhat sol. in K_2CO_3+Aq. (Wackenroder, A. **24.** 30.)

Solubility of $BaCO_3$ in KCl+Aq at bpt. of solution

g. KCl per 100 g. solution	g. $BaCO_3$ per 1000 cc. sat. solution
0 15	0.0847
1	0.1781
3	0.2667
10	0 4274
30	0.5550

(Cantoni and Goguelia, Bull. Soc. 1905, (3) **33.** 13.)

Solubility of $BaCO_3$ in NaCl+Aq at bpt. of solution

g. NaCl per 100 g. solution	g. $BaCO_3$ per 1000 cc. sat. solution
0.15	0.0587
1	0.0787
3	0.1056
10	0.1575
30	0.2784

(Cantoni and Goguelia, l. c.)

Solubility of $BaCO_3$ in 10% KCl+Aq at t°.

t°	g. $BaCO_3$ per 1000 cc. sat. solution
10	0.2175
20	0.2408
40	0.2972
60	0.3491
80	0.4049

(Cantoni and Goguelia, l. c.)

Solubility of $BaCO_3$ in 10% NaCl+Aq at t°.

t°	g. $BaCO_3$ per 1000 cc. sat. solution
10	0.1085
20	0.1126
40	0.1231
60	0.1303
80	0.1418

(Cantoni and Goguelia, l. c.)

Slowly sol. in conc. Na_2SO_4, $MgSO_4$, $ZnSO_4$, $Ca(NO_3)_2$, or $CaCl_2$+Aq, but insol. in $ZnCl_2$+Aq. (Karsten.)

Sl. decomp. by boiling K_2SO_4+Aq.

Sl. decomp. in the cold by 1 pt. K_2SO_4+2 pts. Na_2SO_4+Aq.

Decomp. by salts of Al, Mn, Cr, Fe, U, Bi, Cd, Cu, Hg, Pb, Sn^{ii}, Sn^{iv}, Hg_2, Rh, Ir, Au, with pptn. of oxide of metal. (Rose, Tr.)

Pptn. of $BaCO_3$ is hindered by presence of alkali citrates or metaphosphates.

Sol. in solutions of various salts, as in the case of calcium carbonate (see *Calcium carbonate*). The solvent power of these solutions for barium carbonate is somewhat less than for calcium carbonate.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Min. *Witherite.*

Barium hydrogen carbonate, $BaH_2(CO_3)_2$(?).

100 pts. H_2O containing CO_2 dissolve 0.079 pt. $BaCO_3$. (Bineau.)

100 pts. H_2O containing CO_2 dissolve 0.17 pt. $BaCO_3$. (Lassaigne.)

100 pts. H_2O sat. with CO_2 under a pressure of 4–6 atmospheres dissolve 0.725 pt. $BaCO_3$. Upon evaporating, $BaCO_3$ is deposited. (Wagner, Z. anal. **6.** 167.)

$BaCO_3$ is sol. in 833 pts. H_2O sat. with CO_2 at 10°. (Lassaigne.)

$BaCO_3$ is sol. in 830 pts. H_2O sat. with CO_2 at 10°. (Fourcroy.)

$BaCO_3$ is sol. in 1550 pts. H_2O sat. with CO_2 at 10°. (Bergman.)

100 cc. H_2O sat. with CO_2 dissolve 0.73 g. $BaH_2(CO_3)_2$. (McCoy and Smith, J. Am. Chem. Soc. 1911, **33.** 473.)

Barium calcium carbonate, $BaCO_3$, $CaCO_3$.

Min. *Barytocalcite, Bromlite.* Sol. in dil. acids.

Barium uranyl carbonate, BaO, $2UO_3$, $2CO_2$ $+5H_2O$. Decomp. by H_2O. (Blinkoff. Dissert. **1900**.)

$+8H_2O$. Decomp. by H_2O. (Blinkoff.)

Bismuth carbonate, basic, $(BiO)_2CO_3$+ ½H_2O.

Insol. in H_2O; sol. in acids. Insol. in CO_2+Aq. (Bergman.)

Completely sol. in $(NH_4)_2CO_3$+Aq; sl. sol. in K_2CO_3+Aq.; insol. in Na_2CO_3+Aq. (Laugier.)

Absolutely insol. in $(NH_4)_2CO_3$+Aq unless H_3PO_4 or H_3AsO_4 are present. (Berzelius.)

Insol. in $(NH_4)_2CO_3$, K_2CO_3, or Na_2CO_3+Aq. (Rose.)

Sol. in NH_4Cl+Aq. (Wackenroder.) Insol. in NH_4NO_3+Aq. (Brett.)

Sol. in $CaCl_2$+Aq. (Pearson.)

Min. *Bismuthosphaerite.*

$3Bi_2O_3$, CO_2. Min. *Bismuthite.* Easily sol. in acids.

$4Bi_2O_3$, $3CO_2$+4½H_2O. Min. *Bismuth spar.* Easily sol. in acids.

Bismuth potassium carbonate, $Bi_2OK_4(CO_3)_4$ +H_2O.

Decomp. by large quantities of H_2O. (Reynolds, Chem. Soc. 1898, **73.** 266.)

Cadmium carbonate, $CdCO_3$.

Insol. in H_2O; easily sol. in acids; insol. in K_2CO_3, and Na_2CO_3+Aq; very sl. sol. in $(NH_4)_2CO_3$+Aq. (Fresenius.)

Easily sol. in NH_4 sulphate, nitrate, and succinate+Aq. (Wittstein.)

Sol. in KCN+Aq; sol. in cold NH_4Cl+Aq; less sol. in NH_4NO_3+Aq. (Brett, **1837.**)

Not prevented from pptn. by non-volatile organic substances. (Rose.)

Not pptd. from solutions containing sodium citrate. (Spiller.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

+½H_2O. (Lefort, J. B. **1847.** 346.) (Kraut, Z. anorg. 1897, **13.** 14.)

Cadmium carbonate hydrazine, $CdCO_3$, $2N_2H_4$.

Easily sol. in cold NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 281.)

Cæsium carbonate, Cs_2CO_3.

Very deliquescent, and sol. in H_2O.

100 pts. absolute alcohol dissolve 11.1 pts. Cs_2CO_3 at 19°; 20.1 pts. Cs_2CO_3 at boiling temp. (Bunsen.)

Cæsium hydrogen carbonate, $CsHCO_3$.

Not deliquescent. Sol. in H_2O.

Calcium carbonate basic, CaO, $CaCO_3$+H_2O.

Hardened by H_2O, but not dissolved. (Raoult, C. R. **92.** 189.)

Calcium carbonate, $CaCO_3$.

More sol. in cold than in hot H_2O. (Gmelin.)

When recently pptd., sol. in 8834 pts. boiling, and 10,601 pts. cold H_2O; much less sol. in H_2O containing NH_4OH and $(NH_4)_2CO_3$, 65,246 pts. of which dissolve 1 pt. $CaCO_3$. (Fresenius (**1846**), A. **59.** 122.)

Sol. in 16,000 pts. pure H_2O. (Brandes, **1825.**)

Sol in 12,858 pts. pure H_2O at 15°. (Kremers, Pogg. **85.** 247.)

Sol. in 16,000–24,000 pts. pure H_2O. (Bucholz.)

1 l. H_2O dissolves 34 mg. $CaCO_3$. (Chevalet, Z. anal. **8.** 91; Hoffmann, Z. anal. **4.** 414.)

1 l. H_2O may contain 0.016 g. $CaCO_3$. *i. e.*, 1 pt. is sol. in 62.500 pts. H_2O. (Bineau, A. ch. (3) **51.** 290.)

1 l. H_2O dissolves 0.02 g. $CaCO_3$, *i. e.*, 1 pt. $CaCO_3$ is sol. in 50,000 pts. H_2O. (Peligot.) Solubility is much affected by CO_2 of the air.

1 l. H_2O at 16° dissolves 13.1 mg. $CaCO_3$. (Schlösing, C. R. **74.** 1552.)

Calculated from electrical conductivity of $CaCO_3$+Aq, 1 pt. $CaCO_3$ is sol. in 99,500 pts. H_2O at 8.7°, and 80,040 pts. at 23.8°. (Hollemann, Z. phys. Ch. **12.** 125.)

By continued boiling $CaH_2(CO_3)_2$, 36 mg. $CaCO_3$ remain in solution. (Weltzien, A. **136.** 165.)

Solubility in H_2O at different pressures.

Pressure in atmos	Solubility
1	1079
2	1403
4	1820
6	2109

(Engel, C. R. **101.** 949.)

100 pts. H_2O dissolve 0.0005 pt. (calculated as CaO) from pptd. $CaCO_3$, and 0.0027 pt. from calcspar. (Lubavin, J. russ. Soc. **24.** 389.)

1 l. H_2O dissolves 13 mg. $CaCO_3$ at 18°. (Kohlrausch, Z. phys. Ch. 1893, **12.** 241.)

1 l. CO_2 free water dissolves 17.4 mg. CaO or 31.0 mg. $CaCO_3$. (Gothe, Ch. Z. 1915, **39.** 305.)

$CaCO_3$ dissolves in 9662 pts. H_2O at 12°. (Pollacci, C. C. **1896,** II. 946.)

1 l. H_2O free from CO_2 dissolves 9.6 mg. $CaCO_3$. (McCoy and Smith, J. Am. Chem. Soc. 1911, **33.** 473.)

Found dissolved in 10,000 pts. sea water. (Davy.)

Pptd. amorphous $CaCO_3$ dissolves in 1600 pts. sea water. Pptd. crystalline $CaCO_3$ dissolves in 8000 pts. sea water. (Irvine and Young, Chem. Soc. **56.** 344.)

Artificial sea water sat. with CO_2 dissolves $CaCO_3$ corresponding to 57.27 mg. of combined CO_2 per litre at 15°.

Sea water which contains 52–55 mg. neutral combined CO_2 per litre must be sat. with $CaCO_3$. (Cohen, Chem. Soc. 1900, **78** (2) 725.)

For action of H_2CO_3+Aq, see *Calcium hydrogen carbonate.*

Sol. in H_2SO_4, even when native. Sol. in acids generally. When treated with acids in closed vessels effervescence ceases on increase of pressure, but is renewed at once on removing it. (Link, **1814**.)

Unacted upon by conc. HNO_3, even when boiling, as $Ca(NO_3)_2$ is insol. in conc. HNO_3.

Not decomp. by mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, but immediately by HNO_3+absolute alcohol.

Not decomp. by absolute alcoholic solutions of oxalic, racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, **1816**.)

Unacted upon by glacial $HC_2H_3O_2$, even when boiling.

Freshly pptd. $CaCO_3$ is sol. in cold NH_4Cl+Aq; but the solution becomes cloudy on exposure to air, a portion, however, of $CaCO_3$ remains dissolved, which cannot be pptd. even by boiling. If ppt. is washed and allowed to stand 24 hours, it is not as sol. in NH_4Cl as at first, but natural $CaCO_3$ is not wholly insol. in NH_4Cl+Aq; it is, however, much less sol. than $MgCO_3$. (Vogel, J. pr. **7.** 453.)

Sol. in boiling NH_4Cl+Aq with evolution of NH_3. (Demarcay, **1834**.)

When NH_4OH+Aq, incompletely sat. with CO_2, is mixed with $CaCl_2$+Aq, no ppt. occurs even during several days. if kept in a closed vessel; and only a slight ppt. if the mixture is exposed to the air, but $CaCO_3$ is pptd. if the solution is boiled.

NH_4OH+Aq wholly sat. with CO_2 produces ppt. when mixed with $CaCl_2$+Aq, but pptn. is not complete until heat is applied. Also when an excess of $CaCl_2$+Aq is added to a solution of crystallized carbonate of ammonia, only a portion of the $CaCO_3$ is pptd. until the solution is boiled. (Vogel, **1814**.)

When $CaCl_2$+Aq mixed with NH_4OH+Aq is exposed to an atmos. of pure CO_2, no ppt. occurs for several hours, but $CaCO_3$ is completely pptd. in several days. (Vogel.)

When recently pptd., readily sol. in NH_4Cl, and NH_4NO_3+Aq. (Brett, **1837**; Wackenroder, A. **41.** 315.)

When recently pptd., readily sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, NH_4NO_3, NH_4Cl, and NH_4 succinate+Aq. (Wittstein.)

Sol. in $NH_4C_2H_3O_2$+Aq. (Thomson.)

More sol. in NH_4Cl, or NH_4NO_3+Aq, or in neutral potassium, or sodium salts+Aq than in H_2O. (Fresenius.)

From solutions in NH_4 salts, NH_4OH, and $(NH_4)_2CO_3$+Aq precipitate $CaCO_3$ more completely than $BaCO_3$. (Fresenius.)

When boiled with NH_4Cl+Aq, $CaCO_3$ is dissolved, and $(NH_4)_2CO_3$ given off. (D. Smith.)

$CaCl_2$+Aq prevents pptn. of $CaCO_3$ in the cold, as do also NH_4Cl, KCl, or NaCl+Aq, but it is pptd. when boiled, if the latter solutions are not too conc. K_2SO_4, KNO_3, $(NH_4)_2SO_4$, or Na_2SO_4+Aq have a similar effect. A large excess of $(NH_4)_2CO_3$+Aq when quickly added to $CaCl_2$+Aq produces no ppt. in the cold. Na_2CO_3, or K_2CO_3+Aq act likewise. (Storer, Am. J. Sci. (2) **25.** 41.)

1 g. $CaCO_3$ requires 13.98 g. NH_4Cl, 8.380 g. $(NH_4)_2SO_4$, or 14.438 g. NH_4NO_3 to effect solution. (Bertrand, Monit. Sci. (3) **10.** 477.)

Less sol. in Na than in NH_4 salts, but more than in K salts. (Berthelot.)

When NH_4OH+Aq, partially neutralized by CO_2, is mixed with CaO_2H_2+Aq, no cloudiness appears until the mixture is boiled; when more CO_2 has been added to NH_4OH+Aq, a ppt. appears at first, which disappears and only reappears on addition of much CaO_2H_2+Aq; but NH_4OH+Aq does not dissolve pptd. $CaCO_3$. (Vogel.)

Solubility in NH_4 salts+Aq at 25°.

NH_4 salt	Millimols NH_4 salt per l.	Millimols CaO dissolved per l.
NH_4Cl	1000	6.770
	500	5.008
	250	3.724
	125	2.743
NH_4NO_3	500	5.267
	250	3.830
	125	2.779
	62.5	2.004
Triammonium citrate	500	66.87
	250	39.80
	125	22.64
	62.5	14.92

(Rindell, Z. phys. Ch. 1909, **70.** 454.)

Solubility of $CaCO_3$ in NH_4Cl+Aq at 12–18°. Time, 98 days.

g. per l. of sat. solution	
NH_4Cl	$CaCO_3$
53.5	0.423
100	0.609
200	0.645

(Cantoni and Goguelia, Bull. Soc. 1905, (3) **33.** 27.)

Solubility of $CaCO_3$ in NH_4NO_3+Aq at 18°.

g. per l. of sat. solution	
NH_4NO_3	$CaCO_3$
0	0.131
5	0.211
10	0.258
20	0.340
40	0.462
80	0.584

(Berju and Kosminiko, Landw. Vers. Sta. 1904, **60.** 422.)

CaO_2H_2+Aq dissolves a little $CaCO_3$. (Welter and Berthollet, **1789**.)

CaO_2H_2+Aq retains a little $CaCO_3$ in solution at ordinary temperature, which is pptd. on boiling. (Eliot and Storer, Proc. Am. Acad. 1860, **5.** 63.)

CaO_2H_2+Aq, mixed with dil. NaOH, KOH, or NH_4OH+Aq, gives no immediate ppt. when CO_2 is passed through it, unless boiled.

Sol. in boiling $MgCl_2$+Aq even when dilute. Cousté.)

Not decomp. when boiled with K_2SO_4, Na_2SO_4, $CaSO_4$, $MgSO_4$, and $Na_2B_4O_7$+Aq; but partially decomp. by boiling with $(NH_4)_2SO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, Na_2HPO_4, $(NH_4)_2HPO_4$, K_2HPO_3, Na_2HPO_3, $(NH_4)_2HPO_3$, K_2HAsO_4, Na_3AsO_4, $K_2C_2O_4$, $(NH_4)_2C_2O_4$, NaF, and K_2CrO_4+Aq. With the NH_4 salts the decomposition is complete. (Dulong, A. ch. **82.** 286.)

Not decomp. by alkali sulphates+Aq. (Malaguti.)

Precipitation of $CaCO_3$ is much hindered by alkali citrates or metaphosphates.

Solubility in KCl+Aq at 25°.

Sp. gr. 25°/25°	% KCl	% $CaCO_3$
1.000	0.00	0.0013
1.024	3.90	0.0078
1.046	7.23	0.0078
1.072	11.10	0.0076
1.092	13.82	0.0072
1.101	15.49	0.0076
1.122	18.21	0.0070
1.133	19.84	0.0072
1.179	26.00	0.0060

(Cameron and Robinson, J. phys. Chem. 1907, **11.** 578.)

Solubility in NaCl+Aq in contact with CO_2 free air at 25°.

Sp. gr. 25°/25°	g. per 100 g. H_2O	
	NaCl	$CaCO_3$
1.0079	1.60	0.0079
1.0314	5.18	0.0086
1.0466	9.25	0.0094
1.0734	11.48	0.0104
1.0949	16.66	0.0106
1.1346	22.04	0.0115
1.1794	30.50	0.0119

(Cameron, Bell and Robinson, J. phys. Ch. 1907, **11.** 396.)

Solubility of $CaCO_3$ in NaOH+Aq.

Solvent	1 litre dissolves	
	at 18°	at 95°–100°
H_2O	12.8 mg. $CaCO_3$	20.7 mg. $CaCO_3$
ca. 0.0001 n. NaOH	8.7 " "	9.6 " "
ca. 0.001 n. NaOH	4.2 " "	6.9 " "
ca. 0.01 n. NaOH	4.3 " "	5.7 " "

(Le Blanc, Z. anorg. 1906, **51.** 185.)

Solubility in K_2SO_4+Aq at 25°.

Sp. gr. 25°/25°	% K_2SO_4	% $CaCO_3$
1.010	1.60	0.0104
1.021	3.15	0.0116
1.033	4.73	0.0132
1.048	6.06	0.0148
1.061	7.85	0.0168
1.069	8.88	0.0192
1.083	10.18	0.0192
1.084	10.48	0.0188

(Cameron and Robinson, J. phys. Chem. 1907, **11.** 578.)

The solubility of $CaCO_3$ in Na_2SO_4+Aq in equilibrium with air steadily increases with increasing amounts of $CaSO_4$ in the solution up to saturation point of the $CaSO_4$. In the presence of solid $CaSO_4$ the solubility of $CaCO_3$ is much decreased. (Cameron and Seidell, J. phys. Chem. 1902, **6.** 56.)

See under $CaH_2(CO_3)$.

Solubility in Na_2SO_4+Aq in contact with CO_2 free air at 25°.

g. per 100 g. H_2O	
Na_2SO_4	$CaCO_3$
0.97	0.0151
1.65	0.0180
4.90	0.0262
12.69	0.0313
14.55	0.0322
19.38	0.0346
23.90	0.0360

(Cameron, Bell and Robinson, J. phys. Ch. 1907, **11.** 396.)

Solubility in salts+Aq.

g. salt added per litre	mg. CaO dissolved per litre
0.000	17.4
0.585 g. NaCl	20.05
1.17 g. "	24.9
2.93 g. "	31.1
0.85 g. $NaNO_3$	24.35
1.70 "	27.7
4.25 "	34.5
0.805 g. Na_2SO_4, $10H_2O$	25.95
1.61 g. "	31.15
4.03 g. "	40.7
0.53 g. Na_2CO_3	8.4
1.06 g. "	7.2
2.65 g. "	4.4
0.55 g. $CaCl_2$, $6H_2O$	9.0
1.10 g. "	8.4
2.75 g. "	8.4

The solubility of $CaCO_3$ in CO_2-free water

is therefore increased by the addition of NaCl, $NaNO_3$ or $Na_2SO_4, 10H_2O$, but decreased by the addition of Na_2CO_3 or $CaCl_2, 6H_2O$.

(Gothe, Ch. Z. 1915, **39.** 306.)

Sol. in ferric chloride or nitrate+Aq with evolution of CO_2 and pptn. of $Fe_2C_6H_6$ (Fuchs, **1831**); also in chlorides or nitrates of Al, Mn, Cr, or U, but not in $FeCl_2$+Aq.

Sol. in cold $SnCl_4$+Aq with pptn. of SnO_2.

Insol. in conc. Na_2SO_4, $MgSO_4$, $BaCl_2$, $MgCl_2$, $Pb(NO_3)_2$, or $AgNO_3$+Aq. (Karsten.)

Abundantly sol. when freshly precipitated in $CaCl_2$+Aq, and $MgSO_4$+Aq. (Hunt.)

Absolutely insol. at 15–19° in BaO_2H_2+Aq; also on boiling.

1 l. H_2O containing 3–4 g. $MgSO_4$ dissolves 1–2 g. $CaCO_3$, and also 1 g. $MgCO_3$. (Hunt, Am. J. Sci (2) **26.** 109.)

100 pts. NaCl+Aq (2.525% NaCl) dissolve 0.0037 pt. (calculated as CaO) pptd. $CaCO_3$, and 0.0053 pt. calcspar. (Lubavin, J. russ. Soc. **24.** 389.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Alcohol dissolves traces of $CaCO_3$. (Grischow.)

Sol. in Na citrate+Aq. (Spiller.)

Sol. in Ca sucrate+Aq. (Barreswill.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann. C. C. **1899,** II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Amorphous. Solubility in H_2O cannot be determined because of its instability. (Kendall, Phil. Mag. 1912, (6) **23.** 972.)

Min. *Calcite.* In contact with air free from CO_2, 1 l. H_2O dissolves **at**:

25°	50°	100°
0.01433	0.01504	0.01779 g. calcite.

(Kendall, Phil. Mag. 1912, (6) **23.** 964.)

In contact with air containing 3.7 pts. CO_2 per 10,000, the solubility of calcite in H_2O was found to be 0.04608 g. per l. at 25° and 0.02925 g. per l. at 50°. (Kendall, Phil. Mag. 1912, (6) **23.** 973.)

Min. *Aragonite.* In contact with air free from CO_2, 1 l. H_2O dissolves at:

25°	50°	100°
0.01528	0.01617	0.01902 g. aragonite.

(Kendall, Phil. Mag. 1912, (6) **23.** 964.)

$+5H_2O$. Efflorescent.
$+6H_2O$. (Pelouze.)

Calcium hydrogen carbonate, $CaH_2(CO_3)_2$.

Known only in aqueous solution.
$CaCO_3$ dissolves in CO_2+Aq.

$CaCO_3$ is sol. in 1428 pts. H_2O sat. with CO_2 at 0°, and 1136 pts. at 10°. (Lassaigne, J. ch. med. **4.** 312.)

Bineau could dissolve, even in large quantities of H_2O sat. with CO_2 only 4/5 enough $CaCO_3$ to form $CaH_2(CO_3)_2$.

Chalk dissolves in 994.5 pts. H_2O sat. with CO_2, while Iceland spar requires 3149 pts. (Bischof.)

$CaCO_3$ is sol. in 1015 pts. H_2O sat. with CO_2 at 21° and 748.3 mm. (Warington, Chem. Soc. **6.** 296.)

Solubility of $CaCO_3$ in CO_2+Aq at p pressure in atmospheres. $CaO+CO_2$=mg. CO_2 and CaO dissolved, corresponding to $CaCO_3$=mg. $CaCO_3$.

p	$CaO+CO_2$	$CaCO_3$
0.000504	60.96	74.6
0.000808	72.11	85.0
0.00333	123	137.2
0.03187	218.4	223.1
0.0282	310.4	296.5
0.05008	408.5	360
0.1422	....	533
0.2538	1072	663.4
0.4167	1500	787.5
0.5533	1846	885.5
0.7297	2270	972
0.9841	2864	1086

(Schlösing, C. R. **74.** 1522.)

With high pressure, 1 l. H_2O containing CO_2 dissolves at most 3 g. $CaCO_3$. This maximum is reached at 5° under 4 atmospheres' pressure; at 10–13° under 5 atmospheres; and at 20° under 7 atmospheres. (Caro, Arch. Pharm. (3) **4.** 145.)

$CaCO_3$ is sol. in about 1000 pts. H_2CO_3+Aq, and solubility is considerably increased by Na_2SO_4 or $MgSO_4$.

1000 pts. H_2O sat. with CO_2 dissolve pts. Carrara marble at t°, and B=height of barometer in millimetres.

t°	B	Pts. $CaCO_3$	t°	B	Pts. $CaCO_3$
7.5	754	1.224	22.0	746	0.920
8.5	752	1.202	26.0	740	0.875
9.5	754	1.115	26.5	743	0.860
20.5	741	0.975	27.0	741	0.885
21.5	744	0.935	28.0	737	0.770

Or, from 7.5–9.5°, 1000 pts. H_2O sat. with CO_2 dissolve 1.181 pts. $CaCO_3$; from 20.5–22°, 0.9487 pt. $CaCO_3$; from 26–28°, 0.855 pt. $CaCO_3$.

Other varieties of $CaCO_3$ are dissolved as follows in 1000 pts. H_2O sat. with CO_2.

Variety	t°	B	Pts. $CaCO_3$
Lüneburg chalk	18	740	0.835
Pptd. $CaCO_3$	18	740	0.950
Iceland spar.	18	735	1.970
Calcite	12	754	1.223
Traversella	12	754	.212
Dolomite, semi-transparent	11.5	749	0.654
Dolomite, opaque, in small crystals	11.5	755	0.725
Dolomite, opaque, in large crystals	11	746	.224
Dolomite, transparent, in large crystals	11	749	1.073
Oolithic limestone	15	747	.252
Dolomitic limestone	15.5	740	.573

(Cossa, Z. anal. **8.** 145.)

Solubility of $CaCO_3$ in H_2O containing CO_2 at various pressures.

CO_2 pressure in atm.	1	2	4	6
Solubility	1079	1403	1820	2109

(Engel, C. R. 1885, **101.** 951.)

1 l. H_2O dissolves 0.3850 g. $CaH_2(CO_3)_2$ at 15°. (Treadwell, Z. anorg. 1898, **17.** 186.)

1 l. of sat. $CaH_2(CO_3)_2$+Aq, obtained from pure or impure limestone, contains 1.13-1.17 g. $CaCO_3$ at 15°. (Treadwell, Z. anorg. 1898, **17.** 189.)

Solubility of $CaH_2(CO_3)_2$ in H_2O containing CO_2 at 15°.

% carbonic acid in gas at 0° and 760 mm.	Hg-partial pressure mm.	Free carbonic acid mg.	mg. $CaH_2(CO_3)_2$ in 100 cc. of the solution	mg. Ca
8.94	67.9	157.4	187.2	46.2
6.04	45.9	86.3	175.5	43.3
5.45	41.4	52.8	159.7	39.4
2.18	16.6	48.5	154.0	38.0
1.89	14.4	34.7	149.2	36.8
1.72	13.1	24.3	133.1	32.9
0.79	6.0	14.5	124 9	30 8
0.41	3.1	4.7	82.1	20.3
0.25	1.9	2.9	59.5	14.7
0.08	0.6	...	40.2	9.9
....	....	....	38.5	9.5
....	....	....	38.5	9.5
....	....	....	38.5	9.5

(Treadwell and Reuter, Z. anorg. 1898, **17.** 185.)

1 l. H_2O sat. with carbonic acid dissolves 1.30 g. $CaCO_3$ at 13.2°; 1.45 g. at 2.8°. (Treadwell, Z. anorg. 1898, **17.** 189.)

At 30° C. in equilibrium with the air, not more than 3 per cent of the calcium present is combined as $CaCO_3$. At lower temperatures and lesser concentrations the percentage of normal carbonate is even less, and practically all the calcium present is combined as $Ca(HCO_3)_2$. (Cameron and Briggs, J. phys. Chem. 1901, **5.** 549.)

With pressures less than 4.5 atmospheres of CO_2 no other than normal calcium carbonate or a hydrate of the normal carbonate can exist as the solid phase at 0°. (Cameron, J. phys. Chem. 1908, **12.** 566.)

Solubility in H_2O in contact with air, containing CO_2 with varying partial pressures at t°.

P = partial pressure of CO_2.

P	g. per l. $CaCO_3$	g. per l. CO_2
t = 15°		
0.8	0 193	0.117
1.5	0.193	0 152
1.7	0.238	0.135
6.8	0.445	0 327
9.9	0.627	0.456
13.6	0.723	0.560
14.6	0.686	0.623
31.6	1.050	1.117
t = 25°		
0.7	0.159	0.091
1.6	0.177	0.111
4.6	0.341	0.208
7.8	0.446	0.301
16.5	0.539	0.522
30.1	0.743	0.715
35.5	0.755	0.803
t = 40°		
0 6	0 136	0.078
1.7	0.143	0.085
2.9	0.175	0.106
3.5	0.232	0.169
7	0.284	0.234
14.9	0.384	0.293
22.2	0.427	0.333
31.7	0.480	0.476

Similar results at 20°, 30°, and 35° are also given.

(Leather and Sen, Mem. Dept. Agric. (India) Chem. Ser. 1909, **1.** 117; Seidell, Solubilities, 1919.)

Solubility of calcite in H_2O at 25°, in contact with CO_2 under varying pressures.

P = approximate pressure of CO_2 in atmospheres.

P	g. per l. sat. solution H_2CO_3	$Ca(HCO_3)_2$	Solid phase
0.1	0..22	0.67	$CaCO_3$
1.1	2.3	1.58	"
9.9	20.6	3.62	"
13.2	27.5	4.04	"
16.3	34.1	4.21	$Ca(HCO_3)_2$
25.4	53.2	4.22	"

(McCoy and Smith, J. Am. Chem. Soc. 1911, **33.** 468.)

1 l. H_2O dissolves 2.3374 g. $CaCO_3$ at 5° under a CO_2 pressure of 2 atmos. (Ehlert, Z. Elektrochem. 1912, **18.** 727.)

Solubility data for calcite in H_2O containing CO_2, with and without the presence of salts are given by Seyler and Lloyd (Chem. Soc. 1909, **95.** 346.)

A critical analysis and recalculation of results of Schloesing and others is given by Johnston (J. Am. Chem. Soc. 1915, **37.** 2001).

$CaCO_3$ is not dissolved by CO_2 and H_2O in presence of $MgCO_3$. (Leather and Sen, C. A. **1915.** 181.)

1 l. of 1/10-normal NaCl+Aq dissolves 0.3320 g. $CaH_2(CO_3)_2$ at 15°. (Treadwell and Reuter, Z. anorg. 1898, **17.** 193.)

Solubility of $CaH_2(CO_3)_2$ in NaCl+Aq sat. with carbonic acid at 15°, containing 5 g. NaCl per l. of NaCl+Aq.

% carbonic acid in gas at 0° and 760 mm.	mm. Hg = partial pressure	mg. free CO_2	mg. $CaH_2(CO_3)_2$ in 100 cc. of the solution	mg. Ca
16.95	128.8	132.5	218.4	53.9
11.47	87.2	110.1	214.3	52.9
6.07	46.1	23.5	149.2	36.8
3.16	24.0	13.5	118.3	29.2
0.50	3.8	2.7	73.9	18.2
0.41	3.4	0.3	49.0	12.1
...	...	...	34.9	8.6
...	...	...	33.7	8.3
...	...	...	32.9	8.1
...	...	...	33.2	8.2

(Treadwell and Reuter, Z. anorg. 1898, **17.** 193.)

Solubility in NaCl+Aq at 25° C. and in equilibrium with air.

$Ca(HCO_3)_2$ Grams per liter	Reacting wts. per liter	NaCl Grams per liter	Reacting wts. per litre
0.1046	0.00065	0.000	0.000
0.1770	0.00110	9.720	0.168
0.2051	0.00128	21.010	0.362
0.2152	0.00134	30.301	0.522
0.2252	0.00140	50.620	0.872
0.2212	0.00138	69.370	1.195
0.2172	0.00135	98.400	1.695
0.1971	0.00123	147.400	2.540
0.1569	0.00095	234.500	4.040
0.1227	0.00076	262.300	4.520

(Cameron and Seidell, J. phys. Chem. 1902, **6.** 51.)

Solubility in various salts+Aq under a CO_2 pressure of 2 atmos. at 5°.

Salt	g. salt per 1000 g H_2O	g. $CaCO_3$ sol. in 1 l. of solvent
H_2O	...	2.3374
$MgCl_2+6H_2O$	6.08	2.3518
	50.0	3.4045
	86.0	4.0826
	350.0	3.3009
	700.0	2.7357
	1150.0	2.2054
	1725.0	1.7058
	2300 (sat.)	1.4060
NaCl	27.96	3.2796
	50.0	3.7399
	86.0	3.7828
	106.9	3.6900
	175.6	3.3495
	263.4	2.8107
	351.2	2.1625 at 8°
$MgSO_4+7H_2O$	105.3 (14°)	2.1768
	sat. at 14°	0.91356
$Na_2SO_4+10H_2O$	137.7 (14°)	1.4060
	sat. at 14°	1.9199

(Ehlert and Hempel, Z. Elektrochem. 1912, **18.** 727.)

Solubility of $CaCO_3$ in KCl+Aq at 25° sat. with CO_2 at atmospheric pressure.

% KCl	% $CaCO_3$
3.90	0.145
7.23	0.150
11.10	0.166
13.82	0.165
15.49	0.167
18.21	0.154
19.84	0.140
26.00	0.126

(Cameron and Robinson, J. phys. Chem. 1907, **11.** 579.)

Solubility in NaCl+Aq in contact with CO_2 at atmospheric pressure at 25°.

g. per 100 g. H_2O	
NaCl	$CaCO_3$
1.45	0.150
5.69	0.160
11.08	0.174
15.83	0.172
19.62	0.159
29.89	0.123
35.85	0.103

(Cameron, Bell and Robinson, J. phys. Ch. 1907, **11.** 396.)

Solubility in K_2SO_4+Aq, sat. with CO_2 at atmospheric pressure and 25° temp.

% SO_3	% CaO
0.69	0.69
1.37	0.69
1.67	0.47 *
2.18	0.30 *
2.99	0.24 *

* Solid phase, $CaSO_4$, K_2SO_4.
(Cameron and Robinson.)

Solubility in Na_2SO_4+Aq at 24° in equilibrium with air.

Total Ca calc. as $Ca(HCO_3)_2$. Grams per liter	Ca actually dissolved as $Ca(HCO_3)_2$. Grams per liter	Na_2SO_4. Grams per liter
0.0925	0.0925	0.000
0.1488	0.1488	2.800
0.1729	0.1729+	5.235
0.2330	0.2210	11.730
0.3240	0.3020	36.860
0.3960	0.3440	74.010
0.4580	0.3660	116.100
0.5630	0.3940	184.200
0.5910	0.4060	213.700
0.6650	0.4300	255.900

(Cameron and Seidell, J. phys. Chem. 1902, **6.** 53.)

Data are also given for solubility of $CaCO_3$ in NaCl+Na_2SO_4+Aq, and $CaCO_3$+$CaSO_4$ in NaCl+Na_2SO_4+Aq. (Cameron, Bell and Robinson.)

Calcium copper uranium carbonate, $CaCO_3$, $3CuCO_3$, $4U(CO_3)_2+24H_2O$.

Sol. in acids.

Calcium lead carbonate, $xCaCO_3$, $yPbCO_3$.

Min. *Plumbocalcite.*

Calcium magnesium carbonate, $CaCO_3$, $MgCO_3$.

Min. *Dolomite.* 1 l. H_2O sat. with CO_2 at 18° and 750 mm. dissolves 0.31 g. dolomite. (Cossa, B. **2.** 697.)

Not obtained by evaporating solution, but can be crystallized from CO_2+Aq between 100° and 200°. (Hoppe-Seyler.)

Dolomite is dissolved by CO_2 and H_2O, but solution is prevented partially by $CaCO_3$, and wholly by $MgCO_3$. (Leather and Sen, C. A. **1915.** 181.)

Insol. in cold dil. acids. (Dolomieu, J. Phys. **39.** 1.)

Insol. in cold acetic acid. (Forchhammer.)

Calcium potassium carbonate, $CaK_2(CO_3)_2$.

Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73.** 265; Bütschli, C. A. **1907.** 2223).

$2CaCO_3$, $3K_2CO_3+6H_2O$. (Bütschli.)

Calcium sodium carbonate, $CaNa_2(CO_3)_2$.

Anhydrous. Decomp. by H_2O.

$+2H_2O$. (Butschli, C. A. **1907.** 2223.)

$+5H_2O$. Min. *Gaylussite.* Sparingly sol. in H_2O.

Calcium uranyl carbonate, $CaCO_3$, $UO_2CO_3+20H_2O$.

Min. *Liebigite.* Sol. in HCl+Aq.

$+xH_2O$. Decomp. by H_2O. (Blinkoff, Dissert. **1900.**)

$2CaO$, $4UO_3$, $3CO_2+24H_2O$. Decomp. by H_2O. (Blinkoff, Dissert. **1900.**)

Calcium carbonate chloride, $CaCO_3$, $CaCl_2+6H_2O$.

Sol. in H_2O with immediate decomp. (Fritzsche, J. pr. **83.** 213.)

Cerous carbonate, $Ce_2(CO_3)_3+5$, and $9H_2O$.

Insol. in H_2O, and solution of CO_2 in H_2O. (Vauquelin.)

Somewhat sol. in $(NH_4)_2CO_3$+Aq. (Jolin.)

Insol. in neutral salt solutions and neutral alkali carbonates+Aq; easily sol. in SO_2+Aq. (Berthier, A. ch. (3) **7.** 77.)

Ceric carbonate, $Ce(CO_3)_2+\frac{1}{2}H_2O$.

Precipitate. (Hisinger, A. ch. **94.** 108.)

Insol. in H_2O. Sol. in slight traces in Na_2CO_3+Aq; sl. sol. in $NaHCO_3$+Aq, and in $(NH_4)_2CO_3$+Aq. (Rose.)

Cerous lanthanum carbonate fluoride.

Min. *Bastnæsite, Hamartite, Hydrofluocerite.* Slowly decomp. by HCl+Aq, easily by H_2SO_4.

Cerous potassium carbonate, $Ce_2(CO_3)_3$, $K_2CO_3+3H_2O$.

Ppt. (Jolin.)

$Ce_2(CO_3)_3$, $K_2CO_3+12H_2O$. Ppt.

Sol. in 30% K_2CO_3+Aq. (Meyer, Z. anorg. 1904, **41.** 103.)

Perceric potassium carbonate, $Ce_2O_3(CO_3)_3$, $4K_2CO_3+12H_2O$.

Crystalline. Sl. sol. in H_2O containing K_2CO_3; sol. in dil. H_2SO_4 with decomp. (Job, C. R. 1899, **128.** 1098.)

Cerous sodium carbonate, $Ce_2(CO_3)_3$, $2Na_2CO_3+2H_2O$.

Ppt. (Jolin.)

$2Ce_2(CO_3)_3$, $3Na_2CO_3+24H_2O(?)$. Ppt. Easily decomp. (Meyer, Z. anorg. 1904, **41.** 103.)

Chromous carbonate, $CrCO_3$.

Sol. in much H_2O; sl. sol. in $KHCO_3+Aq$. (Moberg, J. pr. **44.** 328; Moissan, A. ch. (5) **21.** 199.)

Chromic carbonate, basic, Cr_2O_3, $2CO_2$.

Precipitate. (Parkmann, Sill. Am. J. (2) **34.** 321.)

Cr_2O_3, CO_2+4H_2O. Insol. in H_2O; sol. in acids; when freshly pptd. is sol. in K_2CO_3, or $(NH_4)_2CO_3+Aq$, and still more sol. in KOH +Aq. (Meissner.)

Insol. in ethyl acetate (Naumann, B. 1910, **43.** 314); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$2Cr_2O_3$, CO_2+6H_2O. Precipitate. (Langlois, A. ch. (3) **48.** 502.)

Chromous potassium carbonate, $CrCO_3$, $K_2CO_3+1\frac{1}{2}H_2O$.

Sol. in H_2O when freshly prepared; slowly polymerizes; stable in dry air, decomp. in moist air; sol. in acids with decomp. (Baugé, C. R. 1898, **126.** 1568.)

Chromous sodium carbonate, $CrNa_2(CO_3)_2+H_2O$.

Decomp. when heated. In Aq. solution, passes into the hydrate containing 10 mols. H_2O. (Baugé, C. R. 1897, **125.** 1179.)

$+10\ H_2O$. Very sol. in cold H_2O; Aq. solution decomp. below 100°; effloresces in the air; sol. in HCl+Aq and H_2SO_4+Aq. (Baugé, C. R. 1897, **125.** 1178.)

Cobaltous carbonate, basic, 5CoO, $2CO_2+4H_2O$.

Insol. in H_2O; sol. in $(NH_4)_2SO_4$, $(NH_4)_2CO_3$, NH_4NO_3, and NH_4Cl+Aq.

Sol. in cold NH_4NO_3, and NH_4Cl+Aq. (Brett, **1837.**)

Sol. in CO_2+Aq, and acid alkali carbonates +Aq, from which it is pptd. on boiling. Very sl. sol. in conc. Na_2CO_3, or K_2CO_3+Aq; largely sol. in $(NH_4)_2CO_3$+Aq, and partly sol. in NH_4OH+Aq. (Berzelius.)

Not pptd. from solutions containing Na citrate. (Spiller.)

4CoO, CO_2+4H_2O. Ppt. (Beetz.)

$+3H_2O$. (Meigen, C. C. **1905,** I. 1363.)

Cobaltous carbonate, basic, 3CoO, CO_2+2H_2O.

(Meigen, C. C. **1905,** I. 1363.)

$3H_2O$. (Rose, Pogg. **84.** 551.)

3CoO, $2CO_2+4H_2O$. (Bratin, Z. anal. **6.** 76.)

2CoO, $CO_2+3\frac{1}{2}H_2O$. Converted into 5CoO, $2CO_2+4H_2O$ by H_2O. (Beetz.)

Cobaltous carbonate, $CoCO_3$.

Anhydrous. Not attacked by cold conc. HCl, or HNO_3+Aq. (Senarmont, A. ch. (3) **30.** 128.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Min. *Sphærocobaltite.* Sl. attacked by cold HNO_3, or HCl+Aq.

$+^2/_3H_2O$. Sol. in acids. (Deville, A. ch. (3) **33.** 95.)

$+6H_2O$. (Deville.)

Decomp. by H_2O with formation of a basic carbonate. (Berzelius.)

Cobaltous potassium carbonate, $CoCO_3$, $K_2CO_3+4H_2O$.

Decomp. by H_2O. (Deville, A. ch. (3) **33.** 90.)

Ppt. Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73.** 264.)

$CoCO_3$, $KHCO_3+4H_2O$. Decomp. by H_2O. (Deville.)

Cobaltous sodium carbonate, $CoCO_3$, Na_2CO_3 $+4H_2O$, and $10H_2O$.

Decomp. by H_2O. (Deville, A. ch. (3) **33.** 75.)

Cupric carbonate, basic.

The compounds produced by pptn. of copper solutions by carbonates are unstable and possess varying solubilities in solutions of CO_2. On treatment with solutions of CO_2, these substances pass over into an apparently stable compound possessing a definite solubility in solutions of CO_2 of definite concentration, which solubility increases with the concentration of CO_2. Solubility of this compound in various salts+Aq is recorded. (Free, J. Am. Chem. Soc. 1908, **30.** 1374.)

8CuO, CO_2+5H_2O. (Deville, A. ch. (3) **33.** 75.)

6CuO, CO_2. (Field, Chem. Soc. **14.** 70.)

3CuO, CO_2+2H_2O. (Favre, A. ch. (3) **10.** 119.)

5CuO, $2CO_2+6H_2O$. (Struve.)

2CuO, CO_2+H_2O. Insol. in H_2O; easily sol. in acids, even H_2SO_3+Aq; sl. sol. in H_2CO_3+Aq, 30,720 pts. of the solution containing 1 pt. CuO. (Jahn.) Sol. in 4690 pts. H_2CO_3+Aq sat. at 4–6 atmos. pressure. (Wagner.) Sol. in 3833 pts. sat. H_2CO_3+Aq. (Lassaigne, J. ch. méd. **4.** 312.)

Sol. in NH_4 salts+Aq. Partially sol. in Na_2CO_3, or K_2CO_3+Aq, and more sol. in

$NaHCO_3$, or $KHCO_3$+Aq; sol. in $(NH_4)_2CO_3$ +Aq. (Favre, A. ch. (3) **10.** 18.)

Less sol. in $(NH_4)_2CO_3$+Aq than CuO in NH_4OH+Aq. (Thomson, **1831.**) Sol. in KCN+Aq. (Berzelius.) Sol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sol. in ferric salts with pptn. of $Fe_2O_6H_6$.

Insol. in liq. NH_3. (Franklin and Kraus, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Sol. in ethyl amine carbonate+Aq. (Wurtz.)

Sol. in cane sugar+Aq. (Peschier, Repert. 1820, **6.** 85.)

Not pptd. from solutions containing sodium citrate. (Spiller.)

Insol. in pyridine. (Schroeder, Dissert. **1901.**)

Min. *Malachite*. Sol. in acids, and NH_4OH +Aq.

$+2H_2O$. (Favre.)

8CuO, $5CO_2+7H_2O$. (Gröger, Z. anorg. 1900, **24.** 137.)

3CuO, $2CO_2+H_2O$. Insol. in H_2O. Sol. in NH_4OH+Aq, also in hot conc. $NaHCO_3$+ Aq.

Min. *Azurite*.

Copper potassium carbonate, basic, 8CuO, $2K_2CO_3$, $7CO_2+17H_2O$.

Ppt.; decomp. by H_2O. (Gröger, B. 1901, **34.** 430.)

Mixture. (Wood and Jones, C. A. **1907.** 2667).

5CuO, $4CO_2$, $K_2CO_3+10H_2O$. Decomp. by H_2O. (Deville, A. ch. (3) **33.** 102).

Cupric potassium carbonate, $CuCO_3$, K_2CO_3.

Decomp. by H_2O. (Wood and Jones, C. A. **1907.** 2667.)

$+H_2O$. (Wood and Jones.)

$+4H_2O$. Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73.** 263.)

Could not be obtained. (Wood and Jones.)

$2CuCO_3$, $K_2CO_3+4H_2O$. Decomp. by H_2O. (Wood and Jones.)

Cupric sodium carbonate, $CuCO_3$, Na_2CO_3.

Not decomp. by cold H_2O. (Debray, C. R. **49.** 218.)

$+3H_2O$.

Cupric zinc carbonate, 2CuO, 3ZnO, $2CO_2$+ $3H_2O$, or 3CuO, 9ZnO, $4CO_2+8H_2O$.

Min. *Aurichalcite*. Easily sol. in HCl+Aq.

Cupric carbonate ammonia (cuprammonium carbonate), $CuCO_3$, $2NH_3$.

Decomp. by H_2O. Insol. in alcohol and ether. Sol. in $(NH_4)_2CO_3$+Aq. (Favre, A. ch. (3) **10.** 116.)

Didymium carbonate, $Di_2(CO_3)_3+H_2O$, or $6H_2O$.

Insol. in H_2O. Only traces dissolve in CO_2 +Aq. Insol. in solutions of alkali carbonates or bicarbonates+Aq. (Marignac, A. ch. (3) **38.** 166.) Very sl. sol. in conc. NH_4Cl+Aq. (Rose.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+8H_2O$. (Cleve, Bull. Soc. (2) **43.** 363.)

Didymium potassium carbonate, $Di_2(CO_3)_3$, $K_2CO_3+4H_2O$.

Insol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 363.)

$+12H_2O$. (Cleve.)

Didymium sodium carbonate, $2Di_2(CO_3)_3$, $3Na_2CO_3+9H_2O$.

Ppt. (Cleve.)

$Di_2(CO_3)_3$, $2Na_2CO_3+8H_2O$. Ppt. (Cleve.)

Dysprosium carbonate, $Dy_2(CO_3)_3+4H_2O$.

Insol. in H_2O. (Jantsch, B. 1911, **44.** 1277.)

Erbium carbonate, Er_2O_3, $2CO_2+2H_2O$.

Insol. in H_2O. (Höglund.)

Erbium sodium carbonate, $Er_2(CO_3)_3$, $5Na_2CO_3+36H_2O$.

Efflorescent. Decomp. by H_2O.

Gadolinium carbonate, basic, $Gd(OH)CO_3$+ H_2O.

Ppt. (Benedicks, Z. anorg. 1900, **22.** 417.)

Glucinum carbonate, basic, 3GlO, CO_2; 4GlO, CO_2; 5GlO, CO_2+5H_2O, etc.

Not perceptibly sol. in H_2O or H_2CO_3+Aq. Decomp. by boiling H_2O. Easily sol. in acids. Sol. in NH_4 salts, and KOH, or NaOH+Aq. Sol. in alkali carbonates, especially $(NH_4)_2CO_3$+Aq. (Vauquelin.) Sl. sol. in K_2CO_3+Aq. When solution in $(NH_4)_2CO_3$ is boiled, a more basic carbonate is pptd. (Rose.)

Glucinum carbonate, $GlCO_3+4H_2O$.

Efflorescent. Sol. in 278 pts. H_2O. (Klatzo, J. pr. **106.** 242.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

No definite carbonate of glucinum exists. (Cameron, J. phys. Chem. 1908, **12.** 572.)

Glucinum potassium carbonate, $3GlCO_3$, $2K_2CO_3$.

Easily sol. in H_2O, but decomp. by boiling. (Debray.) Less easily sol. in alcohol.

Indium carbonate, $In_2(CO_3)_3$.

Ppt. Insol. in K_2CO_3, or Na_2CO_3+Aq. Sol. in $(NH_4)_2CO_3+Aq$. (Winkler, J. pr. **94.** 1.)

Iron (ferric) carbonate, basic.

$9Fe_2O_3$, CO_2+12H_2O. (Wallace, Chem. Gaz. **1858.** 410.)

$3Fe_2O_3$, CO_2+4H_2O, and $8H_2O$. (Barratt, C. N. **1.** 110.)

$+6H_2O$. (Wallace.)

$2Fe_2O_3$, $CO_2+1\frac{1}{2}H_2O$. (Rother, Pharm. J. Trans. (3) **4.** 576.)

Fe_2O_3, CO_2. (Parkmann, Sill. Am. J. (2) **34.** 321.)

These and other similar basic salts are ppts., easily decomp. on standing into $Fe_2O_6H_6$.

Iron (ferrous) carbonate, $FeCO_3$.

Insol. in H_2O.

Sol. in acids, even in H_2CO_3+Aq.

See **Carbonate, ferrous hydrogen.**

Min. *Siderite, Spathic ore.* Sl. attacked by dil. acids. Sol. in H_2CO_3+Aq under pressure.

Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

$+H_2O$. Sl. sol. in H_2O; easily sol. in acids; sol. in H_2CO_3+Aq.

Sol. in NH_4Cl+Aq. Sol. in ferric salts$+Aq$ with evolution of CO_2 and pptn. of $Fe_2O_6H_6$.

Soluble in an aqueous solution of cane sugar.

Solubility in salts+Aq free from CO_2.

Salt	g. salt per 1000 g. H_2O	1 l. of solvent dissolves g. $FeCO_3$
NaCl	351.2	0.35042
$MgCl_2+6H_2O$	2300.0	4.2049
$Na_2SO_4+10H_2O$	137.7	0.70085
	sat. at +14°	0.93444
$MgSO_4+7H_2O$	105.3	1.4667
	sat. at +18°	2.9334

(Ehlert, Z. Elektrochem. 1912, **18.** 728.)

Iron (ferrous) hydrogen carbonate, $FeH_2(CO_3)_2(?)$.

Known only in aqueous solution.

By conducting CO_2 at ordinary pressure through H_2O, in which Fe is suspended, a solution containing 9.1 pts. $FeCO_3$ to 10,000 pts. H_2O is obtained. (v. Hauer, J. pr. **81.** 391.)

100 pts. H_2CO_3+Aq dissolve 0.72 pt. $FeCO_3$. (Wagner.)

$FeCO_3$ dissolves in 1381 pts. H_2O saturated with CO_2, under a pressure of 4–6 atmospheres. (Wagner, J. B. **1867.** 135.)

1 l. H_2O dissolves 6.1907 g. $FeCO_3$ (pure) under a CO_2 pressure of 2 atmos. (Ehlert, Z. Elektrochem. 1912, **18.** 728.)

Solubility in various salts+Aq in presence of CO_2 under pressure of 2 atmos.

Salt	With CO_2 of 2 atmos. pressure	
	g. salt per 1000 g. H_2O	1 l. of solvent dissolves g. $FeCO_3$
H_2O	....	6.1907
NaCl	50	....
	106.9	...
	175.6	...
	263.4	....
	351.2	....
$MgCl_2+6H_2O$	86.9	5.8403
	700.0	4.5553
	1150.0	4.4587
	1437.5	4.6934
	1725.0	5.3975
	2300.0	9.0524
$Na_2SO_4+10H_2O$	137.7	7.9428
	sat. at +14°	9.5780
$MgSO_4+7H_2O$	105.3	6.2423
	sat. at +18°	7.3922

(Ehlert, Z. Elektrochem. 1912, **18.** 728.)

A bicarbonate of ferrous iron is not formed under pressures of CO_2 up to 5 atmospheres at 0°. (Cameron, J. phys. Chem. 1908, **12.** 571.)

Iron (ferrous) magnesium carbonate, $FeCO_3$, $MgCO_3$.

Min. *Pistomesite.*

$FeCO_3$, $2MgCO_3$. Min. *Mesitite.*

Iron (ferrous) potassium carbonate, $FeK_2(CO_3)_2+4H_2O$.

Ppt. Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73.** 265.)

Lanthanum carbonate, $La_2(CO_3)_3+H_2O$, $3H_2O$, and $8H_2O$.

Insol. in H_2O. CO_2+Aq dissolves traces. Insol. in $(NH_4)_2CO_3+Aq$.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Min. *Lanthanite.*

Lanthanum potassium carbonate, $La_2(CO_3)_3$, $K_2CO_3+12H_2O$.

Sol. in 30% K_2CO_3+Aq. (Meyer, Z. anorg. 1904, **41.** 101.)

Lanthanum sodium carbonate, $2La_2(CO_3)_3$, $3Na_2CO_3+20H_2O$(?).

Ppt. Easily decomp. (Meyer, Z. anorg. 1904, **41.** 102.)

Lead carbonate, basic, $2PbCO_3$, PbO_2H_2; $5PbCO_3$, $3PbO_2H_2$; $3PbCO_3$, PbO_2H_2; $5PbCO_3$, PbO_2H_2.

White Lead. Insol. in H_2O. Nearly insol. in H_2CO_3+Aq, even under pressure. Sol. in dil., insol. in conc. KOH+Aq. Insol. in normal, or acid alkali carbonates+Aq. (Böttger.)

Sol. in cold dil. NH_4Cl+Aq. (Brett.)

$PbCO_3$, PbO_2H_2. Very sl. sol. in H_2O. (Yorke.)

$2PbCO_3$, PbO_2H_2.

Solubility is less than 0.0002 millimol Pb in 1 liter H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

When not exposed to air, sol. in 32,000 pts. $(NH_4)_2SO_4$+Aq (0.2 g. per l.); 26,000 pts. KNO_3+Aq (0.2 g. per l.); 23,000 pts. $CaCl_2$+Aq (0.2 g. per l.); 4600 pts. NH_4NO_3+Aq (0.2 g. per l.); 4300 pts. H_2O sat. with CO_2.

When exposed to air in beakers, sol. in 43,000 pts. $(NH_4)_2SO_4$+Aq (0.2 g. per l.); 43,000 pts. KNO_3+Aq (0.2 g. per l.); 26,000 pts. $CaCl_2$+Aq (0.2 g. per l.); 26,000 pts. NH_4NO_3+Aq (0.2 g. per l.); 4300 pts. H_2O sat. with CO_2 (0.2 g. per l.). (Muir, Chem. Soc. **31.** 664.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$3PbO, 4PbCO_3+2H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 446.)

Lead carbonate, $PbCO_3$.

Sol. in 50,551 pts. H_2O at ordinary temp.

Sol. in 23,450 pts. H_2O with little ammonium acetate, carbonate, and free ammonia; and in somewhat less H_2O, containing much ammonium nitrate with carbonate and free ammonia. (Fresenius, A. **59.** 124.)

Calculated from electrical conductivity of $PbCO_3$+Aq, 1 l. H_2O dissolves 3 mg. $PbCO_3$ at 10°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Solubility is 0.0002 millimol. Pb in 1 liter H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

Sl. sol. in H_2O. 1.5 x 10^{-3} g. are contained in 1 l. of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 604.)

Easily sol. in acids, even $HC_2H_3O_2$; but not decomp. by conc. HNO_3+Aq on account of insolubility of $Pb(NO_3)_2$ in HNO_3+Aq. Insol. in a mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, or in an alcoholic solution of racemic or tartaric acids.

Insol. in H_2CO_3+Aq. (Jahn, A. **28.** 117.) Very sl. sol. in H_2CO_3+Aq, but solution is prevented by traces of various salts. (Tünnerman.) Sol. in 7144 pts. sat. H_2CO_3+Aq. (Lassaigne, J. ch. méd. **4.** 312.) H_2O sat. with CO_2 under 4–6 atmos. pressure dissolves only traces of Pb; 1000 pts. of solution containing 0.5 pt. $PbCO_3$. (Wagner, Z. anal. **6.** 167.)

Solubility of $PbCO_3$ in H_2CO_3+Aq at 18°.

mg. per l.	
CO_2	$PbCO_3$
0	1.75
2.8	6
5.4	7
14.4	8.2
26	9.9
43.5	10.9
106	15.4

(Pleissner, C. C. **1907,** II. 1056.)

Sol. in $NH_4C_2H_3O_2$+Aq, and NH_4Cl+Aq. (Weppen, **1837.**) Sol. in KOH+Aq; not absolutely insol. at ord. temp. in an excess of K_2CO_3, or Na_2CO_3+Aq, and still more sol. at 100°; but absolutely insol. in $NaHCO_3$, $KHCO_3$, or $(NH_4)_2CO_3$+Aq. (Rose.) Insol. in NH_4OH+Aq; sol. in KOH or NaOH+Aq; decomp. by boiling $Ca(NO_3)_2$+Aq. (Berzelius.)

Sl. decomp. (Persoz), not at all decomp. (Malaguti) by alkali sulphates+Aq.

Partially decomp. by boiling with K_2SO_4, Na_2SO_4, $(NH_4)_2SO_4$, $CaSO_4$, $MgSO_4$, Na_2HPO_4, $NaNH_4HPO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, Na_2HPO_3, $Na_2B_4O_7$, K_3AsO_4, Na_3AsO_4, $K_2C_2O_4$, $Na_2C_2O_4$, NaF, and K_2CrO_4+Aq. With the NH_4 salts, the decomp. is complete. (Dulong, A. ch. **82.** 290.)

Easily sol. in hot NH_4Cl+Aq. (Brett; Rose.)

When 1 mol. $PbCO_3$ is boiled with 1 mol. $K_2C_2O_4$, 15% of the $PbCO_3$ is decomp.; with 1 mol. K_2CO_3, 93.28% is decomp. (Malaguti.)

Not decomp. by K_2SO_4+Aq. (Rose.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in an aqueous solution of acetates. (Mercer, **1844.**)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Not pptd. in presence of Na citrate. (Spiller.)

Min. *Cerussite.*

Lead sodium carbonate, $4PbCO_3$, Na_2CO_3.

Insol. in H_2O. (Berzelius, Pogg. **47.** 199.)

Lead carbonate bromide, $PbCO_3$, $PbBr_2$.

Insol. in H_2O. (Storer's Dict.)

Lead carbonate chloride, $PbCO_3$, $PbCl_2$.

Insol. in H_2O. (Miller, Chem. Soc. (2) **8.** 37.)

Min. *Phosgenite.* Easily sol. in acids.

Lead carbonate iodide, $PbCO_3$, PbI_2.

Insol. in H_2O. (Poggiale.)

Lead carbonate sulphate, $PbCO_3$, $PbSO_4$.

Min. *Lanarkite.* Sol. in HNO_3+Aq with residue of $PbSO_4$.

$3PbCO_3$, $PbSO_4$. Min. *Leadhillite.* As above.

Lithium carbonate, Li_2CO_3

100 pts. H_2O dissolve 1 pt. Li_2CO_3. (Vauquelin, A. ch. **7.** 284.)

100 pts. H_2O at 13° dissolve 0.769 pt. Li_2CO_3; at 102°, 0.778 pt. Li_2CO_3. (Kremers, Pogg. **99.** 48.)

100 pts. H_2O, cold or hot, dissolve 1.2 pts. Li_2CO_3. (Troost, A. ch. (3) **51.** 103.)

100 pts. H_2O dissolve 1.4787 pts. at 15°, 0.7162 pt. at 100°. (Draper, C. N. **55.** 169.)

100 pts. H_2O dissolve pts. Li_2CO_3 at t°.

t°	Pts. Li_2CO_3	t°	Pts. Li_2CO_3
0	1.539	75	0.866
10	1.406	100	0.728
20	1.329	102	0.796
50	1.181	...	...

0.796 pt. is dissolved at 102° in less than ¼ hour, and 0.955 in 1 hour. (Beketow, J. russ. Soc. **1884.** 591.)

Sat. solution at 15° has sp. gr. 1.014, and contains 1 g. Li_2CO_3 to 70 g. H_2O, while solution sat. at 0° has sp. gr. 1.0168 and contains 1 g. Li_2CO_3 in 64.6 g. H_2O. By long spontaneous evaporation at 15° a solution can be obtained of 1.0278 sp. gr. containing 1 g. Li_2CO_3 in 45.57 g. H_2O. (Flückiger, Arch. Pharm. (3) **25.** 549.)

By boiling for an instant with H_2O a solution is obtained, which has sp. gr. 1.0074 and contains 1 g. Li_2CO_3 to 139 g. H_2O. (Flückiger, Arch. Pharm. (3) **26.** 543.)

0.1687 mol. is sol. in 1 l. H_2O at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 531.)

Sat. Li_2CO_3+Aq contains at:

95°	75°
0.723	0.833% by wt. Li_2CO_3.

(Tschugæff, Z. anorg. 1914, **86.** 159.)

Sat. solution boils at 102°. (Kremers.)

More sol. in CO_2+Aq than in H_2O. 100 pts. sat. CO_2+Aq dissolve 5.25 pts. Li_2CO_3. (Troost.) *See* $LiHCO_3$.

Sol. in NH_4 salts+Aq.

Solubility in salts+Aq at 25°.

C = concentration of salt solution in g.-equiv. per l.

S = solubility of Li_2CO_3 in g.-equiv. per l.

Salt	C	S
KNO_3	0.25	0.3647
	0.50	0.3688
	0.75	0.3676
	1.00	0.3656
	1.50	0.3490
	2.00	0.3268
KCl	0.10	0.3553
	0.25	0.3590
	0.50	0.3782
	0.75	0.3832
	1.00	0.3835
	1.50	0.3731
	2.00	0.3558
NaCl	0.10	0.3569
	0.25	0.3691
	0.50	0.3867
	0.75	0.3956
	1.00	0.3946
	1.50	0.3901
	2.00	0.3776
$\frac{K_2SO_4}{2}$	0.25	0.4028
	0.50	0.4356
	1.00	0.4860
$\frac{Na_2SO_4}{2}$	0.50	0.4411
	1.00	0.4926
	2.00	0.5534
NH_4Cl	0.10	0.3902
	0.25	0.4677
	0.50	0.5659
	0.75	0.6270
	1.00	0.6810
	1.50	0.7463
	2.00	0.7739
	4.00	0.7881
$\frac{(NH_4)_2SO_4}{2}$	0.25	0.5059
	0.50	0.7863
	1.00	0.9804
	1.50	1.109
	2.00	1.174
$KClO_3$	0.1	0.3500
	0.2	0.3570
	0.4	0.3616

(Geffcken, Z. anorg. 1905, **43.** 198.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Solubility in organic compds.+Aq at 25°.
Solubility in H_2O at 25° = 0.1687 mols. litre.

Organic compd.	Normality of the solution	Mol. Li_2CO_3 sol. in 1 l.
Methyl alcohol	0.250 0.5 1.0	0.1604 0.1529 0.1394
Ethyl alcohol	0.125 0.250 0.5 1.0	0.1614 0.1555 0.1417 0.1203
Propyl alcohol	0.125 0.250 0.5 1.0	0.1604 0.1524 0.1380 0.1097
Tertiary amyl alcohol	0.125 0.250 0.5 1.0	0.1564 0.1442 0.1224 0.0899
Acetone	0.125 0.250 0.5 1.0	0.1600 0.1515 0.1366 0.1104
Ether	0.125 0.250 0.5	0.1580 0.1476 0.1300
Formaldehyde	0.125 0.250 0.5 1.0	0.1668 0.1653 0.1606 0.1531
Glycol	0.125 0.250 0.5 1.0	0.1660 0.1629 0.1565 0.1472
Glycerine	0.125 0.250 0.5 1.0	0.1670 0.1647 0.1613 0.1532
Mannitol	0.125 0.250 0.5	0.1705 0.1737 0.1778
Glucose	0.125 0.250 0.5 1.0	0.1702 0.1728 0.1752 0.1778
Sucrose	0.125 0.250 0.5 1.0	0.1693 0.1689 0.1661 0.1557
Urea	0.125 0.250 0.5 1.0	0.1686 0.1673 0.1643 0.1605

Solubility in organic compds.+Aq. at 25°—*Continued.*

Organic compd.	Normality of the solution	Mol. Li_2CO_3 sol. in 1 l.
Thio-urea	0.125 0.250 0.5 1.0	0.1667 0.1643 0.1600 0.1523
Dimethyl-pyrone	0.125 0.250 0.5 1.0	0.1562 0.1460 0.1284 0.0992
Ammonia	0.125 0.250 0.5 1.0	0.1653 0.1630 0.1577 0.1466
Diethylamine	0.125 0.250 0.5 1.0	0.1589 0.1481 0.1283 0.0937
Pyridine	0.125 0.250 0.5 1.0	0.1592 0.1503 0.1347 0.1091
Piperidine	0.125 0.250 0.5 1.0	0.1584 0.1488 0.1320 0.1009
Urethane	0.125 0.250 0.5 1.0	0.1604 0.1525 0.1377 0.1113
Acetamide	0.250 0.5 1.0	0.1614 0.1520 0.1358
Acetonitrile	0.125 0.250 0.5 1.0	0.1618 0.1556 0.1429 0.1178
Mercuric cyanide	0.125 0.250	0.1697 0.1704

(Rothmund, Z. phys. Ch. 1909, **69.** 531.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Lithium hydrogen carbonate, $LiHCO_3$.

100 pts. H_2O dissolve 5.501 pts. at 13°. (Bewad, B. **17.** 406 R.)

Magnesium carbonate, basic, $Mg_3C_2O_7+3H_2O=3MgO, 2CO_2+3H_2O$ or $2MgCO_3, MgO_2H_2+2H_2O$. (Fritzsche, Pogg. **37.** 310.)

Magnesia alba, $3MgCO_3, Mg(OH)_2+4H_2O$, $4MgCO_3, Mg(OH)_2+5H_2O$, or $5MgCO_3, 2Mg(OH)_2+7H_2O$.

Very sl. sol. in H_2O. Sol. in 10,000 pts. hot or cold H_2O. (Bineau.)

Sol. in 2500 pts. cold, and 9000 pts. hot H_2O. (Fyfe.)

Sol. in H_2O containing CO_2.

Very easily sol. in acids.

Easily sol. in dil. HCl+Aq.

Easily sol. in NH_4 sulphate, nitrate, or succinate+Aq, also in $(NH_4)_2CO_3$+Aq. (Wittstein.) Sol. in cold Na_2CO_3, K_2CO_3, K_2SO_4, KCl, or KNO_3+Aq (Longchamp); also in NH_4Cl+Aq, separating out on heating. (Vogel, J. pr. **7.** 455.) Slowly sol. in conc. $BaCl_2$, $CaCl_2$, or $ZnSO_4$+Aq. (Karsten.)

Sol. in $MgSO_4$+Aq. (Dulong.)

Sol. in ferric salts+Aq with evolution of CO_2 and pptn. of $Fe_2O_6H_6$. (Fuchs.)

Sol. in boiling Co, Ni, Zn, Mn, or Cu nitrates or chlorides+Aq.

Min. *Hydromagnesite,* $4MgO, 3CO_2+4H_2O$.

$+10H_2O$. Sol. in considerable amount in H_2CO_3+Aq as $MgH_2(CO_3)_2$+Aq. (Engel, C. R. **100.** 911.)

Magnesium carbonate, $MgCO_3$.

Anhydrous. Insol. in H_2O. 1 l. H_2O dissolves 106 mg. $MgCO_3$. (Chevalet, Z. anal. **8.** 91.) Sol. in 5071 pts. H_2O at 15°. (Kremers.) $MgCO_3$ combines with H_2O to form $MgCO_3+3H_2O$, and $+5H_2O$, which are less sol. in H_2O than anhydrous salt. (Engel, C. R. **101.** 814.)

Very hydroscopic. About 20 g. are sol. in 1 l. H_2O. (Engel, C. R. 1899, **129.** 598.)

0.7156 g. are sol. in 1 l. H_2O at 15°.

0.627 g. are sol. in 1 l. H_2O at 15° with vapour pressure of CO_2 equal to zero.

6.977 grams are sol. in 1 l. H_2O at 15° with vapour pressure CO_2 equal to 1 atmos. (Treadwell and Reuter, Z. anorg. 1898, **17.** 202.)

94.4 mg. are sol. in 1 l. of CO_2-free water. (Gothe, Ch. Z. 1915, **39.** 306.)

Solubility in H_2O in equilibrium with $Mg(HCO_3)_2$ and CO_2.

System: $MgCO_3$, $Mg(HCO_3)_2$ and CO_2 at 30° C.

Total Mg (grams per liter)	Mg as $MgCO_3$ (grams per liter)	Mg as $Mg(HCO_3)_2$ (grams per liter)
0.02410	0.01205	0.01205
0.13135	0.06820	0.06314
0.16087	0.08676	0.07411

Solubility in H_2O in equilibrium with $Mg(HCO_3)_2$ and CO_2—*Continued.*

System: $MgCO_3$, $Mg(HCO_3)_2$ and CO_2 at 30° C.

Total Mg (gram-atoms per liter)	Mg as $MgCO_3$ Per cent	Mg as $Mg(HCO_3)_2$ Per cent
0.00100	50.00	50.00
0.00545	51.92	48.08
0.00667	53.93	46.07

Total salts in solution Grams per liter	$MgCO_3$ Grams per liter	$MgCO_3$ Per cent	$Mg(HCO_3)_2$ Grams per liter	$Mg(HCO_3)_2$ Per cent
0.1144	0.0418	36.5	0.0726	63.5
0.6174	0.2368	38.2	0.3806	61.7
0.7479	0.3012	40.3	0.4467	59.7

In a solution near the saturation point and in equilibrium with atmospheric air upwards of 50 per cent of the magnesium is in the form of the normal carbonate. When the solution is brought in contact with the solid phase, the proportion of the base combined as normal carbonate falls to about 34 per cent, or lower. (Cameron and Briggs, J. phys. Chem. 1901, **5.** 552–3.)

For solubility in H_2CO_3+Aq, see *Magnesium hydrogen carbonate.*

Scarcely acted upon by HCl+Aq. (Senarmont.)

The solubility of $MgCO_3$ in NaCl+Aq when in contact with ordinary air increases with increasing concentration of NaCl up to a maximum, and then decreases. (Cameron and Seidell, J. phys. Chem. 1903, **7.** 579.)

Solubility of $MgCO_3$ in salts+Aq in equilibrium with an atmosphere free from CO_2.

NaCl+Aq; t=23°.

Weight of liter of solution	Grams NaCl per liter	Grams $MgCO_3$ per liter	Reacting weights NaCl per liter	Reacting weights $MgCO_3$ per liter
996.92	0.0	0.176	0.000	0.00210
1016.82	28.0	0.418	0.482	0.00500
1041.09	59.5	0.527	1.025	0.00630
1070.50	106.3	0.585	1.831	0.00699
1094.53	147.4	0.544	2.539	0.00650
1142.48	231.1	0.460	3.981	0.00550
1170.14	272.9	0.393	4.701	0.00470
1199.28	331.4	0.293	5.709	0.00350

(Cameron and Seidell, J. phys. Chem. 1903, **7.** 585.)

Solubility of $MgCO_3$ in salts+Aq—*Continued*

Na_2SO_4+Aq; t=24°.

Weight of liter of solution	Grams Na_2SO_4 per liter	Grams $MgCO_3$ per liter	Reacting wts. Na_2SO_4 per liter	Reacting wts. MgCO per liter
997.52	0.00	0.216	0.000	0.00258
1021.24	25.12	0.586	0.178	0.00700
1047.60	54.76	0.828	0.388	0.00990
1080.95	95.68	1.020	0.678	0.01219
1133.85	160.80	1.230	1.140	0.01470
1157.34	191.90	1.280	1.360	0.01530
1206.03	254.60	1.338	1.804	0.01600
1223.91	278.50	1.338	1.973	0.01600
1241.99	305.10	1.388	2.162	0.01660

t=35.5°.

Weight of liter of solution	Grams Na_2SO_4 per liter	Grams $MgCO_3$ per liter	Reacting weights Na_2SO_4 per liter	Reacting weights $MgCO_3$ per liter
995.15	0.32	0.131	...	0.00156
1032.89	41.84	0.577	0.296	0.00689
1067.23	81.84	0.753	0.579	0.00900
1094.77	116.56	0.904	0.826	0.01080
1120.38	148.56	0.962	1.052	0.01149
1151.70	186.70	1.047	1.323	0.01251
1179.82	224.00	1.088	1.587	0.01300
1196.32	247.20	1.100	1.751	0.01314
1236.52	199.20	1.130	2.120	0.01350

(Cameron and Seidell.)

Na_2CO_3+Aq; t=25°.

Weight of liter of solution	Grams Na_2CO_3 per liter	Grams $MgCO_3$ per liter	Reacting weights Na_2CO_3 per liter	Reacting weights $MgCO_3$ per liter
996.84	0.00	0.223	0.000	0.00266
1019.89	23.12	0.288	0.220	0.00344
1047.72	50.75	0.510	0.482	0.00620
1082.47	86.42	0.879	0.820	0.01027
1118.91	127.30	1.314	1.209	0.01570
1147.66	160.80	1.636	1.526	0.01955
1166.05	181.90	1.972	1.727	0.02357
1189.38	213.20	2.317	2.024	0.02770

(Cameron and Seidell.)

Solubility in salts+Aq.

g. salt added per litre	mg. $MgCO_3$ dissolved per litre
0.0	94.4
0.585 g. NaCl	128.3
1.17 g. "	134.4
2.93 g. "	120.95
0.85 g. $NaNO_3$	122.85
1.70 g. "	138.80
4.25 g. "	137.20

Solubility in salts+Aq.—*Continued*

g. salt added per litre	mg. $MgCO_3$ dissolved per litre
0.805 g. Na_2SO_4, $10H_2O$	145.05
1.61 g. "	162.05
4.03 g. "	150.75
0.53 g. Na_2CO_3	98.6
1.06 g. "	53.5
2.65 g. "	15.7
0.51 g. $MgCl_2$, $6H_2O$	47.0
1.02 g. "	39.5
2.55 g. "	35.3

The solubility of $MgCO_3$ in CO_2-free water is increased by the addition of NaCl, $NaNO_3$ or Na_2SO_4, $10H_2O$ but decreased by the addition of Na_2CO_3 or $MgCl_2$, $6H_2O$.

(Gothe, Ch. Z. 1915, **39.** 306.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Min. *Magnesite.* Very sl. attacked by warm conc. HCl+Aq. 100 pts. H_2O dissolve 0.0027 pt., calculated as MgO. (Lubavin.)

Solution in H_2O contains 0.018 g. Mg and 0.065 g. CO_2 per l. at 20°. (Wells, J. Am. Chem. Soc. 1915, **37.** 1705.)

Solution in H_2O containing 27.2 g. NaCl per l. contains 0.028 g. Mg and 0.086 g. CO_2 per l. at 20°. (Wells, J. Am. Chem. Soc. 1915, **37.** 1705.)

$+H_2O$.

$+2H_2O$. Decomp. by suspension in H_2O into basic salt. (Engel, C. R. **100.** 911.)

$+3H_2O$. Small quantities of this salt are wholly dissolved by much H_2O. (Bineau.)

The solution contains in 100 pts. at—

0°	6.5°	8°	16°	
0.15	0.153	0.155	0.179	pts. $MgCO_3+3H_2O$.

(Norgaard, **1850.**)

Decomp. by boiling H_2O into a basic insol. salt and CO_2. 100 pts. H_2O dissolve 0.1518 pt. at 19°. (Fritzsche, Pogg. **37.** 304.)

Sol. in 48 pts. H_2O, and decomp. by large amt. (Fourcroy.)

100 pts. H_2O dissolve 0.1518 pt. at 19°, or sol. in 658 pts. H_2O at 19°. (Beckurts, J. B. **1881.** 212.)

100 pts. H_2O dissolve 0.0812 pt., calculated as MgO. (Lubavin, J. russ. Soc. **24.** 389.)

Solution in H_2O contains 0.36 g. Mg and 1.01 g. CO_2 per l. at 20°. (Wells, J. Am. Chem. Soc. 1915, **37.** 1707.)

Solubility in H_2O sat. with CO_2 has been determined at 20°, 25°, 30°, 34° and 39° and

at CO_2 pressures corresponding with 0.5 to 30.3% CO_2 in the gas phase. (Leather and Sen, Chem. Soc. 1915, **108** (2) 13.)

Easily sol. in acids. even when dil

Not decomp. by 1 pt. H_2SO_4+6 pts. alcohol, or by alcoholic solutions of glacial acetic, racemic, or tartaric acids, but is slowly decomp. by alcoholic solution of citric acid, or HNO_3+abs. alcohol. (Butini, **1827.**)

100 pts. NaCl+Aq (2.525%) dissolve 0.1250 pt., calculated as MgO. (Lubavin.)

1% Na_2CO_3+Aq, when mixed with 1% $MgSO_4$+Aq, cause no ppt., but 1.5–2% solutions ppt. this salt. (Brandes, **1825.**)

More sol. in NH_4Cl+Aq than $CaCO_3$ Sol. in NH_4NO_3+Aq, but less easily than in NH_4Cl+Aq.

Solubility in $KHCO_3$+Aq at t°.

Values are given in mol./litre

t°	K	Mg	Solid phase
15°	0.0	0.0095	$MgCO_3+3H_2O$
	0.0992	0.0131	"
	0.1943	0.0167	"
	0.3992	0.0211	" labile
	0.2681	0.0192	$MgCO_3+3H_2O+MgCO_3$ $KHCO_3+4H_2O$
	0.5243	0.0097	$MgCO_3$, $KHCO_3+4H_2O$.
	0.6792	0.0074	"
	0.9810	0.0028	"
25°	0.0	0.0087	$MgCO_3+3H_2O$
	0.0985	0.0115	"
	0.2210	0.0149	"
	0.3188	0.0175	"
	0.3434	0.0181	"
	0.4216	0.0205	" labile
	0.4985	0.0207	" "
	0.3906	0.0196	$MgCO_3+3H_2O+MgCO_3$ $KHCO_3+4H_2O$
	0.5893	0.0128	$MgCO_3$, $KHCO_3+4H_2O$
	0.6406	0.0117	"
	0.788	0.0089	"
	1.125	0.0061	"
35°	0.0	0.0071	$MgCO_3+3H_2O$
	0.1092	0.0098	"
	0.2001	0.0132(?)	"
	0.2811	0.0142	"
	0 3704	0 0163	"
	0 4847	0 0177	"
	0 5807	0 0198	"
	0 5088	0 0184	$MgCO_3+3H_2O+MgCO_3$, $KHCO_3+4H_2O$
	0 6231	0 0153	$MgCO_3$, $KHCO_3+4H_2O$
	0 8435	0 0119	"

The experiments were performed in such a way as to prevent, as far as possible, loss of CO_2 from the solutions.

(Auerbach, Z. Elektrochem. 1904, **10.** 164.)

1 l. H_2O, containing 6% $MgSO_4+7H_2O$ and a little NaCl, dissolves 5 g. $MgCO_3$. (Hunt, Sill. Am. J. (2) **42.** 49.)

More sol. in cold alkali borates+Aq than in hot. (Wittstein.)

Sol. in Na citrate+Aq.

$+4H_2O$. Efflorescent.

$+5H_2O$. Two modifications.

a. Plates. Sol. in 600 pts. H_2O at 0–7°; solution gradually separates out $MgCO_3+2H_2O$. H_2CO_3+Aq sat. at 3–4 atmos. pressure dissolves 9% at 0–4°. $MgSO_4$+Aq dissolves 1% moist salt at 3 4°, and it is easily sol. in Na_2CO_3, or $NaHCO_3$+Aq. (Norgaard.)

β. Prisms. More efflorescent than *a*. Sol. in 600 pts. H_2O but not in $MgSO_4$, or Na_2CO_3 +Aq. Both forms are decomp. by boiling H_2O. (Norgaard.)

Magnesium hydrogen carbonate,
$MgH_2(CO_3)_2$(?).

Known only in solution.

1 l. H_2CO_3+Aq sat. at 1 atmos. pressure dissolves 23.5 g. $MgCO_3$. (Bineau.)

1 l. carbonic acid water dissolves 0.115 g. magnesite at 18° and 0.75 m. pressure. (Cossa, B. **2.** 697.)

1 pt. $MgCO_3$ dissolves in H_2O saturated with CO_2 at 5° and a pressure of—

	1	2	3	4	5	6 atmospheres
in	161	144	134	106.7	110	76 pts. H_2O

(Merkel, Techn. J. B. **1867.** 213.)

H_2CO_3+Aq sat. at 3–4 atmos. pressure and 0–4° dissolved 9% $MgCO_3+5H_2O$. (Norgaard.)

$MgCO_3+3H_2O$ is sol. in 72.4 pts. H_2CO_3+Aq sat. at 20° and ord. pressure; 30.5 pts. H_2CO_3+Aq sat. at 2 atmos. pressure; 26.0 pts. H_2CO_3+Aq sat. at 3 atmos. pressure; 21.1 pts. H_2CO_3+Aq sat. at 4 atmos. pressure; 17.09 pts. H_2CO_3+Aq sat. at 5 atmos. pressure. (Beckurts, J. B. **1881.** 212.)

1. H_2O sat. with CO_2 at p pressure and t° dissolves g. $MgCO_3$.

p atmos.	t°	g. $MgCO_3$	p mm.	t°	g. $MgCO_3$
1.0	19.5	27.79	751	13.4	28.45
2 1	19.5	33.11	760	19.5	25.79
3.2	19.7	37.3	762	29.3	21.95
4.7	19.0	43.5	764	46	15.7
5.6	19.2	46.2	764	62	10.4
6.2	19.2	48.51	765	70	8.1
7.5	19.5	51.2	765	82	4.9
9.0	18.7	56.59	765	91	2.4
...	....	...	765	100	0.0

(Engel and Ville, C. R. **93.** 34.)

The low figures of other observers are due to their using basic carbonates. By very careful experiments it was found that 1 l. H_2O

sat. with CO_2 at 1 atmos. pressure and t° dissolved the following amts. of $MgCO_3$:

t°	g. $MgCO_3$	t°	g. $MgCO_3$	t°	g. $MgCO_3$
3.5	35.6	18	22.1	40	22.1
12	26.5	30	15.8	50	9.5

(Engel, C. R. **100.** 444.)

1.9540 g. are sol. 1 l. H_2O at 15°. (Treadwell and Reuter, Z. anorg. 1898, **17.** 202.)

$MgH_2(CO_3)_2$ is not stable except in the presence of free CO_2.

At 15° and 760 mm., a solution having the partial pressure of $CO_2=0$, contains 1.9540 g. $MgH_2(CO_3)_2$ and 0.7156 g. $MgCO_3$ per liter. (Treadwell and Reuter, Z. anorg. 1898, **17.** 204.)

Solubility of $MgH_2(CO_3)_2$ in H_2O containing carbonic acid, at 15°.

% carbonic acid in the gas at 0° and 760 mm.	partial pressure mm. Hg	mg. free CO_2	mg. $MgH_2(CO_3)_2$ in 100 cc. of the solution	mg. $MgCO_3$ in 100 cc. of the solution	mg. Mg
18.86	143.3	119.0	1210.5	....	201.6
5.47	41.6	86.6	1210.5	....	201.6
4.45	33.8	223.5	1210.5	....	201.6
1.54	11.7	...	1076.6	77.3	201.6
1.35	10.3	...	762.9	76.5	149.2
1.07	8.2	...	595.2	80.7	122.4
0.62	4.7	..	366.3	70.1	86.5
0.60	4.6	...	341.7	75.8	78.8
0.33	2.5	...	263.2	74.8	65.5
0.21	1.6	...	222.9	77.1	59.4
0.14	1.1	...	216.9	71.0	56.6
0.03	0.3	...	203.6	71.1	54.5
...	...	...	203.3	68.5	53.6
...	...	...	196.0	70.2	52.9
...	...	...	203.6	62.5	52.0
...	...	...	195.4	61.6	51.1
...	...	...	195.4	64.1	51.8

(Treadwell and Reuter, Z. anorg. 1898, **17.** 200.)

No bicarbonate of magnesium is formed under pressures of CO_2 up to five atmospheres at 0°. (Cameron, J. phys. Chem. 1908, **12.** 570.)

A critical analysis and recalculation of results of Engel and others is given by Johnston (J. Am. Chem. Soc. 1915, **37.** 2001.)

Solubility in NaCl+Aq at 23°C. in equilibrium with an atmosphere of CO_2.

g. NaCl per liter	g. $Mg(HCO_3)_2$ per liter
7.0	30.64
56.5	30.18
119.7	27.88
163.9	24.96
224.8	20.78
306.6	10.75

(Cameron and Seidell, J. phys. Chem. 1903, **7.** 582.)

Solubility in Na_2SO_4+Aq at 23° C. in equilibrium with an atmosphere of CO_2.

Strength of Na_2SO_4+Aq	g. $Mg(HCO_3)_2$ in 100 ccm.
0.0	1.463
12%	1.916
saturated	1.612

(Cameron and Seidell.)

Magnesium potassium carbonate, $MgK_2(CO_3)_2+4H_2O$.

Quickly decomp. by cold H_2O. (Deville, A. ch. (3) **33.** 87.)

Ppt. Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73,** 264.)

$MgKH(CO_3)_2+4H_2O$. Insol. in H_2O, but decomp. thereby into an insol. basic Mg carbonate, and $MgH_2(CO_3)_2$ and $KHCO_3$, which dissolve. (Berzelius.)

Magnesium rubidium hydrogen carbonate, $MgRbH(CO_3)_2+4H_2O$.

Decomp. in the air. (Erdmann, A. 1897, **294.** 75.)

Magnesium sodium carbonate, $MgCO_3$, Na_2CO_3.

Quickly decomp. with H_2O. (Deville, A. ch. (3) **33.** 89.)

$+15H_2O$. (Norgaard.)

Magnesium sodium carbonate sodium chloride, $MgCO_3$, Na_2CO_3, NaCl.

Decomp. by H_2O. (de Schulten, C. R. 1896, **122.** 1427.)

Manganous carbonate, $MnCO_3$.

Permanent. Practically insol. in H_2O. Sol. in H_2CO_3+Aq and in acids generally.

1 l. H_2O dissolves 0.065 g. at 25°. (Ageno and Valla, Att. Accad. Linc. 1911, **20,** II. 706.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Min. *Rhodochrosite.*

$+\frac{1}{2}$, or $1H_2O$. Insol. in H_2O. Sol. in acids. Sol. in H_2CO_3+Aq. 1 pt. $MnCO_3$ requires 2000 pts. H_2CO_3+Aq for solution.

(Lassaigne.) Sol. in 7680 pts. H_2O, and 3840 pts. H_2O containing CO_2. (Jahn.) When freshly precipitated is sol. in NH_4 salts+Aq. (Wittstein.) Not more sol. in H_2O containing Na_2CO_3 or K_2CO_3 than in pure H_2O. (Ebelmen.) Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sol. in ferric salts+Aq, with evolution of CO_2 and pptn. of $Fe_2C_6H_6$. (Fuchs.)

Not pptd. in presence of Na citrate. (Spiller.)

Manganous potassium carbonate, $MnK_2(CO_3)_2+4H_2O$.

Ppt. Decomp. by H_2O alone.

Sl. sol. in $Mn(C_2H_3O_2)_2$+Aq or K_2CO_3+Aq. (Reynolds, Chem. Soc. 1898, **73.** 264.)

Manganous carbonate hydroxylamine, $4MnCO_3$, $3NH_3O+2H_2O$.

Ppt. Sol. in acids. (Goldschmidt and Syngros, Z. anorg. **5.** 138.)

Mercurous carbonate, Hg_2CO_3.

Ppt. Decomp. by hot H_2O. Sol. in hot or warm NH_4Cl+Aq, but less easily than mercuric carbonate; less sol. in NH_4NO_3+Aq. (Brett, **1837.**)

Sl. sol. in K_2CO_3+Aq; partially sol. with decomp. in NH_4OH+Aq. (Wittstein.)

Mercuric carbonate, basic, $4HgO$, CO_2.

Can be washed with cold H_2O without decomp. (Millon, A. ch. (3) **19.** 368.)

$3HgO$, CO_2. Insol. in cold H_2O. Sol. in CO_2+Aq; sl. sol. in K_2CO_3+Aq. Easily sol. in NH_4Cl+Aq. (Berzelius.)

Neodymium potassium carbonate, $Nd_2(CO_3)_3$, $K_2CO_3+12H_2O$.

Ppt. Sol. in 30% K_2CO_3+Aq. (Meyer, Z. anorg. 1904, **41.** 105.)

Neodymium sodium carbonate, $2Nd_2(CO_3)_3$, $3Na_2CO_3+22H_2O(?)$.

Ppt. Easily decomp.

Sl. sol. in conc. Na_2CO_3+Aq. (Meyer, Z. anorg. 1904, **41.** 106.)

Nickel carbonate, basic, $3NiO$, CO_2+5H_2O.

Min. *Zaratite.* Easily sol. in HCl+Aq.

Pptd. nickel carbonate is a basic salt of varying composition. Insol. in H_2O or H_2CO_3+Aq. Sol. in acids. Sol. in $(NH_4)_2CO_3$+Aq; very sl. sol. in Na_2CO_3+Aq; sol. in warm NH_4Cl+Aq, and KCN+Aq. (Rose.)

Not pptd. in presence of Na citrate. (Spiller.)

Nickel carbonate, $NiCO_3$.

1 l H_2O dissolves 0.0925 g at 25%. (Ageno and Valla, Att. Accad. Linc. 1911, **20,** II. 706.)

Not attacked by cold conc. HCl, or HNO_3+Aq. (Senarmont, A. ch. (3) **30.** 138.)

$+6H_2O$. Sol. in acids. (Deville, A. ch. (3) **35.** 446.)

See also **Carbonate, nickel, basic.**

Nickel potassium carbonate, $NiCO_3$, K_2CO_3+$4H_2O$.

Ppt. (Deville, A. ch. (3) **33.** 96.)

$NiCO_3$, $KHCO_3+4H_2O$. Decomp. by H_2O, but may be washed by $KHCO_3$+Aq without decomp. (Rose, Pogg. **84.** 566.)

Nickel sodium carbonate, $NiCO_3$, Na_2CO_3+$10H_2O$.

Ppt. (Deville.)

Nickel carbonate hydroxylamine, $2Ni(OH)_2$, $4NiCO_3$, $5NH_2OH+7H_2O$.

Ppt. (Goldschmidt and Syngros, Z. anorg. 1894, **5.** 143.)

$2Ni(OH)_2$, $4NiCO_3$, $6NH_2OH+6H_2O$.

Ppt. (Goldschmidt and Syngros.)

Palladious carbonate, $PdCO_3$, $9PdO$+$10H_2O$.

Insol. in H_2O; partly sol. in NH_4OH+Aq; sl. sol. in Na_2CO_3+Aq; sol. in acids. (Kane, **1842.**)

Potassium carbonate, K_2CO_3.

Deliquescent. Very sol. in H_2O with evolution of heat.

Sol. in 1.05 pts. H_2O at 3°; 0.962 pt. at 6°; 0.900 pt. at 12.6°; 0.747 pt. at 26°; and 0.490 pt. at 70°. (Osann.)

Sol. in 0.92 pt. H_2O. (M. R. and P.)

Sol. in 0.922 pt. H_2O at 15°. (Gerlach.)

Sol. in 1 pt. H_2O. (Abl.)

100 pts. H_2O at 15.5° dissolve 100 pts. K_2CO_3. (Ure's Dict.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2CO_3	t°	Pts. K_2CO_3	t°	Pts. K_2CO_3
0	83.12	40	106.20	80	134.25
10	88.72	50	112.90	90	143.18
20	94.06	60	119.24	100	153.66
30	100.09	70	127.10	135	205.11

(Poggiale, A. ch. (3) **8.** 468.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2CO_3	t°	Pts. K_2CO_3	t°	Pts. K_2CO_3
0	89.4	46	119	91	148
1	94	47	120	92	149
2	97	48	120	93	150
3	100	49	121	94	151
4	102	50	121	95	151
5	104	51	122	96	152
6	105	52	122	97	153
7	106	53	123	98	154
8	107	54	124	99	155
9	108	55	124	100	156
10	109	56	125	101	157
11	109	57	125	102	158
12	109	58	126	103	159
13	110	59	127	104	160
14	110	60	127	105	161
15	110	61	128	106	162
16	111	62	128	107	163
17	111	63	129	108	164
18	111	64	130	109	166
19	111	65	130	110	167
20	112	66	131	111	168
21	112	67	132	112	169
22	112	68	132	113	171
23	112	69	133	114	172
24	112	70	133	115	173
25	113	71	134	116	175
26	113	72	135	117	176
27	113	73	135	118	178
28	113	74	136	119	179
29	114	75	137	120	181
30	114	76	137	121	182
31	114	77	138	122	184
32	114	78	139	123	185
33	115	79	139	124	187
34	115	80	140	125	188
35	115	81	141	126	190
36	115	82	141	127	191
37	116	83	142	128	193
38	116	84	143	129	195
39	116	85	144	130	196
40	117	86	144	131	198
41	117	87	145	132	200
42	117	88	146	133	201
43	118	89	147	134	203
44	118	90	147	135	205
45	119	..	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 97.)

112 g. are sol. in 100 g. H_2O at 20°. (Frankforter, J. Am. Chem. Soc. 1914, **36.** 1106.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
0.489	1.0048	11.748	1.1282
0.979	1.0098	12 727	1 1400
1.958	1.0108	13.706	1 1520
2 934	1.0299	14.685	1 1642
3.916	1.0401	15.664	1 1766
4.895	1.0505	16.643	1 1892
5 874	1 0611	17.622	1 2020
6.853	1 0719	18 601	1.2150
7.832	1.0829	19.580	1.2282
8.811	1.0940	20.539	1.2417
9.790	1.1052	21.538	1 2554
10.769	1.1166	22.517	1 2694

Sp. gr. of K_2CO_3+Aq at 15°—*Continued.*

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
23 496	1.2836	33 286	1.3915
24.475	1.2980	34 265	1.4030
25.454	1 3078	35 244	1.4147
26.432	1.3177	36.223	1.4265
27.412	1 3277	37 202	1.4384
28.391	1.3378	38 181	1.4504
29 360	1.3480	39 160	1.4626
30 349	1.3585	40 139	1 4750
31 328	1.3692	40 504	1.4812
32 807	1.3803	. .	...

(Tünnerman.)

Sp. gr. and boiling-point of K_2CO_3+Aq.

% K_2CO_3	Sp gr.	B.-pt.	% K_2CO_3	Sp. gr.	B.-pt.
4 7	1 06	100 56°	43 3	1 46	109 44°
9 0	1 11	100 56	45 8	1 50	111 11
13 2	1 15	101 11	48 8	1.54	112 78
16 8	1 19	101 11	52 1	1 58	114 44
20.5	1 22	101.66	56 0	1 63	116 11
24 0	1 25	102 22	60 4	1 70	117 78
27 3	1 28	102 78	65 5	1 80	119 44
30 5	1 31	103 33	71 8	1 95	122 22
33 6	1 34	104 44	79 2	2 15	125 56
36 2	1 38	105 56	88 4	2 40	129 44
39 0	1 41	107 22	100 0	2 60	137.78
41 7	1 44	108 33		.	

(Dalton.)

Sp. gr. of K_2CO_3+Aq at 17.5°.

% K_2CO_3	Sp gr.	% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
1	1.009	19	1.182	36	1.368
2	1 018	20	1.192	37	1.380
3	1.027	21	1.203	38	1.392
4	1.036	22	1,213	39	1.404
5	1.045	23	1.224	40	1.416
6	1.054	24	1.235	41	1.429
7	1.064	25	1.245	42	1.441
8	1 073	26	1.256	43	1.453
9	1.082	27	1.267	44	1.466
10	1.092	28	1.278	45	1.478
11	1.102	29	1.289	46	1.489
12	1.112	30	1.300	47	1.503
13	1.122	31	1.312	48	1.516
14	1.132	32	1.323	49	0.529
15	1.141	33	1.334	50	1.542
16	1.151	34	1.345	51	1.555
17	1.161	35	1.357	52	1.569
18	1.172	..	...	..	...

(Hager, Comm. **1883.**)

The sp. gr. increases or diminishes between 8° and 20° by a decrease or increase of temp. of 1° by the following amounts:—

% K_2CO_3	Corr.
40-50	0.0007
30-40	0.0005
20-30	0.0003
10-20	0.0002

(Hager.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
1	1.00914	28	1.27893
2	1.01829	29	1.28999
3	1.02743	30	1.30105
4	1.03658	31	1.31261
5	1.04572	32	1.32417
6	1.05513	33	1.33573
7	1.06354	34	1.34729
8	1.07396	35	1.35885
9	1.08337	36	1.37082
10	1.09278	37	1.38279
11	1.10258	38	1.39476
12	1.11238	39	1.40673
13	1.12219	40	1.41870
14	1.13199	41	1.43104
15	1.14179	42	1.44388
16	1.15200	43	1.44573
17	1.16222	44	1.46807
18	1.17243	45	1.48041
19	1.18265	46	1.49314
20	1.19286	47	1.50588
21	1.20344	48	1.51861
22	1.21402	49	1.53135
23	1.22459	50	1.54408
24	1.23517	51	1.55728
25	1.24575	52	1.57048
26	1.25681	52.024	1.57079
27	1.26787	...	...

(Gerlach, Z. anal. **8.** 279.)

Sp. gr. of K_2CO_3+Aq at 15°.

% K_2CO_3	Sp. gr.	% K_2CO_3	Sp. gr.
5	1.0449	30	1.3002
10	1.0919	40	1.4170
20	1.1920	50	1.5428

(Kohlrausch, W. Ann. **1879.** 1.)

K_2CO_3+Aq containing 10% K_2CO_3 boils at 100.8°

K_2CO_3+Aq containing 20% K_2CO_3 boils at 102.2°

K_2CO_3+Aq containing 30% K_2CO_3 boils at 104.5°

K_2CO_3+Aq containing 40% K_2CO_3 boils at 108.6°

K_2CO_3+Aq containing 50% K_2CO_3 boils at 115.2°

(Gerlach.)

Sat. K_2CO_3+Aq containing 158 pts. K_2CO_3 to 100 pts. H_2O forms a crust at 126°; highest temp. observed 134.9°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of K_2CO_3+Aq containing pts. K_2CO_3 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 459); L = according to Legrand (A. ch. (2) **59.** 438).

B.-pt	G	L
101°	11.5	13
102	22.5	22.5
103	32	31
104	40	38.8
105	47.5	46.1
106	54.5	53.1
107	61	59.6
108	67	65.9
109	73	71.9
110	78.5	77.6
111	83.5	83.0
112	88.5	88.2
113	93.5	93.2
114	98.5	98.0
115	103.5	102.8
116	108.5	107.5
117	113.5	112.3
118	117.5	117.1
119	122.5	122.0
120	127.5	127.0
121	132.5	132.0
122	137.5	137.0
123	142.5	142.0
124	147.5	147.1
125	152.5	152.2
126	158	157.3
127	163.5	162.5
128	169.5	167.7
129	175.5	172.9
130	181.5	178.1
131	187.5	183.4
132	193.5	188.8
133	199.5	194.2
133.3	202.5	....
134	....	199.6
135	....	205.0

When K_2CO_3+Aq is sat. with NH_3, two layers form. When K_2CO_3 is added to NH_4OH+Aq, it dissolves with formation of two layers and evolution of NH_3. The same takes place also when sat. K_2CO_3+Aq and NH_4OH+Aq are brought together. (Girard, Bull. Soc. (2) **43.** 552.)

Solubility of K_2CO_3+$KHCO_3$ in H_2O at 0°.

g. per 100 cc. solution		Sp. gr.
K_2CO_3	$KHCO_3$	
0.0	21.2	1.133
11.8	15.3	1.182
16.7	12.6	1.200
23.8	10.3	1.241
34.0	7.6	1.298
43.0	5.9	1.350
51.6	4.9	1.398
60.5	3.8	1.448
81.4	0.0	1.542

(Engel, A. ch. 1888, (6) **13.** 348.)

Equilibrium between K_2CO_3 and $KHCO_3$ in H_2O and in contact with the air. System: K_2CO_3, $KHCO_3$, and CO_2 at 25° c.

Grams atoms K per liter	Amount of solution used for titration cc.	Amount K combined as K_2CO_3 Per cent	Amount K combined as $KHCO_3$ Per cent
0.393	5 5	77.5	22.5
0.553	2 5	83.9	16.1
1.025	2 2 2	86.8	13.2
1.865	2 2	91.4	8.6
2.820	2 2	89.0	11.0
3.710	2 2	88.6	11.4
4.310	1 1	89.6	10.4
5.695	1 1	88.7	11.3

(Cameron and Briggs, J. phys. Chem. 1901, **5.** 546.)

Solubility of K_2CO_3+Na_2CO_3 in H_2O at 25°.

g. per 100 g. solution		g. per 100 g. H_2O		Solid phase
K_2CO_3	Na_2CO_3	K_2CO_3	Na_2CO_3	
52.82	0	112	0	$K_2CO_3.2H_2O$
52.0	1.0	110 7	2 2	"
50.7	2.6	108.7	5 7	"
49.0	4.6	105.5	10.0	$K_2CO_3.2H_2O$ + Na_2CO_3, $K_2CO_3.12H_2O$
46.5	4.3	94.6	8.8	Na_2CO_3, $K_2CO_3.12H_2O$
46.2	5.2	94.8	10.6	"
41.0	6.3	77.6	11.8	"
37.7	7.0	68 3	12 6	"
31.0	10.5	53.0	17 9	"
29.8	11 3	50.5	19.1	"
25.2	14.1	41.4	23.2	"
22.4	16 6	36.8	27 3	"
19.8	18 7	32.1	30 3	"
19.1	19 7	31.2	32.1	"
15.1	23.2	24 5	37.6	Na_2CO_3, $K_2CO_3.12H_2O$ + $Na_2CO_3.10H_2O$
14.5	22.8	23.1	36.4	$Na_2CO_3.10H_2O$
10.8	22.7	16.2	34.0	"
10.7	22.4	16.0	33.5	"
4.7	21.9	6 4	29.8	"
0	22.71	0	29 37	"

(Osaka, J. Tok. Chem. Soc. 1911, **32.** 870.)

Solubility of K_2CO_3+Na_2CO_3 in H_2O at 24.2°.

In 1000 ccm. H_2O		Solid phase
Na_2CO_3	K_2CO_3	
28.35	.....	Na_2CO_3
354.2	150.03	"
369.7	226.6	"
363.0	243.5	Na_2CO_3, $K_2CO_3.6H_2O$
330.8	282.7	"
273.8	344.9	"
187.2	483.9	"
130.0	921 5	"
137 9	982 6	"
112.3	1074.0	Na_2CO_3, $K_2CO_3.6H_2O$ + Na_2CO_3
95.2	1085.1	"
25.5	1108.6	K_2CO_3
....	1125.7	"

(Kremann and Zitek, M. 1909, **30.** 317.)

Solubility of K_2CO_3+Na_2CO_3 in H_2O at 10°.

In 1000 ccm. H_2O		Solid phase
Na_2CO_3	K_2CO_3	
119.8	.....	Na_2CO_3
176.4	354.1	"
108.	500.1	"
61.19	0052.9	Na_2CO_3, K_2CO_3
....	1084.0	K_2CO_3

(Kremann and Zitek, M. 1909, **30.** 324.)

Solubility of K_2CO_3+KNO_3 in H_2O at 25.2°.

1 l. of the solution contains	
Mol. K_2CO_3	Mol. KNO_3
0.00	3.217
0.59	2.62
1.35	1.97
2.10	1.46
2.70	1.14
3.58	0.79

(Touren, C. R. 1900, **131.** 259.)

Solubility of K_2CO_3+KNO_3 in H_2O at 10°.

In 1000 ccm. H_2O		Solid phrase
KNO_3	K_2CO_3	
208.9	...	KNO_3
26.62	1076.0	KNO_3, K_2CO_3
....	1084.0	K_2CO_3

(Kremann and Zitek, M. 1909, **30.** 325.)

Solubility of K_2CO_3+KNO_3 in H_2O at 24.2°.

In 1000 ccm. H_2O		Solid phase
KNO_3	K_2CO_3	
376.85	....	KNO_3
285.00	130.3	"
161.67	348.4	"
141.80	371.9	"
73.04	688.1	"
38.78	878.3	"
31.11	1112.2	KNO_3, K_2CO_3

(Kremann and Zitek, M. 1909, **30.** 316.)

Solubility of K_2CO_3+KCl in H_2O at 30°.

% K_2CO_3	% KCl	Solid phase
53.27	0	$K_2CO_3.1\frac{1}{2}H_2O$
52.22	1.03	$K_2CO_3.1\frac{1}{2}H_2O$+KCl
51.66	1.07	KCl
* :	:	:
1.64	26.22	KCl
0	28.01	"

* Author gives intermediary data.

(de Waal, Dissert. **1910.**)

Solubility of K_2CO_3+KOH in H_2O at 30°.

% KOH	% K_2CO_3	Solid phase
55.75	0	$KOH.2H_2O$
55.14	2.05	$KOH.2H_2O+K_2CO_3.1\frac{1}{2}H_2O$
53.77	2.50	$K_2CO_3.1\frac{1}{2}H_2O$
* :	:	
0	53.27	$K_2CO_3.1\frac{1}{2}H_2O$

* Author gives intermediary data.

(de Waal, Dissert. **1910.**)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20,** 828.)

Sol. in 9 pts. alcohol of 17° B. Insol. in absolute alcohol.

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol. Not decomp. by 1 pt. HNO_3+6 pts. absolute alcohol. Not decomp. by an alcoholic solution of HCl, oxalic, racemic, tartaric, or glacial acetic acids, but is decomp. by alcoholic solution of citric acid.

Solubility in methyl alcohol. Composition of liquids in equilibrium with solid K_2CO_3 at t°.

t°	Upper layer % K_2CO_3	Upper layer % CH_3OH	Upper layer % H_2O	Lower layer % K_2CO_3	Lower layer % CH_3OH	Lower layer % H_2O
−30	21.7	42.2	36.1	....	....	....
−20	13.8	52.1	34.1	....	....	....
−20	12.4	....	....	44.2	8.2	47.6
0	7.6	66.3	26.1	46.3	6.7	47
0	7.4	....	....	46.6	6.6	46.8
+17	6.2	69.6	24.2	48.3	5.7	46
35	5.0	72.9	22.1	....	4.3	44.7

(de Bruyn, Z. phys. Ch. 1900, **32.** 63 and ff.)

Solubility in ethyl alcohol. Composition of liquids in equilibrium with solid K_2CO_3 at t°.

t°	Upper layer % K_2CO_3	Upper layer % C_2H_5OH	Upper layer % H_2O	Lower layer % K_2CO_3	Lower layer % C_2H_5OH	Lower layer % H_2O
−18	0.03	90.3	9.7	51.2	0.2	48.6
0	0.04	91.9	8.1	51.3	0.2	48.5
+17	0.06	91.5	8.4	52.1	0.2	47.7
35	0.07	90.9	9	53.4	0.2	46.4
50	0.09	91.8	8.1	55.3	0.2	44.5
75	0.12	91.4	8.5	57.9	2.0	40.9

(de Bruyn.)

Solubility in ethyl alcohol+Aq at 25°.

When K_2CO_3 is dissolved in ethyl alcohol+Aq two layers are formed, the compositions of which are as follows:

Upper layer % alcohol	Upper layer % H_2O	Upper layer % K_2CO_3	Lower layer % alcohol	Lower layer % H_2O	Lower layer % K_2CO_3
81.25	18.61	0.14	0.82	55.42	43.76
71.67	27.91	0.42	1.79	61.61	36.60
56.98	41.55	1.47	4.02	65.73	30.25
53.92	44.13	2.05	4.88	66.87	28.25
50.21	47.24	2.55	5.54	67.06	27.41
43.93	52.04	3.92	7.71	67.56	24.74
37.64	56.45	5.90	10.54	67.40	22.06
28.43	61.57	10.00	15.73	66.38	17.90

(Cuno, W. Ann. 1909, (4) **28.** 664.)

Solubility of K_2CO_3 in alcohol+Aq at 30°.

% K_2CO_3	% Alcohol	% H_2O	Solid phase
53.27	0	46.73	$K_2CO_3.1\frac{1}{2}H_2O$
53.09	0.1	46.81	"
....	....	.... *	"
....	....	....	"
....	....	....	"
0.13	90.49	9.38	$K_2CO_3.1\frac{1}{2}H_2O$
....	....	....	"
....	....	....	"
....	....	....	"
0.04	99.92	0.04	$K_2CO_3+K_2CO_3.1\frac{1}{2}H_2O$

* Solution separates into two layers.

(de Waal, Dissert. Leiden, **1910.**)

A full discussion of the solubility of K_2CO_3 in methyl, ethyl, propyl, isopropyl, and allyl alcohols is given by Frankforter and Frary (J. phys. Ch. 1913, **17.** 402), and Frankforter and Temple (J. Am. Chem. Soc. 1915, **37.** 2697).

K_2CO_3 will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of K_2CO_3, acetone and H_2O just become homogeneous at 20°. 100 g. of the solution contain:

g. K_2CO_3	g. H_2O	g. acetone	g. K_2CO_3	g. H_2O	g. acetone
18.84	73.22	7.94	2.43	55.36	42.21
13.32	71.38	15.30	22.29	72.81	4.90
11.83	70.34	17.83	17.86	73.12	9.02
10.13	69.03	20.84	15.81	72.53	11.66
8.24	67.31	24.45	14.39	71.89	13.72
7.22	65.99	26.79	10.29	69.46	20.25
6.04	64.39	29.57	1.91	54.05	44.04
28.87	69.08	2.05	1.76	52.86	45.38
23.94	71.98	4.08	1.60	51.60	46.80
21.52	72.75	5.33	1.29	49.57	49.14
19.60	73.10	7.70	1.08	47.86	51.06
6.46	65.34	28.20	0.94	46.73	52.33
5.91	64.65	29.44	0.75	44.72	54.53
5.60	63.93	30.47	0.66	43.31	56.03
5.04	62.80	32.16	0.60	42.49	56.91
4.50	61.48	34.02	0.54	41.73	57.73
3.80	59.79	36.41	0.50	40.69	58.81
3.18	57.95	38.87	0.46	40.48	60.06
2.73	56.50	40.77	...	...	...

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, **36.** 1121.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **34.** 314.)

Sol. in phenol.

Sol. in 13.5 pts. glycerine of 1.225 sp. gr. (Vogel, N. Repert. **16.** 557.)

100 g. sat. K_2CO_3+sugar+Aq contains 22.44 g. K_2CO_3 and 56 g. sugar at 31.25° (Köhler, Z. Ver. Zuckerind. 1897, **47.** 447.)

$+H_2O$.

$+1\frac{1}{2}H_2O$. Very deliquescent. (Pohl.)

Deliquescent only in very moist air. (Städeler.)

Sol. in H_2O with evolution of heat. (Pohl.)

Sol. at 17.6° with absorption of heat, at 32° with evolution of heat, and at 25° with neither absorption nor evolution of heat. (Berthelot, C. R. **78.** 1722.)

Sat. solution of $K_2CO_3+1\frac{1}{2}H_2O$ in H_2O contains 53.27 g. anhydrous K_2CO_3 in 100 g. solution at 30°. (de Waal, Dissert. **1910.**)

$+2H_2O$. Salt usually given as containing $1\frac{1}{2}H_2O$ contains $2H_2O$. (Gerlach, Z. anal. **26.** 460.)

Sat. solution of $K_2CO_3+2H_2O$ contains 112 g. anhydrous K_2CO_3 in 100 g. H_2O at 25°. (Osaka, J. Tok. Ch. Soc. 1911, **32.** 870.)

$+4H_2O$. Not deliquescent in closed vessels. (Gerlach, *l. c.*)

Potassium hydrogen carbonate, $KHCO_3$.

Not deliquescent.

Sol. in 3.5 pts. H_2O at 15°. (Redwood.) Sol. in 4 pts. H_2O at moderate temperatures. (Bergmann.) Sol. in 0.8333 pt. boiling H_2O (Pelletier); in 4 pts. cold, and 1.2 pts. boiling H_2O (M. R. and P.'s Pharm.). Sol. in 4 pts. H_2O at 18.75°. (Abl.) 100 pts. H_2O at 15.5° dissolve 30 pts. and at 100°, 83 pts. (Ure's Dict.)

100 pts. H_2O at 10–11.2° dissolve 26.1 pts. $KHCO_3$, and the sp. gr. of solution is 1.1536. (Anthon. Dingl. **161.** 216.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°	
19.61	23.23	26.91	30.57	pts. $KHCO_3$,
40°	50°	60°	70°	
34.15	37.92	41.35	45.24	pts. $KHCO_3$.

(Poggiale, A. ch. (3) **8.** 468.)

100 pts. H_2O dissolve pts. $KHCO_3$ at t°.

t°	Pts. $KHCO_3$	t°	Pts. $KHCO_3$
0	22.4	40	45.2
20	33.2	60	46.4

(Dibbits, J. pr. (2) **10.** 417.)

Sp. gr. of $KHCO_3$+Aq at 15° containing 5% $KHCO_3$ = 1.0328; containing 10% $KHCO_3$ = 1.0674. (Kohlrausch, Z. anal. **28.** 472.)

Sol. in 1200 pts. boiling alcohol. (Berthollet.) Insol. in alcohol. (Dumas.)

100 pts. H_2O dissolve 19.3 pts. $KHCO_3$ and 8.3 pts. $NaHCO_3$ if the sat. solution of latter is sat. with former; and 26.1 pts. $KHCO_3$ and 6.0 pts. $NaHCO_3$, if the sat. solution of the former is sat. with the latter, all at 10°. (Mulder, J. B. **1866.** 67.)

Insol. in sat. K_2CO_3+Aq. (Engel, C. R. **102.** 365.)

Solubility of $KHCO_3+KNO_3$ in H_2O in an atmosphere of CO_2.

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol. $KHCO_3$	Mol. KNO_3	Mol. $KHCO_3$	Mol. KNO_3
0.00	2.33	0.00	3.28
0.39	2.17	0.89	2.84
0.76	2.03	1.33	2.65
1.16	1.92	1.91	2.45
1.55	1.81	...	....

This case is complicated by the fact that KNO_3 is more sol. in H_2O sat. with CO_2 than in pure H_2O.

(Touren, C. R. 1900, **131.** 261.)

Insol. in benzonitrile (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate (Naumann, B. 1910, **43.** 314.)

Potassium praseodymium carbonate, K_2CO_3, $Pr_2(CO_3)_3+12H_2O$.

Ppt. Sol. in 50% K_2CO_3+Aq. (Meyer, Z. anorg. 1904, **41.** 104.)

Potassium samarium carbonate, K_2CO_3, $Sm_2(CO_3)_3+12H_2O$.

(Cleve.)

Potassium silver carbonate, $KAgCO_3$.

Decomp. by H_2O. (de Schulten, C R. **105.** 811.)

Ppt. Decomp. by H_2O. (Reynolds, Chem. Soc. 1898, **73.** 265.)

Potassium sodium carbonate, $KNaCO_3+6H_2O$.

Slightly efflorescent. Sol. in 0.75 pt. H_2O at 12.5°; in 0.54 pt. H_2O at 15°.

Sat. solution at 15° has sp. gr. = 1.366. (Stolba, J. pr. **94.** 406.)

Decomp. by recrystallizing from H_2O, but crystallizes undecomposed from sat. K_2CO_3+Aq.

Sol. in H_2O. (Osaka, C. A. **1911.** 2601.)

See $K_2CO_3+Na_2CO_3$ under Na_2CO_3.

$+3H_2O$. (Kremann and Zitek, M. 1909. **30.** 317.) Does not exist. (Osaka.)

K_2CO_3, $2Na_2CO_3+18H_2O$. Sl. efflorescent. Very sol. in H_2O. (Marignac.)

Potassium stannous carbonate, K_2CO_3, $2SnCO_3+2H_2O$.

Decomp. by H_2O. (Deville.)

Potassium uranyl carbonate, $2K_2CO_3$, $(UO_2)CO_3$.

Sol. without decomp. in 13.5 pts. H_2O at 15°, and in somewhat less warm H_2O. Sol. in boiling H_2O with decomp.

More sol in K_2CO_3, or $KHCO_3$+Aq than in H_2O. (Rose.)

Insol. in alcohol. (Ebelmen, A. ch. (3) **5.** 189.)

Potassium zinc carbonate, $4K_2O$, $6ZnO$, $11CO_2+8H_2O$.

Can be washed with cold H_2O without decomp. (Deville, A. ch. (3) **33.** 99.)

Praseodymium carbonate, $Pr_2(CO_3)_3+8H_2O$.

Sol. in H_2O. (von Schule, Z. anorg. 1898, **18.** 362.)

Praseodymium sodium carbonate, $2Pr_2(CO_3)_3$, $3Na_2CO_3+22H_2O$(?).

Ppt. Easily decomp. (Meyer, Z. anorg. 1904, **41. 105.**)

Radium carbonate.

Less sol. in H_2O than corresponding Ba comp. (Curie, Dissert. **1903.**)

Rubidium carbonate, Rb_2CO_3.

Very deliquescent, and sol. in H_2O. 100 pts. absolute alcohol dissolve 0.74 pt. Rb_2CO_3. (Bunsen.)

Rubidium hydrogen carbonate, $RbHCO_3$.

Not deliquescent. Easily sol. in H_2O. (Bunsen.)

Samarium carbonate, $Sm_2(CO_3)_3+3H_2O$.

Insol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 168.)

Samarium sodium carbonate, $Sm_2(CO_3)_3$, $Na_2CO_3+16H_2O$.

Ppt. (Cleve.)

Scandium carbonate, $Sc_2(CO_3)_3+12H_2O$.

(Crookes, Roy. Soc. Proc. 1908, **80,** A. 518.)

Scandium sodium carbonate, $Sc_2(CO_3)_3$, $4Na_2CO_3+6H_2O$.

Difficultly sol. in H_2O.

Sol. in cold, less sol. in hot alkali carbonates +Aq. (R. Meyer, Z. anorg. 1910, **67.** 410.)

Silver carbonate, Ag_2CO_3.

Somewhat sol. in H_2O. Sol. in 31,978 pts. H_2O at 15°. (Kremers, Pogg. **85.** 248.) 1 g. Ag_2CO_3 dissolves in 2 l. boiling H_2O. (Joulin, A. ch. (4) **30.** 260.)

Solubility in H_2O at 25° = 1.16 x 10^{-4} mol./l. (Spencer and Le Pla, Z. anorg. 1910, **65.** 14.)

1 l. H_2O at 25° dissolves 1.2 x 10^{-4} gram atoms of silver. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

Insol. in H_2CO_3+Aq. (Bergman.) Sol. in 961 pts. H_2CO_3+Aq. (Lassaigne.) 1 l. sat. H_2CO_3+Aq dissolves 0.846 g. Ag_2CO_3 at 15°. (Johnson, C. N. **54.** 75.)

Sol. in $(NH_4)_2CO_3$+Aq or NH_4OH+Aq; sl. sol. in K_2CO_3+Aq. (Wittstein.) Easily sol. in $Na_2S_2O_3$+Aq. (Herschel, **1819.**) Sol. in hot NH_4Cl+Aq, and sl. sol. in NH_4NO_3+Aq. (Brett, **1837.**) Not pptd. in presence of Na citrate. (Spiller.) Decomp. by HCl+Aq, and chlorides+Aq.

Somewhat sol. in conc. $NaNO_3$+Aq. (de Coninck, Belg. Acad. Bull. **1909,** 333.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol.

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Silver carbonate ammonia.

Easily sol. in H_2O. Sol. in NH_4OH+Aq, from which it is precipitated by absolute alcohol. (Berzelius.)

Ag_2CO_3, $4NH_3$. Ppt. Insol. in alcohol. (Keen, C. N. **31.** 231.)

Sodium carbonate, Na_2CO_3.

Anhydrous. Sol. in H_2O with evolution of heat.

Sol. in 5.967 pts. H_2O at 15°. (Fresenius.) 100 pts. H_2O at 14.6° dissolve 7.74 pts. Na_2CO_3, or 20.64 pts. Na_2CO_3 $10H_2O$ is sol. in rather less than 1 pt. boiling H_2O (Thomson, 1831.)

Sol. in 2 pts. H_2O. (Bergman.)

Sol. in 2 pts. H_2O at 18.75°. (Abl.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2CO_3	Pts. Na_2CO_3 $+10H_2O$	t°	Pts. Na_2CO_3	Pts. Na_2CO_3 $+10H_2O$
0	7.08	21.52	25	35.90	171.33
10	16.66	61.98	30	35.90	241.57
20	30.83	123.12	104.6	48.50	420.68

(Poggiale, A. ch. (3) **8.** 468.)

Possesses four different degrees of solubility, according to different states of molecular constitution and degrees of hydration. (Löwel, A. ch. (3) **44.** 330.)

Little more sol. at 34–38° than at 104°, but maximum of solubility is probably at 15°. (Löwel.)

Solubility of Na_2CO_3, $Na_2CO_3+10H_2O$, $Na_2CO_3+7H_2O$ (*a*), and $Na_2CO_3+7H_2O$ (*b*) in H_2O.

t°	Sat. solution of $Na_2CO_3+10H_2O$ contains—		Sat. solution of $Na_2CO_3+7H_2O$ (*b*) contains—			Sat. solution of $Na_2CO_3+7H_2O$ (*a*) contains—		
	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+7H_2O$ (*b*) in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O	Pts. Na_2CO_3 in 100 pts. H_2O	Pts. $Na_2CO_3+7H_2O$ (*a*) in 100 pts. H_2O	Pts. $Na_2CO_3+10H_2O$ in 100 pts. H_2O
0	6.97	21.33	20.39	58.93	84.28	31.93	112.94	188.37
10	12.06	40.94	26.33	83.94	128.57	37.85	150.77	286.13
15	16.20	63.20	29.58	100.00	160.51	41.55	179.90	381.29
20	21.71	92.82	38.55	122.25	210.58	45.79	220.20	556.71
25	28.50	149.13	38.07	152.36	290.91	...	...	...
30	37.24	273.64	43.45	196.93	447.93	...	...	...
38	51.67	1142.17	...	...	...	...	...	...
104	45.47	539.63	...	...	...	...	...	...

(Löwel, A. ch. (3) **33.** 382.)

100 pts. H_2O at 14° dissolve 60.4 pts. $Na_2CO_3+10H_2O$; at 36°, 833 pts.; at 104°, 445 pts. Solubility increases to 36°, then diminishes. (Payen, A. ch. (3) **43.** 233.)

There are apparently two maxima of solubility; the one occurring at 15°, or even lower, as warm solutions cool; the other at 34–38°, when cold solutions are warmed. (Payen, A. ch. (3) **44.** 330.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3
0	7.1	22	23.8	43	46.2
1	7.5	23	25.1	44	46.2
2	7.8	24	26.5	45	46.2
3	8.4	25	28.0	46	46.2
4	8.9	26	29.7	47	46.2
5	9.5	27	31.6	48	46.2
6	10.0	28	33.6	49	46.2
7	10.6	29	35.8	50	46.2
8	11.2	30	38.1	51	46.2
9	11.9	31	41.4	52	46.2
10	12.6	32	46.2	53	46.2
11	13.3	32.5	59.0	54	46.2
12	14.0	33	46.2	55	46.2
13	14.8	34	46.2	56	46.2
14	15.6	35	46.2	57	46.2
15	16.5	36	46.2	58	46.2
16	17.4	37	46.2	59	46.2
17	18.3	38	46.2	60	46.2
18	19.3	39	46.2	61	46.2
19	20.3	40	46.2	62	46.2
20	21.4	41	46.2	63	46.2
21	22.6	42	46.2	64	46.2

Solubility in 100 pts. H_2O at t°—*Continued*

t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3	t°	Pts. Na_2CO_3
65	46.2	79	46.2	93	45.6
66	46.2	80	46.1	94	45.6
67	46.2	81	46.1	95	45.6
68	46.2	82	46.1	96	45.6
69	46.2	83	46.0	97	45.5
70	46.2	84	46.0	98	45.5
71	46.2	85	45.9	99	45.5
72	46.2	86	45.9	100	45.4
73	46.2	87	45.8	101	45.4
74	46.2	88	45.8	102	45.3
75	46.2	89	45.8	103	45.3
76	46.2	90	45.7	104	45.2
77	46.2	91	45.7	105	45.1
78	46.2	92	45.7	...	....

(Mulder, Scheik. Verhandel. **1864.** 129.)

Liable to form supersaturated solutions.

Supersat. Na_2CO_3+Aq (2 pts. Na_2CO_3, $10H_2O$: 1 pt. H_2O) may be kept in a flask closed with cotton wool. (Schröder.)

When supersat. Na_2CO_3+Aq is exposed to low temperatures, the $10H_2O$ salt crystallizes out; but under other circumstances two other salts are formed, each containing $7H_2O$; one is four times as sol. at 10° as the $10H_2O$ salt, and the other twice as sol. See above. (Löwel, A. ch. (3) **33.** 337.)

See also $Na_2CO_3+H_2O$, $7H_2O$, and $10H_2O$.

Sp. gr. of Na_2CO_3+Aq at 15°.

% Na_2CO_3	Sp. gr.	% Na_2CO_3	Sp. gr.
0.372	1.0040	7.812	1.0892
0.744	1.0081	8.184	1.0937
1.116	1.0121	8.556	1.0982
1.488	1.0163	8.928	1.1028
1.850	1.0204	9.300	1.1074
2.232	1.0245	9.672	1.1120
2.504	1.0286	10.044	1.1167
2.976	1.0327	10.416	1.1214
3.348	1.0368	10.788	1.1261
3.720	1.0410	11.160	1.1308
4.090	1.0452	11.532	1.1356
4.464	1.0494	11.904	1.1404
4.836	1.0537	12.276	1.1452
5.208	1.0576	12.648	1.1500
5.580	1.0625	13.020	1.1549
5.972	1.0669	13.392	1.1598
6.324	1.0713	13.764	1.1648
6.396	1.0757	14.136	1.1698
6.768	1.0802	14.508	1.1748
7.440	1.0847	14.880	1.1816

(Tünnerman.)

Sp. gr. of Na_2CO_3+Aq at 15°.

%	Sp. gr. if % is Na_2CO_3	Sp. gr. if % is $Na_2CO_3+10H_2O$
1	1.0105	1.004
2	1.0210	1.008
3	1.0315	1.012
4	1.0420	1.016
5	1.0525	1.020
6	1.0631	1.023
7	1.0737	1.027
8	1.0843	1.031
9	1.0950	1.035
10	1.1057	1.039
11	1.1165	1.043
12	1.1274	1.047
13	1.1384	1.050
14	1.1495	1.054
15	....	1.058
16	....	1.062
17	....	1.066
18	....	1.070
19	....	1.074
20	....	1.078
21	....	1.082
22	....	1.086
23	....	1.090
24	....	1.094
25	....	1.099
26	....	1.103
27	....	1.106
28	....	1.110
29	....	1.114
30	....	1.119
31	....	1.123
32	....	1.126
33	....	1.130
34	....	1.135
35	....	1.139
36	....	1.143
37	....	1.147
38	....	1.150

(Gerlach, Z. anal. **8**. 279.)

Sp. gr. of Na_2CO_3+Aq at 17.5°.

% Na_2CO_3	% $Na_2CO_3+10H_2O$	Sp. gr.	% Na_2CO_3	% $Na_2CO_3+10H_2O$	Sp. gr.
1	2.70	1.010	9	24.30	1.095
2	5.40	1.020	10	27.00	1.105
3	8.10	1.031	11	29.70	1.116
4	10.18	1.041	12	32.40	1.127
5	13.50	1.052	13	35.10	1.137
6	16.20	1.063	14	37.80	1.148
7	18.90	1.073	15	40.50	1.157
8	21.60	1.084	..	...	...

(Hager.)

Sp. gr. of Na_2CO_3+Aq increases or diminishes by a change of temperature of 1° by the following amounts—

Corr.	% Na_2CO_3
0.0004	13–15
0.00033	8–12
0.00026	3–7

(Hager, Comm. **1883**.)

Sp. gr. of conc. Na_2CO_3+Aq at 30°.

Sp. gr.	% Na_2CO_3	g. Na_2CO_3 in 1 l.	Sp. gr.	% Na_2CO_3	g. Na_2CO_3 in 1 l.
1.310	28.13	368.5	1.220	20.47	249.7
1.300	27.30	354.9	1.210	19.61	237.3
1.290	26.46	341.3	1.200	18.76	225.1
1.280	25.62	327.9	1.190	17.90	214.0
1.270	24.78	314.7	1.180	17.04	201.1
1.260	23.93	301.5	1.170	16.18	189.3
1.250	23.08	288.5	1.160	15.32	177.7
1.240	22.21	275.4	1.150	14.47	166.4
1.230	21.33	262.3	1.140	13.62	155.3

(Lunge, Chem. Ind. **1882**. 320.)

Sp. gr. of Na_2CO_3+Aq at 23°.

% $Na_2CO_3+10H_2O$	% Na_2CO_3	Sp. gr.	% $Na_2CO_3+10H_2O$	% Na_2CO_3	Sp. gr.
1	0.370	1.0038	16	5.929	1.0628
2	0.741	1.0076	17	6.299	1.0668
3	1.112	1.0114	18	6.670	1.0708
4	1.482	1.0153	19	7.041	1.0748
5	1.853	1.0192	20	7.412	1.0789
6	2.223	1.0231	21	7.782	1.0836
7	2.594	1.0271	22	8.153	1.0871
8	2.965	1.0309	23	8.523	1.0912
9	3.335	1.0348	24	8.894	1.0953
10	3.706	1.0388	25	9.264	1.0994
11	4.076	1.0428	26	9.635	1.1035
12	4.447	1.0468	27	10.005	1.1076
13	4.817	1.0508	28	10.376	1.1117
14	5.188	1.0548	29	10.746	1.1158
15	5.558	1.0588	30	11.118	1.1200

Sp. gr. of NA_2CO_3+Aq at 23°—*Continued.*

% $Na_2CO_3+10H_2O$	% Na_2CO_3	Sp. gr.	% $Na_2CO_3+10H_2O$	% Na_2CO_3	Sp. gr.
31	11.488	1.1242	41	15.195	1.1662
32	11.859	1.1284	42	15.556	1.1704
33	12.230	1.1326	43	15.936	1.1746
34	12.600	1.1368	44	16.307	1.1788
35	12.971	1.1410	45	16.677	1.1830
36	13.341	1.1452	46	17.048	1.1873
37	13.712	1.1494	47	17.418	1.1916
38	14.082	1.1536	48	17.789	1.1959
39	14.530	1.1578	49	18.159	1.2002
40	14.824	1.1620	50	18.530	1.2045

(Schiff, A. **113.** 186.)

Sp. gr. of Na_2CO_3+Aq at 23.3°. a = number of grms. × ½ mol. wt., dissolved in 1000 grms. H_2O; b = sp. gr. if $a = Na_2CO_3, 10H_2O$ (½ mol. wt. = 143); c = sp. gr. if $a = Na_2CO_3$ (½ mol. wt. = 53).

a	b	c	a	b	c
1	1.048	1.052	5	1.163	1.226
2	1.086	1.100	6	1.182	...
3	1.117	1.145	7	1.198	...
4	1.142	1.187	..	...	...

(Favre and Valson, C. R. **79.** 968).

Sp. gr. of Na_2CO_3+Aq at 18°.

% Na_2CO_3	Sp. gr.	% Na_2CO_3	Sp. gr.
5	1.0511	15	1.1590
10	1.1044	..	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of Na_2CO_3+Aq.

g.-equivalents Na_2CO_3 per l.	t°	Sp. gr. t°/t°.
0.002524	16.004	1.0001418
0.005041	16.026	1.0002844
0.01006	16.049	1.000568
0.02501	16.028	1.001413
0.04954	16.050	1.002789
0.10188	16.030	1.005699
0.24646	16.041	1.013598
0.002628	16.051	1.0001473
0.003948	16.088	1.0002216
0.009182	16.081	1.0005181
0.01830	16.089	1.001033
0.10842	16.042	1.006048
0.21570	16.055	1.011910
0.4297	15.14	1.02346
2.5015	16.05	1.12533

(Kohlrausch, W. Ann. 1894, **53.** 26.)

Sp. gr. of Na_2CO_3+Aq at t°. H_2O at 4° = 1.

t°	% Na_2CO_3	Sp. gr.
60°	28.74	1.2971
	25.20	1.2546
	22.25	1.2191
	18.23	1.1746
	14.06	1.1277
80°	28.59	1.2807
	18.26	1.1607

(Wegscheider, M. 1905, **26.** 690.)

Sp. gr. of dil Na_2CO_3+Aq at 20.004°.
Conc. = g. equiv. Na_2CO_3 per l. at 20.004° and 730 mm.
Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,005,6
0.0002	1.000,011,2
0.0004	1.000,022,5
0.0005	1.000,028,1
0.0010	1.000,056,3
0.0020	1.000,112,7
0.0040	1.000,225,8
0.0050	1.000,282,4
0.0100	1.000,564,8

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1685.)

Na_2CO_3+Aq containing 5% Na_2CO_3 boils at 100.5°; 10% Na_2CO_3, at 101.1°; 15% Na_2CO_3, at 101.8°. (Gerlach.)

Sat. solution boils at 104.4° (Griffiths, **1825**); 106° (Kremers); 104°. (Payen.)

Sat. solution forms a crust at 104.1°, and contains 42.2 pts. Na_2CO_3 to 100 pts. H_2O; highest temperature observed, 105°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of Na_2CO_3+Aq containing pts. Na_2CO_3 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 458); L = according to Legrand (A. ch. (2) **59.** 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	5.2	7.5	103.5°	36.2	41.0
101.0	10.4	14.4	104.0	41.2	44.7
101.5	15.6	20.8	104.5	46.2	47.9
102.0	20.8	26.7	104.63	....	48.5
102.5	26.0	32.0	105.0	51.2	....
103.0	31.1	36.8	....	....	....

Less sol. in dil. NH_4OH+Aq than in H_2O. (Fresenius.)

See also under **Ammonia.**

Solubility of $Na_2CO_3+NH_4Cl$. See under **Ammonium Chloride.**

Solubility of $Na_2CO_3+K_2CO_3$. See under **Carbonate, potassium.**

The reciprocal solubility of sodium carbonate and sodium hydrogen carbonate in H_2O has been determined. (de Paepe, C. A. **1911,** 2603, and **1912,** 2723.)

Solubility of $Na_2CO_3+NaHCO_3$ in H_2O at 25°.

g. per 100 g. H_2O		Solid phase
$NaHCO_3$	Na_2CO_3	
0	28.3	$Na_2CO_3.10H_2O$
2.1	27.3	"
4.2	26.5	$Na_2CO_3.10H_2O+NaHCO_3$
5.7	19.2	$NaHCO_3$
7.3	12.4	"
9.0	6.2	"
10.1	1.0	"

(de Paepe, Bull. Soc. Chim. Belg. 1911, **25.** 174.)

Solubility of $Na_2CO_3+NaHCO_3$ in H_2O at 25°.

g. per l.		Solid phase
$NaHCO_3$	Na_2CO_3	
98.7	0.0	$NaHCO_3$
50.8	216.6	$NaHCO_3+Na_2CO_3,NaHCO_3.2H_2O$
27.6	276.3	$Na_2CO_3,NaHCO_3.2H_2O+Na_2CO_3.10H_2O$
0.0	276.4	$Na_2CO_3.10H_2O$

(McCoy and Test, J. Am. Chem. Soc. 1911, **33.** 474.)

Equilibrium between Na_2CO_3, $NaHCO_3$ and CO_2. See under **Carbonate, sodium hydrogen.**

Solubility of $NaNO_3$ in Na_2CO_3+Aq at 10°.

In 1000 ccm. H_2O		Solid phase
$NaNO_3$	Na_2CO_3	
805.0	...	$NaNO_3$
704.8	87.5	$NaNO_3$, Na_2CO_3
...	119.8	Na_2CO_3

(Kremann, M. 1909, **30.** 325.)

Solubility of $NaNO_3$ in Na_2CO_3+Aq at 24.2°.

In 1000 ccm. H_2O		Solid phase
$NaNO_3$	Na_2CO_3	
913.58	....	$NaNO_3$
844.50	59.61	"
627.75	217.85	$NaNO_3+Na_2CO_3.7H_2O$
544.3	246.30	......
459.6	263.30	$Na_2CO_3.7H_2O$
		$Na_2CO_3.10H_2O$
....	28.55	$Na_2CO_3.10H_2O$

(Kremann.)

Solubility of Na_2CO_3+NaBr in H_2O at 30°.

% Na_2CO_3	% NaBr	Solid phase
27.98	0	$Na_2CO_3.10H_2O$
27.54	2.41	"
26.72	4.06	"
26.23	6.26	$Na_2CO_3.10H_2O+Na_2CO_3.7H_2O$
23.40	11.00	$Na_2CO_3.7H_2O$
22.68	12.22	"
19.86	16.88	"
19.57	16.95	$Na_2CO_3.7H_2O+Na_2CO_3.H_2O$
18.11	19.32	$Na_2CO_3.H_2O$
8.45	35.39	"
6.90	36.13	"
3.04	44.75	"
2.99	45.31	$NaBr.2H_2O+Na_2CO_3.H_2O$
2.60	45.68	$NaBr.2H_2O$
0	49.40	"

(Cocheret, Dissert. **1911.**)

Solubility in NaCl+Aq. 100 pts. H_2O dissolve pts. NaCl and pts. $Na_2CO+10H_2O$, when that salt is in excess at 15°.

Pts. NaCl	Pts. Na_2CO_3 $+10H_2O$	Pts. NaCl	Pts. Na_2CO_3 $+10H_2O$
0.00	61.42	23.70	39.06
4.03	53.86	27.93	39.73
8.02	48.00	31.65	41.44
12.02	43.78	35.46	43.77
16.05	40.96	sat.	
19.82	39.46	37.27	45.32

Solubility of anhydrous Na_2CO_3 in 100 pts. NaCl+Aq containing % NaCl at 15°.

% NaCl	Pts. Na_2CO_3	% NaCl	Pts. Na_2CO_3
0	16.408	12	10.488
1	15.717	13	10.244
2	15.060	14	10.041
3	14.438	15	9.880
4	13.851	16	9.762
5	13.299	17	9.686
6	12.783	18	9.655
7	12.305	19	9.667
8	11.864	20	9.725
9	11.461	21	9.828
10	11.097	22	9.997
11	10.773	..	....

(Reich, W. A. B. **99, 2b.** 433.)

Solubility of Na_2CO_3+NaCl in H_2O at 30°.

% Na_2CO_3	% NaCl	Solid phase
27.98	0	$Na_2CO_3.10H_2O$
27.48	0.9	"
27.12	3.33	"
26.82	4.15	$Na_2CO_3.10H_2O+Na_2CO_3.7H_2O$
25.59	5.17	$Na_2CO_3.7H_2O$
24.26	5.93	"

Solubility of Na_2CO_3+NaCl in H_2O at 30°—*Continued.*

% Na_2CO_3	% NaCl	Solid phase
22.75	10.24	$Na_2CO.7H_2O+Na_2CO_3.H_2O$
20.72	11.49	$Na_2CO_3.H_2O$
18.00	14.12	$NaCl+Na_2CO_3.H_2O$
14.81	16.26	NaCl
9.71	18.76	"
5.05	21.94	"
0	26.47	"

(Cocheret, Dissert. **1911.**)

Solubility of Na_2CO_3+NaI in H_2O at 30°.

% Na_2CO_3	% NaI	Solid phase
27.4	0	$Na_2CO_3.10H_2O$
26.5	2.4	"
25.5	4.7	"
25.2	5.2	"
24.4	8.6	"
24.3	9.5	$Na_2CO_3.10H_2O+Na_2CO_3.7H_2O$
23.0	11.2	$Na_2CO_3.7H_2O$
20.8	14.0	"
20.0	15.7	"
18.7	18.4	"
15.3	25.4	$Na_2CO_3.7H_2O+Na_2CO_3.H_2O$
13.1	29.1	$Na_2CO_3.H_2O$
10.4	33.3	"
6.4	40.4	"
4.2	46.0	"
3.1	49.5	"
2.7	51.0	"
1.5	54.6	"
0.9	57.6	"
0.6	61.2	"
0.3	65.6	$NaI.2H_2O+Na_2CO_3.H_2O$
0.0	65.5	$NaI.2H_2O$

(Cocheret, Dissert. **1911.**)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol. (Fresenius.)

Sl. sol. in absolute alcohol; apparently insol. in an alcoholic solution of soap. (Duffy, Chem. Soc. **5.** 305.)

Solubility of Na_2CO_3 in ethyl alcohol at 20°.

Alcohol, wt. per cent	g. Na_2CO_3 per 100 g. solution
44	1.7
46	1.13
48	0.9
50	0.84
54	0.80

(Linebarger, A. Ch. J. 1892, **14.** 380.)

Solubility of Na_2CO_3 in alcohol+H_2O at 30°.

% Na_2CO_3	% alcohol	Solid phase
27.4	0	$Na_2CO_3.10H_2O$
26.61	2.64	"
26.14*	3.41*	"
1.38	44.81	"
0.62	52.99	"
0.61	53.26	"
0.53	55.70	$Na_2CO_3.10H_2O+Na_2CO_3.7H_2O$
0.51	56.56	$Na_2CO_3.7H_2O$
0.47	62.61	"
0.40	63.20	"
0.15	72.80	"
0.11	73.06	$Na_2CO_3.7H_2O+Na_2CO_3.H_2O$
0.07	78.19	$Na_2CO_3.H_2O$
0.07	82.26	"
0.06	86.76	"
0.06	90.95	"
0.04	93.09	"
0.03	95.06	$Na_2CO_3.H_2O+Na_2CO_3$
...	95.65	Na_2CO_3
...	98.46	"

* Conjugated liquid phases.

(Cocheret, Dissert. **1911.**)

See also under $Na_2CO_3+H_2O$, $+7H_2O$ and $+10H_2O$.

Not decomp. by 1 pt. H_2SO_4+6 pts. absolute alcohol.

Not decomp. by alcoholic solutions of racemic, tartaric, or glacial acetic acids; slowly decomp. by HNO_3+absolute alcohol.

Solubility of Na_2CO_3+NaBr, NaCl and NaI in alcohol. Numerical data given by Cocheret (Dissert. **1911**), reported in Tables annuelles internationales des Constants, etc. for 1911.

Solubility of Na_2CO_3 in propyl alcohol at 20°.

Alcohol, wt. per cent	g. Na_2CO_3 per 100 g solution
28	4.4
38	2.7
44	1.7
46	1.5
48	1 3
50	1.2
54	0.9
62	0.4

(Linebarger, A. Ch. J. 1892, **14.** 380.)

A full discussion of the solubility of Na_2CO_3 in propyl, and allyl alcohol is given by Frankforter and Temple (J. Am. Ch. Soc. 1915, **37.** 2697).

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Solubility in mixtures of pyridine and H_2O from —65° to +200°. Solubility curves are given. (Limbosch, Chem. Soc. 1909, **96** (2), 472.)

Insol. in acetone and in methylal. (Lidmann, C. C. **1899**, II. 1014.)

100 g. glycerine (sp. gr. = 1.262) dissolve 98.3 g. Na_2CO_3 at 15–16°. (Ossendowski, Pharm. J. 1907, **79**. 575.)

100 g. sat. solution in glycol contain 3.28–3.4 g. Na_2CO_3. (de Coninck, Bull. Soc. Belg. 1907, **21**. 141.)

100 g. sat. Na_2CO_3+sugar+Aq contain 6.89 g. Na_2CO_3+64.73 g. sugar at 31.25°. (Kohler, Z. Ver. Zuckerind. 1897, **47**. 447.)

$+H_2O$. Takes up H_2O from the air. Less sol. in H_2O at 104° than at 38°; at 15–20°, 100 pts. H_2O dissolve 52.4 pts. of this salt, calculated as Na_2CO_3. Insol. in alcohol. (Löwel.)

Solubility in 100 pts. H_2O at t°.

Corrected t°. (Hydrogen scale)	Pts. anhydrous salt
29.86	50.53
29.89	50.75
31.80	50.31
35.17	49.63
35.37	49.67
35.66	49.37
35.86	49.44
36.45	49.36
36.90	49.29
37.91	49.11
38.92	49.09
40.94	48.51
40.93	48.52
43.94	47.98

(Wells and McAdam, J. Am. Chem. Soc. 1907, **29**. 726.)

Solubility in alcohol+Aq.

Composition of the alcohol and water layers in contact with the solid phase $Na_2CO_3+H_2O$.

t°	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
68	55.8	0.9	43.3	2.3	28.8	68.9
49	61.0	0.4	38.6	1.2	31.5	67.3
40	61.0	0.4	38.6	1.2	31.9	66.9
36	62.0	0.3	37.7	1.1	32.1	66.8
35	62.9	0.3	36.8	1.0	32.4	66.6

(Ketner, Z. phys. Ch. 1902, **39**. 651.)

$+3H_2O$. (Schickendantz, A. **155**. 359.)

$+5H_2O$. (Persoz, Pogg. **32**. 303.)

Not efflorescent. Sol. in H_2O.

$+6H_2O$. (Mitscherlich, Pogg. **8**. 441.)

$+7H_2O$. Efflorescent. Two salts, $7H_2O$ (*b*) (= + $8H_2O$ of Thomson), and $7H_2O$ (*a*). *See also* under Na_2CO_3.

Solubility in 100 pts. H_2O at t°.

Corrected t°. (Hydrogen scale)	Pts. anhydrous salt
30.35	43.50
31.82	45.16
32.86	46.28
34.37	48.22
34.76	48.98
35.15	49.23
35.17	49.34
35.62	50.08

(Wells and McAdam, J. Am. Chem. Soc. 1907, **29**. 726.)

Composition of the solutions which can be in equilibrium with $Na_2CO_3+7H_2O\beta$ at different temperatures.

t°	% Na_2CO_3
32.1	31.8
32.5	32.1
33.3	32.7
33.9	33.0
34.5	33.9

(Ketner, Z. phys. Ch. 1902, **39**. 646.)

Composition of the alcohol and water layers in contact with the solid phase, $Na_2CO_3+7H_2O\beta$, at different temperatures.

t°	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
33.2	58.1	0.5	42.4	1.4	31.0	67.6
32.3	56.1	0.6	43.3	1.5	30.2	68.3
31.9	54.8	0.7	44.5	1.7	29.8	68.5
31.45	53.5	0.7	45.8	...	29.3	....
31.2	52.4	0.8	46.8	...	29.3	....

(Ketner.)

Composition of the two liquid layers which at different temperatures can be in metastabile equilibrium with $Na_2CO_3+7H_2O\beta$.

t°	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
28.9	46.9	1.3	51.8	2.3	26.3	71.4
26.6	39.1	1.3	59.6	3.3	25.4	71.3
23.0	24.5	6.7	68.8	7.0	20.2	72.8

(Ketner.)

$+10H_2O$. Efflorescent. Sol. in 1.05 pts. H_2O at 23°, and sat. solution has sp. gr. 1.1995. (Schiff, A. **109**. 326.)

Melts in crystal H_2O at 34°. (Tilden, Chem. Soc. **45**. 409.)

See above under Na_2CO_3 for further data.

Solubility in 100 pts. H_2O at t°.

Corrected t°. (Hydrogen scale)	Pts. anhydrous salt
27.84	34.20
29.33	37.40
29.85	38.89
30.35	40.12
31.45	43.25
31.66	43.95
31.72	44.21
32.06	45.64

(Wells and McAdam, J. Am. Chem. Soc. 1907, **29.** 726.)

Sat. solution at 25° contains 29.37 g. anhyd. Na_2CO_3 in 100 g. H_2O. (Osaka, J. Tok. Ch. Soc. **1911, 32.** 870.)

Sat. solution at 25° contains 28.3 g. anhyd. Na_2CO_3 in 100 g. H_2O. (de Paepe, Bull. Soc. Chim. Belg. 1911, **25.** 174.)

Sat. solution at 30° contains 27.4–27.98 g. anhyd. Na_2CO_3 in 100 g. of the solution. (Cocheret, Dissert. **1911.**)

Sat. solution at 25° contains 27.64 g. anhyd. Na_2CO_3 in 100 cc. of the solution. (McCoy and Test, J. Am. Chem. Soc. 1911, **33.** 474.)

Solubility in alcohol.

Composition of the alcohol and water layers in contact with the solid phase, $Na_2CO_3+10H_2O$, at different temperatures.

t°	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
30.6	47.8	1.2	51.0	2.3	27.8	69.9
29.7	40.0	2.1	57.9	2.9	25.5	71.6
29.0	32.7	3.8	63.5	4.3	22.7	73.0
28.2	23.5	7.3	69.2	7.9	18.6	73.5

(Ketner, Z. phys. Ch. 1902, **39.** 651.)

Solubility in alcohol+Aq.

Liquids which can be in equilibrium with $Na_2CO_3+10H_2O$ at 21°.

% alcohol	% salt	% water
0	18.5	81.5
6.2	12.7	81.1
15.3	6.9	77.8
26.1	3.2	70.7
39.2	1.2	59.6
58.2	0.2	41.6
67.1	0.1	32.8
73.3	0.06	26.64

(Ketner.)

Composition of the alcohol liquids which can be in equilibrium with $Na_2CO_3+10H_2O$ and $Na_2CO_3+7H_2O\beta$ at different temperatures.

t°	% alcohol	% salt	% water
29°	62.3	0.3	37.4
26°	67.8	0.1	32.1
21°	73.3	0.06	26.6

(Ketner.)

See also under Na_2CO_3.

$+15H_2O$. (Jacquelain, A. **80.** 241.)

Sodium hydrogen carbonate, $NaHCO_3$.

100 pts. cold H_2O dissolve 7.7 pts. $NaHCO_3$. (Rose, Schw. J. **6.** 52.)

100 pts. H_2O at 11.25° dissolve 8.27 pts. $NaHCO_3$ to form solution of 1.0613 sp. gr. (Anthon, Dingl. **161.** 216.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°	
8.95	10.04	11.15	12.24	pts. $NaHCO_3$,
40°	50°	60°	70°	
13.35	14.45	15.57	16.69	pts. $NaHCO_3$.

(Poggiale, A. ch. (3) **8.** 468.)

100 pts. H_2O dissolve pts. $NaHCO_3$ at t°.

t°	Pts. $NaHCO_3$	t°	Pts. $NaHCO_3$	t°	Pts. $NaHCO_3$
0	6.90	21	9.75	42	13.05
1	7.00	22	9.90	43	13.20
2	7.10	23	10.05	44	13.40
3	7.20	24	10.20	45	13.55
4	7.35	25	10.35	46	13.75
5	7.45	26	10.50	47	13.90
6	7.60	27	10.65	48	14.10
7	7.70	28	10.80	49	14.30
8	7.85	29	10.95	50	14.45
9	8.00	30	11.10	51	14.65
10	8.15	31	11.25	52	14.85
11	8.25	32	11.40	53	15.00
12	8.40	33	11.55	54	15.20
13	8.55	34	11.70	55	15.40
14	8.70	35	11.90	56	15.60
15	8.85	36	12.05	57	15.80
16	9.00	37	12.20	58	16.00
17	9.15	38	12.35	59	16.20
18	9.30	39	12.50	60	16.40
19	9.40	40	12.70	..	...
20	9.60	41	12.90	..	...

(Dibbits, J. pr. (2) **10.** 417.)

Experiments with solutions of sodium hydrogen carbonate show that they gradually decompose after a time. (Treadwell, Z. anorg. 1898, **17.** 204.)

The source of error of many solubility determinations of this substance is due to loss of CO_2. Solutions exposed to the air lose CO_2. (McCoy, Am. Ch. J. 1903, **29.** 438.)

1 l. sat. solution at 25° contains 98.4 g. $NaHCO_3$. (McCoy and Test, J. Am. Chem. Soc. 1911, **33.** 474.)

$NaHCO_3$+Aq sat. at 16° has sp. gr. = 1.06904. (Stolba.)

Nearly insol. in sat. NaCl, or Na_2SO_4+Aq. (Balmain, B. **5.** 121.)

Equilibrium between Na_2CO_3 and $NaHCO_3$ in H_2O and in contact with the air.
System: Na_2CO_3, $NaHCO_3$, and CO_2.
Temperature, 25° C.

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as Na_2CO_3 Per cent	Amount Na combined as $NaHCO_3$ Per cent
0.0044	50 50	8.7	91.3
0.0143	20 20	20.0	80.0
0.0562	10 10	37.3	62.7
0.2248	10 10	59.3	40.7
0.8847	2 2 3	64.0	36.0

Temperature, 37° C.

Gram atoms Na per liter	Amount solution used for titration cc	Amount Na combined as Na_2CO_3 Per cent	Amount Na combined as $NaHCO_3$ Per cent
0.0019	50 50	10.5	89.5
0.0071	20 20	21.1	78.9
0.0276	10 10	41.3	58.7
0 .030	10 10	64.5	35.5
0.421	2 2	81.9	18.1
0.815	2 2	86.5	13.5
1.795	2+ 2	83.4	16.6

Temperature, 50° C.

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as Na_2CO_3 Per cent	Amount Na combined as $NaHCO_3$ Per cent
0.0017	50 25	22.2	77.8
0.0071	20 20	32.9	67.1
0.0266	10 20	50.7	49.3
0.1014	10 10	70.0	30.0
0.4066	10 2	81.0	19.0
0.8068	2 2	86.8	13.2
1.7486	2.1 2	87.1	12.9

Temperature, 75° C.

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as Na_2CO_3 Per cent	Amount Na combined as $NaHCO_3$ Per cent
0.003	50 25 25	25.7	74.3
0.019	20 20	34.8	65.2
0.036	10 10	55.7	44.3
0.270	5 5	79.5	20.5
0.702	1 1	85.0	15.0
6.56	1 1	84.8	15.2

System: Na_2CO_3 and $NaHCO_3$ at 25° C.

Total salts dissolved grams	Na_2CO_3		$NaHCO_3$	
	Weight Grams	Per cent	Weight Grams	Per cent
0.3555	0.0203	5.71	0.3352	94.29
1.1053	0.1505	13.62	0.9548	86.38
4.0443	1.1041	27.30	2.9402	72.70
14.6558	7.0212	47.91	7.6346	52.09
56.3982	29.8223	52.88	26.5759	47.12

(Cameron and Briggs, J. phys. Chem. 1901, **5.** 540.)

100 g. alcohol of 0.941 sp. gr. dissolve 1.2 g. $NaHCO_3$ at 15.5°.

100 g. glycerol dissolve 8 g. $NaHCO_3$ at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sodium *di*hydrogen *tri*carbonate, $Na_4H_2(CO_3)_3+3H_2O$.

More sol. than $NaHCO_3$, less sol. than Na_2CO_3 in H_2O. (Rose, Pogg. **34.** 160.)

100 pts. H_2O dissolve, calculated as $2Na_2O$, $3CO_2$—

at 0°	12.63 pts.	at 60°	29.68 pts.
" 10°	15.50 "	" 70°	32.55 "
" 20°	18.30 "	" 80°	35.8 "
" 30°	21.15 "	" 90°	38.63 "
" 40°	23.95 "	" 100°	41.59 "
" 50°	26.78 "		

(Poggiale, A. ch. (3) **8.** 468.)

Min. *Trona, Urao.* *See* $Na_3H(CO_3)_2+2H_2O$.

Trisodium hydrogen carbonate, $Na_3H(CO_3)_2 + 2H_2O$.

Sol. in H_2O.

True formula of "Trona" and "Urao." (Zepharovich, Zeit. Kryst. **13.** 135; de Mondesir, C. R. **104.** 1505.)

Sodium thorium carbonate, $3Na_2CO_3$, $Th(CO_3)_2 + 12H_2O$.

Decomp. by H_2O. (Cleve.)

Sodium uranyl carbonate, $2Na_2CO_3$, $(UO_2)CO_3$.

Slowly sol. in H_2O. Solution sat. at 15° has sp. gr. = 1.161. (Anthon, Dingl. **156.** 207.)

Sodium yttrium carbonate, Na_2CO_3, $Y_2(CO_3)_3 + 4H_2O$.

Ppt. Not decomp. by cold H_2O. (Cleve.)

Sodium zinc carbonate, $3Na_2O$, $8ZnO$, $11CO_2 + 8H_2O = 3Na_2CO_3$, $8ZnCO_3 + 8H_2O$.

Sl. decomp. by pure H_2O. (Wöhler.)

Less easily decomp. by H_2O than most double carbonates. (Deville, A. ch. (3) **33.** 101.)

Na_2O, $3ZnO$, $4CO_2 + 3H_2O$. (Kraut, Z. anorg. 1897, **13.** 13.)

Sodium carbonate sulphite, Na_2CO_3, $2Na_2SO_3 + 21H_2O$.

Sol. in hot H_2O, sl. sol. in cold H_2O. (Johnson, J. Soc. Chem. Ind. 1895, **14.** 271.)

Strontium carbonate, $SrCO_3$.

Sol. in 18,045 pts. H_2O at ordinary temp. (Fresenius.)

Sol. in 12,522 pts. H_2O at 15°. (Kremers, Pogg. **85.** 247.)

Sol. in 33,000 pts. H_2O. (Bineau, C. R. **41.** 511.)

Less sol. in H_2O than $SrSO_4$. (Dulong.)

Sol. in 1536 pts. boiling H_2O. (Hope, Edinb. Trans. **4.** 5.)

Calculated from electrical conductivity of $SrCO_3$+Aq, $SrCO_3$ is sol. in 121,760 pts. H_2O at 8.8° and 91,468 pts. at 24.3° (Hollemann, Z. phys. Ch. **12.** 130).

1 l. H_2O dissolves 11 mg. $SrCO_3$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

"Solubility product" = 15.67×10^{-10} mol. litre. (McCoy and Smith, J. Am. Chem. Soc. 1911, **33.** 473.)

Sol. in 833 pts. H_2CO_3+Aq at 10°. (Gmelin.)

Sol. in 56,545 pts. H_2O containing NH_4OH and $(NH_4)_2CO_3$.

Quite sol. in NH_4Cl+Aq or NH_4NO_3+Aq, but reprecipitated on addition of NH_4OH and $(NH_4)_2CO_3$+Aq. (Fresenius.)

Partially decomp. by boiling with aqueous solutions of K_2SO_4, Na_2SO_4, $CaSO_4$, $(NH_4)_2SO_4$, $MgSO_4$, Na_2HPO_4, $(NH_4)_2HPO_4$, K_2SO_3, Na_2SO_3, $(NH_4)_2SO_3$, $Na_2B_4O_7$, Na_2AsO_2, K_2AsO_2, $K_2C_2O_4$, $Na_2C_2O_4$, NaF, and K_2CrO_4. Decomp. is complete with the NH_4 salts. (Dulong, A. ch. **82.** 286.)

Sl. decomp. by Na_2SO_4, or K_2SO_4+Aq. (Persoz.)

Easily sol. in NH_4 chloride, nitrate, or succinate+Aq, but less so than $BaCO_3$. (Fresenius.) Sol. in ferric salts+Aq, with pptn. of $Fe_2O_6H_6$. Sol. in Na citrate+Aq. (Spiller.) Not decomp. by a mixture of 1 pt. H_2SO_4 and 6 pts. absolute alcohol, or by alcoholic solutions of tartaric, racemic, citric, or glacial acetic acids; immediately decomp. by HNO_3+absolute alcohol, or $H_2C_2O_4$+abs. alcohol.

Solubility of $SrCO_3$ in NH_4Cl+Aq.

% NH_4Cl	% $SrCO_3$
5.35	0.179
10	0.259
20	0.358

(Cantoni and Goguelia, Bull. Soc. 1905, (3) **33.** 13.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Insol. in acetone. (Naumann, B. 1904, **37,** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Min. *Strontianite.*

Strontium hydrogen carbonate.

$SrCO_3$ is sol. in 850 pts. of a sat. solution of CO_2 in H_2O.

Strontium uranyl carbonate, SrO, $2UO_3$, $2CO_2 + 16H_2O$.

As Ba comp. (Blinkoff, Dissert. **1900.**)

Terbium carbonate.

Ppt. Insol. in excess $(NH_4)_2CO_3$+Aq. (Potratz, C. N. 1905, **92.** 3.)

Thallous carbonate, Tl_2CO_3.

100 pts. H_2O dissolve pts. Tl_2CO_3 (C = according to Crookes; L = according to Lamy) at—

15.5°	18°	62°	100°	100.8°	
4.2	5.23	12.85	27.2	22.4	pts. Tl_2CO_3.
C	L	L	C	L	

Insol. in absolute alcohol (L), and ether (C).

Insol. in acetone and pyridine. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Thallous carbonate, acid, Tl_2O, $2CO_2$.

Rather easily sol. in cold H_2O. (Carstanjen.)

$TlHCO_3$. (Giorgis, Gazz. ch. it. 1894, **24.** 474–479.)

Thallous carbonate platinocyanide, Tl_2CO_3, $Tl_2Pt(CN)_4$.

Sl. sol. in hot, insol. in cold H_2O. (Friswell, Chem. Soc. (2) **9.** 461.)

Thorium carbonate, basic, $2ThO_2$, CO_2+3H_2O.

Insol. in CO_2+Aq, but sol. in excess of alkali carbonates+Aq, if conc.

Tin (stannous) carbonate, $2SnO$, CO_2.

Easily decomp. on air; insol. in H_2O or H_2CO_3+Aq. (Deville, A. ch. (3) **35.** 448.)

Uranyl carbonate, basic, $5(UO_2)(OH)_2$, $3(UO_2)CO_3+6H_2O$.

Ppt. (Seubert and Elten, Z. anorg. 1893, **4.** 80.)

Ytterbium carbonate, basic, $Yb(OH)CO_3+H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 146.)

Ytterbium carbonate, $Yb_2(CO_3)_3+4H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 146.)

Yttrium carbonate, $Y_2(CO_3)_3+3H_2O$.

Insol. in H_2O; very sl. sol. in H_2CO_3+Aq. Sol. in SO_2+Aq and all mineral acids. Sol. in NH_4 salts, and alkali carbonates+Aq to some extent. More sol. in $(NH_4)_2CO_3$+Aq than in K_2CO_3+Aq. (Berlin.) More sol. in $(NH_4)_2CO_3$+Aq than cerium, but 5 or 6 times less sol. than glucinum carbonate. (Vauquelin.) Sol. in large excess of $KHCO_3$+Aq. (Rose.) Slowly sol. in NH_4 salts+Aq. (Berzelius.)

Zinc carbonates, basic, $8ZnO$, CO_2+2H_2O; $5ZnO$, $2CO_2+3$, or $7H_2O$; $3ZnO$, CO_2+H_2O; $11ZnO$, $4CO_2+14H_2O$; $14ZnO$, $5CO_2+9H_2O$; $2ZnO$, CO_2+H_2O; $8ZnO$, $3CO_2+5H_2O$, etc.

All ppts. formed from Zn salts and carbonates+Aq. Sol. in 2000–3000 pts. cold H_2O, separates out on heating and does not redissolve on cooling. (Schindler.) Sol. in 20,895 pts. H_2O at 15°. (Kremers, Pogg. **85.** 248.) Sol. in 44,600 pts. H_2O at ord. temp. (Fresenius.)

Sol. in 1428 pts. sat. H_2CO_3+Aq. (Lassaigne.) Sol. in 189 pts. H_2CO_3+Aq sat. at 4–6 atmos. (Wagner, Z. anal. **6.** 107.) Easily sol. in KOH, NaOH, NH_4OH, $(NH_4)_2CO_3$+Aq, and in acids. Somewhat sol. in alkali bicarbonates and NH_4 salts+Aq. (Fresenius.) Sol. in hot (Fuchs), also cold (Brett, **1837**) NH_4Cl+Aq; less sol. in NH_4NO_3+Aq. (Brett.)

Sol. in all NH_4 salts+Aq excepting $(NH_4)_2S$+Aq. (Terreil, Bull. Soc. (2) **9.** 441.)

Insol. in Na_2CO_3, or K_2CO_3+Aq. Sol. in ferric salts+Aq with pptn. of $Fe_2O_6H_6$. (Fuchs, **1831.**)

The carbonates described by Boussingault, Wackenroder, Rose, and probably all salts between ZnO, CO_2 and $5ZnO$, $2CO_2$ are mixtures. (Kraut, Z. anorg. 1897, **13.** 1–15.)

$3ZnO$, CO_2+2H_2O. Min. *Zinc bloom, Hydrozincite.*

$ZnCO_3$, $3ZnO_2H_2$. Min. *Auricalcite.*

Zinc carbonate, $ZnCO_3$.

1 l. H_2O at 15° dissolves 0.01 g.; 1 l. H_2O dissolves 1.64×10^{-4} mols, or 0.206 g. $ZnCO_3$ at 25°. (Ageno and Valla, Att. acc. Linc. 1911, **20,** II. 706.)

1 l. 5.85% NaCl+Aq dissolves 0.0586 g; 1 l. 7.45% KCl+Aq dissolves 0.0477 g. $ZnCO_3$. (Essen, Gm.-K. 4, **1.** 680.)

Sol. in acids, KOH+Aq, and NH_4 salts+Aq.

Sol. in H_2CO_3+Aq.

Solubility in various salts+Aq.

Solvent	g. $ZnCO_3$ sol. in 1 l. of the solvent
10% $NaNO_3$+Aq	0.058981
sat. $NaNO_3$+Aq	0.149000
5% NaCl+Aq	0.021730
10% NaCl+Aq	0.046564
sat. NaCl+Aq	0.130380
10% Na_2SO_4+Aq	0.009313
sat. Na_2SO_4+Aq	0.015521

(Ehlert, Z. Elektrochem. 1912, **18.** 728.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Min. *Calamine, Smithsonite.*

Calamine is sol. in NH_4OH+Aq only in the presence of NH_4 salts. (Brandhorst, Zeit. angew. Ch. 1904, **17.** 513.)

$+\frac{1}{2}H_2O$. (Mikusch, Z. anorg. 1908, **56.** 366.)

$+H_2O$. (Belar, Zeit. Kryst. 1890, **17.** 126.)

Zinc carbonate ammonia, $ZnCO_3$, NH_3.

Slowly decomp. by H_2O, but not on the air, or by boiling with alcohol. (Favre, A. ch. (3) **10.** 474.)

Zinc carbonate hydroxylamine, $ZnCO_3$, $2NH_3O$.

Insol. in H_2O. Decomp. by acids. (Goldschmidt and Syngros, Z. anorg. **5.** **129.**)

Zirconium carbonate, $3ZrO_2$, CO_2+6H_2O.

Decomp. by hot H_2O, all CO_2 being given off. (Hermann.)

Sol. in alkali carbonates+Aq.

Percarbonic acid.
See **Percarbonic acid.**

Carbonic anhydride, CO_2.
See **Carbon** ***di*****oxide.**

Carbonophosphoric acid.

Potassium carbonophosphate, $(K_2HPO_4)_2$, $2CO_2$, $2KHCO_3$.

Known only in solution. (Barillé, C. R. 1903, **137.** 566.)

Carbonyl bromide, $COBr_2$.

Decomp. by H_2O. (Besson, C. R. 1895, **120.** 192.)

Carbonyl platinous bromide, $CO, PtBr_2$.

Sol. in H_2O with almost instant decomp. Sol. in absolute alcohol. (Pullinger, Chem. Soc. **59.** 603.)

Quite easily sol. in hot C_6H_6, insol. in ligroine, and can be crystallized from CCl_4. Very easily sol. in HBr+Aq. (Mylius and Förster, B. **24.** 2432.)

Carbonyl bromochloride, $COClBr$.

Decomp. by H_2O. (Besson.)

Carbonyl chloride, $COCl_2$.

Phosgene. Cold H_2O dissolves 1–2 vols. $COCl_2$ gas with slow decomposition. Alcohol decomp. immediately. Immediately absorbed by KOH, or NH_4OH+Aq. Very sol. in glacial $HC_2H_3O_2$, benzene, and most liquid hydrocarbons. (Berthelot, Bull Soc. (2) **13.** 14.)

Sol. in SCl_2.

1 vol. $AsCl_3$ absorbs 10 vols. $COCl_2$.

Di**carbonyl cuprous chloride,** $Cu_2Cl_2, 2CO+4H_2O$.

Decomp. by air. (Jones, Am. Ch. J. 1899, **22.** 305.)

Carbonyl platinous chloride, $2COCl_2, PtCl_2$.

Sl. deliquescent. Easily sol. in H_2O without decomp.; sl. sol. in alcohol. Almost insol. in CCl_4. (Pullinger, Chem. Soc. **59.** 600.)

Mono**carbonyl platinous chloride,** $CO, PtCl_2$.

Decomp. by H_2O and alcohol; sol. in hot CCl_4. (Schützenberger, A. ch. (4) **15.** 100.)

Sol. in conc. HCl+Aq. (Mylius and Förster.)

Di**carbonyl platinous chloride,** $2CO, PtCl_2$.

Decomp. by H_2O and alcohol. Sol. in CCl_4. (Schützenberger.)

Decomp. by conc. HCl+Aq into CO and $CO, PtCl_2$. (Mylius and Förster.)

Sesqui**carbonyl platinous chloride,** $3CO, 2PtCl_2$.

Decomp. by H_2O or alcohol. Much more sol. in CCl_4 than $2CO, PtCl_2$.

Carbonyl platinous iodide, CO, PtI_2.

Not hygroscopic. Insol. in, but slowly decomp. by, H_2O. Easily sol. in benzene or ether, also in alcohol, which decomp. on warming; sol. in HI+Aq. (Mylius and Förster.)

Carbonyl platinous sulphide, CO, PtS.

Easily decomp. Insol. in ordinary solvents. (Mylius and Förster.)

Carbonyl sulphide, COS.

H_2O absorbs 1 vol. COS.

Absorption of COS by H_2O at t°.

t°	Coefficient of absorption
0	1.333
10	0.835
20	0.561
30	0.403

(Winkler, Z. phys. Ch. 1906, **55.** 351.)

1 ccm. H_2O at 13.5° and 756 mm. pres. dissolves 0.8 ccm. COS (Hempel, Zeit. angew. ch. 1901, **14.** 867.)

1 ccm. of a hydrochloric acid solution of Cu_2Cl_2 absorbs about 0.2 ccm. COS. (Hempel.)

Carbonyl ferrocyanhydric acid.
$H_3Fe(CO)(CN)_5$.

Very sol. in H_2O; decomp. on heating. (Müller, A. ch. (6) **17.** 94.)

Cobalt carbonyl ferrocyanide.

Sl. sol. in H_2O; very sol. in dil. HNO_3+Aq. (M.)

Cupric carbonyl ferrocyanide,
$Cu_3[Fe(CO)(CN)_5]_2$.

Insol. in H_2O, H_2SO_4, or dil. HNO_3+Aq. (M.)

Iron (ferric) carbonyl ferrocyanide,
$FeFeCO(CN)_5$.

Insol. in H_2O. Sol. in $H_2C_2O_4$+Aq. Insol. in acetic, lactic, succinic, tartaric, and citric acids+Aq, but easily sol. in the neutral salts of those acids. Insol. in KCl, or KNO_3+Aq, but sensibly sol. in Na_2HPO_4+Aq. Insol even on warming in very dil. H_2SO_4, or H_3PO_4+Aq. (Müller.)

Potassium carbonyl ferrocyanide,
$K_3Fe(CO)(CN)_5+3\frac{1}{2}H_2O$.

100 pts. H_2O dissolve 148 pts. at 16°. (Müller, C. R. **104.** 992.)

Silver carbonyl ferrocyanide, $Ag_3Fe(CO)(CN)_5$.

Insol. in H_2O; sl. sol. in dil. H_2SO_4, HCl, or HNO_3+Aq; scarcely attacked by conc. $HC_2H_3O_2$+Aq. (Müller.)

Sodium carbonyl ferrocyanide, $Na_3Fe(CO)(CN)_5+6H_2O$.

Sol. in H_2O. (Müller.)

Uranyl carbonyl ferrocyanide, $(UO_2)_3[FeCO(CN)_5]_2+5H_2O$.

Sl. sol. in H_2O, but more easily if H_2O is acidified with $HC_2H_3O_2$.

Cericotungstic acid.

Ammonium cericotungstate, $2(NH_4)_2O$, Ce_2O_3, $16WO_3+2H_2O$.

Insol. in H_2O, but decomp. by boiling therewith. (Smith, J. Am. Chem. Soc. 1904, **26.** 1481.)

Cerium, Ce.

Decomp. pure H_2O very slowly at ordinary temp. Not attacked by cold conc. H_2SO_4 or red fuming HNO_3. Sol. in dil. H_2SO_4+Aq, HNO_3+Aq, and conc. or dil. HCl+Aq. (Hillebrand and Norton, Pogg. **155.** 633.)

Cerous bromide, $CeBr_3$.

Anhydrous. As the chloride. (Robinson, Proc. Roy. Soc. **37.** 150.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+xH_2O$. Very deliquescent. (Jolin.)

Cerium gold bromide, $CeBr_3$, $AuBr_3+8H_2O$.

See **Bromaurate, cerium.**

Cerium carbide, CeC_2.

Decomp. by fused alkali nitrates, chlorates, hydroxides and carbonates; and by conc. H_2SO_4 on heating. Insol. in conc. HNO_3; decomp. by H_2O and dil. acids. (Moissan, C. R. 1896, **122.** 359.)

CeC_3. Not attacked by hot conc. acids. (Delafontaine, J. B. **1865.** 176.)

Cerous chloride, $CeCl_3$.

Anhydrous. Deliquescent. Sol. in H_2O with hissing and evolution of heat; sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+7H_2O$. Insol. in NH_4OH+Aq. (Dennis, Z. anorg. 1894, **7.** 260.)

$+7\frac{1}{2}H_2O$. Deliquescent. (Berzelius.)

Decomp. by boiling with H_2O. Sol. in 1 pt. H_2O at ord. temp. and 3–4 pts. alcohol. (Dumas.)

Ceric chloride.

Known only in solution, which decomposes by slight heat. (Berzelius.)

Cerous mercuric chloride.

Not deliquescent. (v. Bonsdorff.)

$CeCl_3$, $4HgCl_2+10H_2O$. Permanent; easily sol. in H_2O. (Jolin, Bull. Soc. (2) **21.** **533.**)

Cerium stannic chloride.

See **Chlorostannate, cerium.**

Cerous chloride zinc iodide.

Sol. in H_2O and alcohol. (Holzmann, J. pr. **84.** 76.)

Cerous fluoride, CeF_3.

Insol. ppt.

$+\frac{1}{2}H_2O$.

Ceric fluoride, CeF_4.

Insoluble precipitate. (Berzelius.)

$+H_2O$ .Insol. in H_2O. (Brauner, B. **14.** 1944.)

Ceric cobaltous fluoride, $2CeF_4$, CoF_2+7H_2O.

Ppt. Easily decomp. by H_2O. (Rimbach, A. 1909, **368.** 107.)

Ceric cupric fluoride, $2CeF_4$, CuF_2+7H_2O.

Ppt. Decomp. by H_2O. (Rimbach, *l. c.*)

Ceric nickel fluoride, $2CeF_4$, NiF_2+7H_2O.

Ppt. Decomp. by H_2O. (Rimbach, *l. c.*)

Ceric potassium fluoride, $2CeF_4$, $3KF+2H_2O$.

Insol. in H_2O. (Brauner, B. **14.** **1944;** **15.** 109.)

Could not be obtained pure. (Rimbach, *l. c.*)

Ceric zinc fluoride, $2CeF_4$, ZnF_2+7H_2O.

Ppt. Decomp. by H_2O. (Rimbach, *l. c.*)

Ceroceric fluoride, $2CeF_3$, CeF_4.

Min. *Fluocerite.*

Cerium hydride, CeH_2.

Decomp. by acids. (Winkler, B. **24.** 873.)

CeH_3. Decomp. in moist air; decomp. by hot or cold H_2O; sol. in acids with evolution of H_2O. Decomp. by alkalis. (Muthmann, A. 1902, **325.** 266.)

Cerous hydroxide, Ce_2O_3, xH_2O.

Easily sol. in acids. Insol. in excess of alkali hydroxides+Aq. Sol. in $(NH_4)_2CO_3$+Aq.

100 ccm. of a solution in glycerine+Aq containing about 60% by vol. of glycerine contain 7.9 g. Ce_2O_3. (Müller, Z. anorg. **1905,** **43.** 322.)

Exists in two modifications: one insol. in

cold HCl+Aq; the other sol. in cold HCl+Aq. (Brauner, C. N. 1895, **71.** 283.)

Ceric hydroxide, $2CeO_2$, $3H_2O$.

Sol. in HNO_3 or H_2SO_4; also in HCl+Aq, forming cerous chloride and free chlorine. Insol. in hydrofluoric, acetic, or formic acids+Aq. Somewhat sol. in dil. HNO_3, or HCl+Aq. (Ordway, Am. J. Sci. (2) **26.** 205.) Insol. in NH_4OH, KOH, and NaOH+Aq. Sl. sol. in alkali carbonates+Aq. (Dumas.)

Sl. sol. in $(NH_4)_2CO_3$+Aq. (Ordway.)

100 ccm. of a solution in glycerine+Aq containing about 60% by vol. of glycerine contain 0.08 g. CeO_2. (Müller, Z. anorg. 1905, **43.** 232.)

Cerous iodide, CeI_3.

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

$+9H_2O$. Very deliquescent and sol. in H_2O. (Lange, J. pr. **82.** 134.)

Sol. in alcohol.

Cerium nitride, CeN.

Decomp. by H_2O and alkali. Sol. in mineral acids with formation of cerous and ammonium salts. (Muthmann, A. 1902, **325.** 272.)

Cerous oxide, Ce_2O_3.

When ignited, insol. in HCl+Aq; when long digested with H_2SO_4, is sol. in HCl+Aq with addition of alcohol.

Ceric oxide, CeO_2.

When ignited, is only dissolved in traces, even on heating, by HCl or HNO_3+Aq. Sol. in conc. H_2SO_4 when warmed. Sol. in the cold in a solution of KI in HCl+Aq (Bunsen), in a mixture of HCl and $FeCl_2$+Aq, or any reducing substance.

Cerium *per*oxide, Ce_4O_9.

Insol. in boiling conc. acids. Sol. in H_2SO_4 by long digestion. (Popp, A. **131.** 361.)

Probably does not exist. (Rammelsberg, Pogg. **108.** 40.)

Ce_2O_5. (Hermann, J. pr. **30.** 184.)

Probably does not exist. (Rammelsberg.)

CeO_3+xH_2O. Sol. in HCl+Aq. (Popp, A. **131.** 361); (Lecoq de Boisbaudran, C. R. **100.** 605.)

$CeO_2+H_2O_2$, according to Cleve (Bull. Soc. (2) **43.** 57.)

Cerium oxycarbide, CeC_2, $2CeO_2$.

Stable in the air. Slowly attacked by cold H_2O. With hot H_2O and with acids, it gives unsat. hydrocarbons. (Sterba, C. R. 1902, **134.** 1058.)

Cerium oxychloride, CeOCl.

Slightly attacked by hot conc. HCl+Aq. Slowly sol. in conc. HNO_3+Aq. (Wöhler.)

Easily sol. in dil. acids. (Didier, C. R. **101.** 882.)

Cerium oxychloride tungsten *tri*oxide, CeOCl, WO_3.

(Didier, C. R. **102.** 823.)

Cerium selenide.

Insol. in H_2O; difficultly sol. in acids. (Berzelius.)

Cerium silicide, $CeSi_2$.

Insol. in H_2O, by which it is acted upon only very slowly.

Sol. in HCl and HF+Aq with evolution of H_2.

Not attacked by alkalis+Aq or NH_4OH+Aq.

Insol. in organic solvents. (Sterba, C. R. 1902, **135.** 170.)

Cerium silicide, Ce_2Si_3.

Insol. in acids. (Ullik, W. A. B. **52, 2.** 115.)

Cerium *di*sulphide, Ce_2S_4.

Not decomp. by cold H_2O.

Slowly sol. in cold dil. H_2SO_4, HCl and acetic acid. Rapidly sol. in warm dil. H_2SO_4, HCl and acetic acid with decomp. (Biltz, B. 1908, **41.** 3342.)

Cerium *sesqui*sulphide, Ce_2S_3.

Insol. in, and not decomp. by, H_2O, but easily decomp. by the weakest acids. (Mosander); (Didier, C. R. **100.** 1461.)

***Mono*chloramine,** NH_2Cl.

Easily sol. in H_2O. (Raschig. Ch. Z. 1907, **31.** 926.)

Chlor*tetr*amine comps.

See **Chlorotetramine comps.**

***Meta*chlorantimonic acid,** $HSbCl_6+4\frac{1}{2}H_2O$.

Hydroscopic. Sol. in H_2O with decomp.; sol. in alcohol, acetone, and acetic acid. (Weinland, Z. anorg. 1905, **44.** 43.)

***Meta*chlorantimonic acid ammonia,** $HSbCl_6$, $2NH_3$.

Sol. in H_2O and in alcohol. (Weinland and Schmid, Z. anorg. 1905, **44.** 59.)

Aluminum *meta*chlorantimonate, $Al(SbCl_6)_3+15H_2O$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland, B. 1903, **36.** 254.)

Ammonium *meta***chlorantimonate,** NH_4SbCl_6 $+H_2O$.

Hydroscopic.

Sol. in H_2O. Solution decomp. slowly when cold, rapidly on warming.

Sol. in dil. HCl. (Weinland, B. 1903, **36.** 251.)

Cadmium *meta***chlorantimonate ammonia,** $Cd(SbCl_6)_2, 7NH_3$.

Ppt. (Weinland and Schmid, Z. anorg. 1905, **44.** 56.)

Calcium *meta***chlorantimonate,** $Ca(SbCl_6)_2+9H_2O$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland, B. 1903, **36.** 253.)

Chromium *meta***chlorantimonate,** $Cr(SbCl_6)_3$ $+13H_2O$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland.)

Chromium *ortho***chlorantimonate,** $CrSbCl_8+10H_2O$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland.)

Cupric *meta***chlorantimonate ammonia,** $Cu(SbCl_6)_2, 5NH_3$.

(Weinland and Schmid, Z. anorg. 1905, **44.** 55.)

Glucinum *meta***chlorantimonate,** $Gl(SbCl_6)_2$ $+10H_2O$.

Very hydroscopic.

Sol. in dil. HCl. (Weinland, B. 1903, **36.** 252.)

Iron (ferric) *ortho***chlorantimonate,** $FeSbCl_8$ $+8H_2O$.

Hydroscopic.

Can easily be cryst. from dil. HCl+Aq. (Weinland.)

Lithium *meta***chlorantimonate,** $LiSbCl_6+4H_2O$.

Very hydroscopic.

Sol. in dil. HCl+Aq. (Weinland, *l. c.*)

Magnesium *pyro***chlorantimonate,** $MgSbCl_7$ $+9H_2O$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland.)

Nickel *meta***chlorantimonate ammonia,** $Ni(SbCl_6)_2, 6NH_3$.

Sol. in H_2O. (Weinland and Schmid, Z. anorg. 1905, **44.** 57.)

Potassium *meta***chlorantimonate,** $KSbCl_6+H_2O$.

Hydroscopic.

Sol. in H_2O. Solution decomp. slowly when cold, rapidly when warmed.

Sol. in dil. HCl+Aq. (Weinland, B. 1903, **36.** 250.)

Rubidium *meta***chlorantimonate,** $RbSbCl_6$.

Hydroscopic.

Sol. in dil. HCl+Aq. (Weinland.)

Silver *meta***chlorantimonate ammonia,** $AgSbCl_6, 2NH_3$.

Decomp. by H_2O. (Weinland and Schmid.)

Zinc *meta***chlorantimonate ammonia,** $Zn(SbCl_6)_2, 4NH_3$.

(Weinland and Schmid.)

Chlorarsenious acid.

See **Arsenyl chloride.**

Chlorauric acid, $HAuCl_4+4H_2O$.

Sol. in H_2O, alcohol, and ether.

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Difficultly sol. in PCl_3. (Walden.)

Cryst. with $3H_2O$ as stated by Weber and Schottlander and not with $4H_2O$ as stated by Thomsen. (Schmidt, C. C. **1906**, II. 855.)

Chloraurates.

All chloraurates are easily sol. in H_2O and in alcohol. (v. Bonsdorff, **1829.**)

Ammonium chloraurate, $NH_4AuCl_4+H_2O$.

Very easily sol. in H_2O.

$+2H_2O$. Very easily sol. in H_2O.

Barium chloraurate, $Ba(AuCl_4)_2+xH_2O$.

Deliquescent in moist air. Sol. in H_2O and alcohol. (v. Bonsdorff, Pogg. **17.** 261.)

Cadmium chloraurate.

Not deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cæsium chloraurate, $CsAuCl_4$.

100 pts. aqueous sat. solution contain at:

10°	20°	30°	40°	50°	
0.5	0.8	1.7	3.2	5.4	pts. anhydrous salt,
60°	70°	80°	90°	100°	
8.2	12.0	16.3	21.7	27.5	pts. anhydrous salt.

(Rosenbladt, B. **19.** 2538.)

$+\frac{1}{2}H_2O$. (Wells and Wheeler, Am. J. (3) **44.** 157.)

Calcium chloraurate, $Ca(AuCl_4)_2+6H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cerium chloraurate, $CeCl_3, AuCl_3+10H_2O$.

Extremely deliquescent. Easily sol. in H_2O and absolute alcohol. (Holzmann, C. C. **1863.** 206.)

$+13H_2O$. (Jolin, Bull. Soc. (2) **21.** 534.)

Cobalt chloraurate, $Co(AuCl_4)_2+8H_2O$.
Sol. in H_2O and alcohol. (Topsoë.)

Didymium chloraurate, $DiCl_3, AuCl_3+10H_2O$.
Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 361.)
$2DiCl_3, 3AuCl_3+20H_2O$. (Cleve.)

Gadolinium chloraurate, $GdCl_3, AuCl_3+10H_2O$.
Sol. in H_2O. (Benedicks, Z. anorg. 1900, **22.** 404.)

Lanthanum chloraurate, $LaCl_3, AuCl_3+5H_2O$.
Deliquescent in moist air. Sol. in H_2O. (Cleve, B. **8.** 128.)

Lithium chloraurate, $LiAuCl_4$.
100 pts. aqueous solution contain at:

10°	20°	30°	40°	
53.1	57.7	62.5	67.3	pts. anhydrous salt,
50°	60°	70°	80°	
72.0	76.4	81.0	85.7	pts. anhydrous salt.

(Rosenbladt.)

$+2H_2O$. (Antony and Lucchesi, Gazz. ch. it. 1890, **20.** 601.)
$+4H_2O$. Not stable.
Sol. in H_2O and alcohol. (Fasbender, C. C. **1894,** I. 409.)

Magnesium chloraurate, $Mg(AuCl_4)_2+8H_2O$.
Somewhat deliquescent. Sol. in H_2O and alcohol. (Topsoë.)
$+12H_2O$.

Manganese chloraurate, $Mn(AuCl_4)_2+8H_2O$.
Deliquescent. Sol. in H_2O and alcohol. (Topsoë.)
$+12H_2O$.

Nickel chloraurate, $Ni(AuCl_4)_2+8H_2O$.
Deliquescent. Sol. in H_2O and alcohol. (Topsoë.)

Potassium chloraurate, $KAuCl_4$.
Anhydrous. Very stable. (Lainer, W. A. B. **99, 2b.** 247.)

100 pts. solution in H_2O contain at:

10°	20°	30°	
27.7	38.2	48.7	pts. anhydrous salt,
40°	50°	60°	
59.2	70.0	80.2	pts. anhydrous salt.

(Rosenbladt, B. **19.** 2538.)

Sol. in H_2O and alcohol; insol. in ether. (Fasbender, C. C. **1894,** I. 409.)
1 pt. is sol. in 4 pts. 98% alcohol. (Fasbender, C. C. **1894,** II. 609.)
$+2H_2O$. Efflorescent.
$+\frac{1}{2}H_2O$.

Praseodymium chloraurate, $PrCl_3, AuCl_3+10H_2O$.
Very sol. in H_2O; sol. in conc. HCl. (von Schule, Z. anorg. 1898, **18.** 354.)

Rubidium chloraurate, $RbAuCl_4$.
100 pts. sat. $RbAuCl_4$+Aq contain at:

10°	20°	30°	40°	50°	
4.6	9.0	13.4	17.7	22.2	pts. anhydrous salt,
60°	70°	80°	90°	100°	
26.6	31.0	35.3	39.7	44.2	pts. anhydrous salt.

(Rosenbladt.)

1 pt. sol. in 54 pts. 98% alcohol. Insol. in ether. (Fasbender, C. C. **1894,** II. 609.)

Samarium chloraurate, $SmCl_3, AuCl_3+10H_2O$.
Deliquescent. Easily sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 165.)

Scandium chloraurate, $3ScCl_3, 2AuCl_3+21H_2O$.
Very deliquescent. (Crookes, Phil. Trans. 1910, **210.** A, 365.)

Silver chloraurate, $AgAuCl_4$.
Decomp. in the air.
Decomp. by H_2O, HCl and NH_3. (Herrmann, B. 1894, **27.** 597.)

Sodium chloraurate, $NaAuCl_4+2H_2O$.
Easily sol. in H_2O and absolute alcohol.
100 pts. aqueous solution contain at:

10°	20°	30°	
58.2	60.2	64.0	pts. anhydrous salt,
40°	50°	60°	
69.4	77.5	90.0	pts. anhydrous salt.

(Rosenbladt.)

Easily sol. in NaCl+Aq.
Easily sol. in H_2O, alcohol and ether. (Fasbender, C. C. **1894,** I. 409.)

Strontium chloraurate.
Sol. in H_2O. (v. Bonsdorff.)

Thallium chloraurate.
(Carstanjen.)

Ytterbium chloraurate, $YbCl_3, AuCl_3+9H_2O$.
Ppt. (Cleve, Z. anorg. 1902, **32.** 138.)

Yttrium chloraurate, $YtCl_3, 2AuCl_3+16H_2O$.
Very sol. in H_2O. (Cleve.)

Zinc chloraurate, $Zn(AuCl_4)_2+8H_2O$.
Sol. in H_2O. (Topsoë.)
$+12H_2O$. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Chlorauricyanhydric acid.

Barium chlorauricyanide, $Ba[Au(CN)_2Cl_2]_2 + 8H_2O$.

Very sol. in H_2O or alcohol. (Lindbom, Lund Univ. Arsk. **12.** No. 6.)

Potassium chlorauricyanide, $KAu(CN)_2Cl_2 + H_2O$.

Very sol. in H_2O or alcohol.

Strontium chlorauricyanide, $Sr[Au(CN)_2Cl_2]_2 + 8H_2O$.

Sol. in H_2O.

Zinc chlorauricyanide, $Zn[Au(CN)_2Cl_2]_2 + 7H_2O$.

Very sol. in H_2O.

Chlorhydric acid, HCl.

Liquid. Miscible with liquid CO_2 and H_2S.

Gas. Absorbed by H_2O with production of much heat.

H_2O absorbs 400–500 vols. at ord. temp and pressure or a little less than 1 pt. by weight (Dalton.)

1 vol. H_2O absorbs 480 vols. at 0°; sp. gr. of sat solution is 1.2109. (Davy.)

1 vol H_2O absorbs 417.822 vols. at 20°, the vol. increasing to 1.4138 vols.; 1 vol. of HCl+Aq then contains 311 vols. HCl, has sp. gr. 1.1958 and contains 40.39% HCl by weight. (Thomson. 1831.)

1 vol H_2O absorbs 464 vols. and sat. solution has 1.21 sp. gr and contains 42.4% HCl by weight. (Wittstein.)

H_2O sat. at 0° contains 480 times its vol. of HCl and sp. gr. = 1.2109; sat. at ord. temp., contains 38.3% of its weight in HCl, and sp. gr. = 1.192. (Berzelius.)

1 vol. H_2O absorbs V vols. HCl at t° and 760 mm pressure, and the liquid formed has the given sp. gr., and contains the given per cent HCl.

t°	V	Sp. gr.	% HCl
0	525.2	1.2257	45.148
4	494.7	1.2265	44.361
8	480.3	1.2185	43.828
12	471.3	1.2148	43.277
14	462.4	1.2074	42.829
18	451.2	1.2064	42.344
18.25	450.7	1.2056	42.283
23	435.0	1.2014	41.536

(Deicke, Pogg. **119.** 156.)

At 760 mm. pressure 1 g. H_2O absorbs g. HCl at t°.

t°	g. HCl	t°	g. HCl	t°	g. HCl
0	0.825	22	0.710	44	0.618
2	0.814	24	0.700	46	0.611
4	0.804	26	0.691	48	0.603
6	0.793	28	0.682	50	0.596
8	0.783	30	0.673	52	0.589
10	0.772	32	0.665	54	0.582
12	0.762	34	0.657	56	0.575
14	0.752	36	0.649	58	0.568
16	0.742	38	0.641	60	0.561
18	0.731	40	0.633	..	...
20	0.721	42	0.626	..	...

(Roscoe and Dittmar.)

Conc. HCl+Aq loses HCl, and dil. HCl+Aq loses H_2O on warming, until an acid of constant composition is formed, containing 20.18% HCl, with a sp. gr. of 1.101 at 15°, which can be distilled unchanged at 110°. (Bineau, A. ch. (3) **7.** 257.)

The above is true if barometer is at 760 mm., but the composition changes with the pressure as follows—

Mm. Hg	% HCl	Mm. Hg.	% HCl	Mm. Hg	% HCl
50	23.2	800	20.2	1700	18.8
100	22.9	900	19.9	1800	18.7
200	22.3	1000	19.7	1900	18.6
300	21.8	1100	19.5	2000	18.5
400	21.4	1200	19.4	2100	18.4
500	21.1	1300	19.3	2200	18.3
600	20.7	1400	19.1	2300	18.2
700	20.4	1500	19.0	2400	18.1
760	20.24	1600	18.9	2500	18.0

(Roscoe and Dittmar.)

Conc. HCl+Aq gradually gives off HCl on the air until it has a sp. gr. 1.128 at 15°, and contains 25.2% HCl. (Bineau, *l. c.*)

According to Roscoe and Dittmar, this depends on the temperature. If a current of air is passed through HCl+Aq, acid or water is given off according as the acid is strong or weak, until an acid of constant composition for a given temperature is formed, as follows—

Temp.	% HCl	Temp.	% HCl	Temp.	% HCl
0°	25.0	35°	23.9	70°	22.6
5	24.9	40	23.8	75	22.3
10	24.7	45	23.6	80	22.0
15	24.6	50	23.4	85	21.7
20	24.4	55	23.2	90	21.4
25	24.3	60	23.0	95	21.1
30	24.1	65	22.8	100	20.7

From the above it is seen that the acid which distils unchanged at a given pressure, that is, boils at a certain constant temperature, is identical with the acid which undergoes no change in composition by a current of dry air at the same temperature, and under the ordinary pressure, thus—

Mm. Hg	B.-pt.	% HCl	Temp. of air current	% HCl
100	61–62°	22.8	62°	22.9
200	76–77	22.1	77	22.2
300	84–85	21.7	85	21.7
380	91	21.3	91	21.4
490	97	20.9	98	21.1
620	103	20.6	..	....

(Roscoe and Dittmar.)

Solubility of HCl in H_2O at 0° under different degrees of pressure. P = partial pressure in mm. Hg, *i. e.*, total pressure minus the tension of aqueous vapour at the given temp.; G = grammes of HCl dissolved in 1 g. H_2O at the pressure P and 0° temp.

P	G	P	G
60	0.613	350	0.751
70	0.628	400	0.763
80	0.640	450	0.772
90	0.649	500	0.782
100	0.657	550	0.791
110	0.664	600	0.800
120	0.670	650	0.808
130	0.676	700	0.817
140	0.681	750	0.824
150	0.686	800	0.831
175	0.697	900	0.844
200	0.707	1000	0.856
225	0.716	1100	0.869
250	0.724	1200	0.882
275	0.732	1300	0.895
300	0.738	...	..

(Roscoe and Dittmar, A. **112.** 334.)

1 vol. H_2O dissolves 560 vols. HCl at −12°
" " 500 " " 0°
" " 440 " " +20°
(Berthelot, C. R. **76.** 779.)

1 vol. H_2O absorbs 480 vols. HCl at 15° to form a solution containing 42.85% HCl with a sp. gr. of 1.215. (Hager.)

Solubility of HCl at low temperatures, and 760 mm. pressure.

t°	Pts. HCl in 1 pt. H_2O	t°	Pts. HCl in 1 pt. H_2O
0	0.842	−18	0.957
− 5	0.864	−19	0.965
−10	0.898	−20	0.974
−15	0.933	−21	0.983
−17	0.949	−24	1.012

(Roozeboom, R. t. c. 1884, **3.** 79.)

Solubility in H_2O at t°.

t°	%HCl
50	61.65
45	61.76
40	62.27
35	62.90
30	63.21
20	64.19
15	64.70
10	65.18
5	65.48
0	65.85
− 5	66.44
−10	66.71
−50	67.29
−20	67.65

(Rupert, J. Am. Chem. Soc. 1909, **31.** 860.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.203	40.66	1.1285	27.21	1.0960	20.44
1.179	37.00	1.1197	25.52	1.0902	19.47
1.162	33.95	1.1127	24.03	1.0860	18.59
1.149	31.35	1.1060	22.70	1.0820	17.79
1.139	29.13	1.1008	21.51	1.0780	17.05

(Thomson, in his System, **2.** 189.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl
1.21	42.43	1.10	20.20
1.20	40.80	1.09	18.18
1.19	38.38	1.08	16.16
1.18	36.36	1.07	14.14
1.17	34.34	1.06	12.12
1.16	32.32	1.05	10.10
1.15	30.30	1.04	8.08
1.14	28.28	1.03	6.06
1.13	26.26	1.02	4.04
1.12	24.24	1.01	2.02
1.11	20.30	.	.

(Edm. Davy.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	B.-pt	Sp. gr.	% HCl	B.-pt.
1.199	34.01	49°	1.094	16.08	111°
1.181	31.09	65	1.075	13.16	[illegible]
1.166	28.29	76	1.064	11.16	107
1.154	26.57	87	1.047	8.62	105
1.144	24.84	100	1.035	6.92	104
1.136	23.25	103	1.018	3.52	102
1.127	21.06	105	1.009	1.86	101
1.121	20.74	109	...	.	..

(Kirwan and Dalton.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.
2.22	1.0103	29.72	1.1504
3.80	1.0189	31.50	1.1588
6.26	1.0310	34.21	1.1730
11.02	1.0557	36.63	1.1844
15.20	1.0751	38.67	1.1938
18.67	1.0942	40.51	1.2021
20.91	1.1048	41.72	1.2074
23.72	1.1196	43.09	1.2124
25.96	1.1308	..	..

(Kolb, C. R. **74.** 337.)

Sp. gr. of HCl+Aq at 15°.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.2000	40.777	1.1620	32.621	1.1206	24.466
1.1982	40.369	1.1599	32.213	1.1185	24.058
1.1964	39.961	1.1578	31.805	1.1164	23.650
1.1946	39.554	1.1557	31.398	1.1143	23.242
1.1928	39.146	1.1536	30.990	1.1123	22.834
1.1910	38.738	1.1515	30.582	1.1102	22.426
1.1893	38.330	1.1494	30.174	1.1082	22.019
1.1875	37.923	1.1473	29.767	1.1061	21.611
1.1859	37.516	1.1452	29.359	1.1041	21.203
1.1846	37.108	1.1431	28.951	1.1020	20.796
1.1822	36.700	1.1410	28.544	1.1000	20.288
1.1802	36.292	1.1389	28.136	1.0980	19.980
1.1782	35.884	1.1369	27.728	1.0960	19.572
1.1762	35.476	1.1349	27.321	1.0939	19.165
1.1741	35.068	1.1328	26.913	1.0919	18.757
1.1721	34.660	1.1308	26.505	1.0899	18.349
1.1701	34.252	1.1287	26.098	1.0879	17.941
1.1681	33.845	1.1267	25.690	1.0859	17.534
1.1661	33.437	1.1247	25.282	1.0838	17.126
1.1641	33.029	1.1226	24.874	1.0818	16.718

Sp. gr. of HCl+Aq at 15°—*Continued.*

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.0798	16.310	1.0517	10.602	1.0259	5.301
1.0778	15.902	1.0497	10.194	1.0239	4.893
1.0758	15.494	1.0477	9.768	1.0220	4.486
1.0738	15.087	1.0457	9.379	1.0200	4.078
1.0718	14.679	1.0437	8.971	1.0180	3.670
1.0697	14.271	1.0417	8.563	1.0160	3.262
1.0677	13.363	1.0397	8.155	1.0140	2.854
1.0657	13.456	1.0377	7.747	1.0120	2.447
1.0637	13.409	1.0357	7.340	1.0100	2.039
1.0617	12.641	1.0337	6.932	1.0080	1.631
1.0597	12.233	1.0318	6.524	1.0060	1.224
1.0577	11.825	1.0298	6.116	1.0040	0.816
1.0557	11.418	1.0279	5.709	1.0020	0.408
1.0537	11.010	...	..	...	...

(Ure, Handwörterbuch.)

Sp. gr. of HCl+Aq. U=sp. gr. at 15.55° according to Ure; K=sp. gr. at 15° according to Kremers.

%HCl	U	K	%HCl	U	K
1	1.005	1.005	22	1.109	1.111
2	1.010	1.010	23	1.114	1.116
3	1.015	1.015	24	1.119	1.121
4	1.020	1.020	25	1.124	1.126
5	1.025	1.025	26	1.128	1.131
6	1.030	1.030	27	1.133	1.136
7	1.034	1.034	28	1.138	1.141
8	1.039	1.039	29	1.143	1.146
9	1.044	1.044	30	1.147	1.151
10	1.048	1.048	31	1.153	1.157
11	1.053	1.053	32	1.157	1.163
12	1.059	1.059	33	1.163	1.169
13	1.064	1.065	34	1.169	1.179
14	1.069	1.070	35	1.174	...
15	1.074	1.075	36	1.179	...
16	1.079	1.080	37	1.183	...
17	1.084	1.085	38	1.188	...
18	1.089	1.090	39	1.193	..
19	1.094	1.095	40	1.197	...
20	1.098	1.100	41	1.203	...
21	1.104	1.105	..	...	...

(Calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of HCl+Aq at 15° (H_2O at 0°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
0	0.9992	15	1.07539	30	1.15079
1	1.00503	16	1.08042	31	1.15581
2	1.01005	17	1.08545	32	1.16084
3	1.01508	18	1.09047	33	1.16587
4	1.02010	19	1.09550	34	1.17089
5	1.02513	20	1.10052	35	1.17592
6	1.03016	21	1.10555	36	1.18095
7	1.03518	22	1.11058	37	1.18597
8	1.04021	23	1.11560	38	1.191
9	1.04524	24	1.12063	39	1.196
10	1.05026	25	1.12566	40	1.200
11	1.05529	26	1.13068	41	1.204
12	1.06031	27	1.13571	42	1.208
13	1.06534	28	1.14074	43	1.212
14	1.07037	29	1.14516	..	...

(Kolb, recalculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
5	1.0244	20	1.0982	35	1.1739
10	1.0488	25	1.1234	40	1.1969
15	1.0733	30	1.1488	41	1.2013

(Hager, Adjumenta varia, Leipzig, **1876.**)

Sp. gr. of HCl+Aq at 15° (H_2O at 15°=1).

% HCl	Sp. gr.	%HCl	Sp. gr.
44.345	1.21479	34.464	1.17138
43.136	1.21076	25.260	1.12479
41.901	1.20430	19.688	1.09675
41.212	1.20204	14.788	1.07255
39.831	1.19703	6.382	1.03150
37.596	1.18687	....	...

(Pickering, B. **26.** 277.)

Most accurate table.

Sp. gr. of HCl+Aq at 15° (H_2O at 4°=1).

Sp. gr.	% HCl	Kg. HCl in 1 l.	Sp. gr.	% HCl	Kg. HCl in 1 l.
1.000	0.16	0.016	1.105	20.97	0.232
1.005	1.15	0.012	1.110	21.92	0.243
1.010	2.14	0.022	1.115	22.86	0.255
1.015	3.12	0.032	1.120	23.82	0.267
1.020	4.13	0.042	1.125	24.78	0.278
1.025	5.15	0.053	1.130	25.75	0.291
1.030	6.15	0.064	1.135	26.70	0.303
1.035	7.15	0.074	1.140	27.66	0.315
1.040	8.16	0.085	1.145	28.61	0.322
1.045	9.16	0.096	1.150	29.57	0.340
1.050	10.17	0.107	1.155	30.55	0.353
1.055	11.18	0.118	1.160	31.52	0.366
1.060	12.19	0.129	1.165	32.49	0.379
1.065	13.19	0.141	1.170	33.46	0.392
1.070	14.17	0.152	1.175	34.42	0.404
1.075	15.16	0.163	1.180	35.39	0.418
1.080	16.15	0.174	1.185	36.31	0.430
1.085	17.13	0.186	1.190	37.23	0.443
1.090	18.11	0.197	1.195	38.16	0.456
1.095	19.06	0.209	1.200	39.11	0.469
1.100	20.01	0.220	...	...	...

(Lunge and Marchlewski, Z. angew. **Ch. 1891.** 133.)

Sp. gr. of HCl+Aq at room temp.

% HCl	Sp. gr.
8.14	1.0370
16.125	1.0843
23.045	1.1138

(Wagner, W. Ann. 1883, **18.** 264.)

Relation of sp. gr. of HCl+Aq at t° to sp. gr. at 19.5° = 1.0.

t°	8.9 % HCl sp. gr. = 1.0401	16.6 % HCl sp. gr. = 1.0704	25.5 % HCl sp. gr. = 1.101	35.8% HCl sp. gr. = 1.133	46.6 % HCl sp. gr. = 1.1608
0	0.99557	0.99379	0.99221	0.99079	0.98982
19.5	1.00000	1.00000	1.00000	1.00000	1.00000
40	1.00707	1.00781	1.00877	1.00990	1.01063
60	1.01588	1.01665	1.01794	1.01969	1.02180
80	1.02639	1.02676	1.02791	1.02986	...
100	1.03855	1.03801	1.03867	1.04059	...

(Kremers, Pogg. **108.** 115.)

Sp. gr. of HCl+Aq.

G. equivalents HCl per liter.	t°	Sp. gr. t°/t°
0.005036	17.111	1.0000943
0.01006	17.125	1.0001892
0.02008	17.148	1.0003775
0.04990	17.138	1.000935
0.09885	17.133	1.001843
0.19641	17.162	1.003633
0.29247	17.147	1.005382
0.48278	17.140	1.008811
0.4994	17.28	1.00908
4.994	17.35	1.08390

(Kohlrausch, W. Ann. 1894, **53.** 28.)

Sp. gr. of a normal solution of HCl+Aq at 18°/4° = 1.0165. (Loomis, W. Ann. 1896, **60.** 550.)

Sp. gr. of HCl+Aq at 19.5°, when p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w\right)$

p.	d.	w
36.0	1.1818	0.4255
29.97	1.1511	0.3450
24.35	1.1207	0.2729
18.55	1.0910	0.2024
12.22	1.0587	0.1294
9.148	1.0433	0.0954
6.559	1.0305	0.0676
3.540	1.0159	0.0360
5.345	1.0246	0.0548
1.356	1.0051	0.0136

(Barnes, J. Phys. Chem. 1898, **2.** 546.)

Sp. gr. of HCl+Aq at 18°/4°.

g. HCl in 100 g. of solution	Sp. gr.
0.12149	0.99928
0.060757	0.99900
0.040609	0.99887
0.030328	0.99881

(Jahn, Z. phys. Ch. 1900, **33.** 567.)

Sp. gr. of HCl+Aq at 20°.

Normality of HCl+Aq.	% HCl.	Sp. gr.
8.42	27.10	1.1336
5.784	19.30	1.0936
3.77	12.94	1.0618
2.031	7.17	1.0334
1.588	5.65	1.0261
1.138	4.05	1.0187
0.523	1.90	1.0076

(Forchheimer, Z. phys. Ch. 1900, **34.** 28.)

Sp. gr. at 20° of HCl+Aq containing M g. mols. HCl per liter.

M	0.025	0.05	0.075	0.10
Sp. gr.	1.00034	1.00101	1.00135	1.00180
M	0.25	0.50	0.75	1.0
Sp. gr.	1.00425	1.00849	1.01264	1.01749
M	1.5	2.0		
Sp. gr.	1.02542	1.03414		

(Jones and Pearce, Am. Ch. J. 1907, **38.** 730.)

HCl is not absorbed by conc. H_2SO_4+Aq, but in large amounts by anhydrous H_2SO_4. (Aimé.)

Absorption of HCl by H_2SO_4+Aq.

Temp. = 17°.

Sp. gr.	g. per l. HCl	g. per l. H_2SO_4	g. per 100 g. HCl	g. per 100 g. H_2SO_4
1.211	517.8	...	42.7	.....
1.220	487.3	22.7	39.9	1.86
1.220	478.8	58.0	39.2	4.75
1.235	455.3	99.3	36.9	8.04
1.260	418.0	161.7	33.2	12.8
1.305	371.4	273.2	28.5	20.9
1.355	306.6	417.7	22.6	30.8
1.430	215.3	638.2	15.0	44.6
1.545	96.7	917.6	6.26	59.4
1.580	51.3	1033.5	3.25	65.4
1.660	10.3	1224.0	0.62	73.7
1.735	1.89	1344.9	0.11	77.5
1.815	1.24	1615.3	0.068	89.0

Absorption of HCl by H_2SO_4+Aq—*Cont.*
Temp. = 40°.

Sp. gr.	g. per l. HCl	g. per l. H_2SO_4	g. per 100 g HCl	g. per 100 g H_2SO_4
1.185	421.4	42.2	35.6	3.56
1.195	416.4	70.0	34.8	5.86
1.210	392.1	107.7	32.4	8.90
1.255	346.3	211.2	27.6	16.8
1.255	325.4	236.3	25.9	18.8
1.340	247.4	383.7	18.5	28.6
1.400	161.6	619.4	11.5	44.2
1.520	50.9	929.3	3.35	61.1
1.575	18.5	1046.0	1.17	66.4
1.650	2.9	1207.6	0.17	73.2
1.725	1.4	1370.5	0.081	79.4
1.755	0.57	1428.4	0.032	81.4
1.770	0.52	1478.4	0.029	83.5

Temp. = 70°.

Sp. gr.	g. per l. HCl	g. per l. H_2SO_4	g. per 100 g. HCl	g. per 100 g. H_2SO_4
1.145	374.1	18.4	32.7	1.61
1.150	357.3	38.9	31.1	3.38
1.160	353.8	55.7	30.5	4.80
1.180	341.3	93.6	28.9	7.93
1.225	277.7	231.9	22.8	18.9
1.230	274.3	246.4	22.3	20.0
1.315	173.7	476.7	13.2	36.2
1.380	96.5	661.8	6.99	48.0
1.510	23.6	946.1	1.56	62.7
1.560	8.4	1055.0	0.54	67.6
1.700	0.86	1371.3	0.05	80.7
1.745	0.62	1448.2	0.035	83.0
1.745	0.57	1455.2	0.032	83.4

(Coppadoro, Gazz. ch. it. 1910, **39.** II, 626.)

100 pts. alcohol of 36° B absorb 68 pts. HCl at 12.5°. (Boullay.)

Alcohol of 0.836 sp. gr. dissolves 327 vols. HCl at 17.5° and 758 mm. pressure, and the solution has sp. gr. = 1.005. (Pierre, A. ch. (3) **31.** 135.)

Solubility of HCl in methyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
−10.3	54.6	18	46.9
0	51.3	31.7	43

(de Bruyn, R. t. c. **11.** 112.)

Solubility of HCl in ethyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
0	45.4	19.2	41
6.5	44.2	23.5	40.2
11.5	42.7	32.0	38.1

(de Bruyn, *l.c.*)

Solubility of HCl in ether at t° and 760 mm. pressure.

t°	% HCl	t°	% HCl
−9.2	37.51	15	27.62
−5	37.0	20	24.9
0	35.6	25	22.18
+5	33.1	30	19.47
10	30.35	..	.....

(Schuncke, Z. phys. Ch. 1894, **14.** 336.)

Sol. in glacial $HC_2H_3O_2$, ether, hexane, benzene, xylene, etc.

Oil of turpentine absorbs 50% HCl. (Thénard.)

Oil of turpentine absorbs 163 vols. HCl at 22° and 724 mm.; isoterebenthene absorbs 34% at 24° and 724 mm.; metaterebenthene absorbs 17.7% at 24° and 724 mm. (Berthelot.)

Oil of lavender absorbs 68.7 vols. at 24°. (Thénard.)

Oil of lavender absorbs 210 vols. without being saturated; oil of rosemary absorbs 218 vols. at 22°; sol. in 0.4 vol. petroleum. (Saussure.)

Absorbed by caprylic alcohol. (Bouis.)

Fuming HCl+Aq is sol. in glycerine and miscible with conc. $HC_2H_3O_2$.

Solubility of HCl in phenol+Aq at 12°.

Comp. of H_2O layer % HCl	Comp. of H_2O layer % phenol	Comp. of phenol layer % HCl	Comp. of phenol layer % phenol
0	7.45	0	72
3.1	6.6	0.09	78
6.6	5.3	0.2	80.3
8.0	5.1	0.36	82.6
10.7	4.8	0.52	84.5

Composition of solution in contact with solid phenol.

% H_2O	% HCl	% phenol
11.22	0	88.78
14.98	0.52	84.5
84.5	10.7	4.8
80.38	15.64	3.98
72.43	24.37	3.2
60.25	36.25	3.5

(Schreinemakers, Z. phys. Ch. 1912, **79.** 553.)

+H_2O. F.-pt. −15.35°.

Very sol. in H_2O but only slightly sol. in HCl. (Rupert, J. Am. Chem. Soc. 1909, **31.** 866.)

+$2H_2O$. M.-pt. −17.4°.

+$3H_2O$. M.-pt. −24.8°. (Pickering, B. 1893, **26.** 280.)

The composition of the hydrates formed by HCl at different dilutions is calculated

from determinations of the lowering of the f.-pt. produced by HCl, and of the conductivity and sp. gr. of HCl+Aq. (Jones, Am. Ch. J. 1905, **34.** 323.)

Chlorhydric cyanhydric acid, 3HCl, 2HCN.

Decomp. by H_2O or alcohol; sol. in $HC_2H_3O_2$. Insol. in ether, chloroform, or acetic ether. (Claisen, B. **16.** 309.)

HCl, HCN. Sol. in H_2O, absolute alcohol, $HC_2H_3O_2$, and $CHCl_3$, with decomp.; decomp. is especially rapid in H_2O. (Gautier, A. ch. (4) **17.** 130.)

Chloric acid, $HClO_3$.

Known only in aqueous solution, which can be concentrated in vacuo to a sp. gr. of 1.282 at 14.2°, and then contains 40.10% $HClO_3$, corresponding to $HClO_3+7H_2O$; if left longer in vacuo over H_2SO_4 an acid corresponding to $HClO_3+4\frac{1}{2}H_2O$ is obtained. Aqueous solution of $HClO_3$ decomp. at 40°. (Kämmerer, Pogg. **138.** 390.)

Chlorates.

All chlorates except mercurous chlorate are sol. in H_2O; most of them are deliquescent; many are sol. in alcohol.

Aluminum chlorate, $Al(ClO_3)_3+6H_2O$.

Very hygroscopic. (Dobroserdow, C. C. **1904,** II. 177.)

$+9H_2O$. Very sol. in cold but much less than in hot H_2O. (Dobroserdow.)

Ammonium chlorate, NH_4ClO_3.

Easily sol. in H_2O; less sol. in alcohol.

Much less sol. in H_2O at 0° than $NaClO_3$. (Storer.)

Very sl. sol. in absolute alcohol. (Wächter, J. pr. **30.** 321.)

Barium chlorate, $Ba(ClO_3)_2+H_2O$.

Sol. in 4 pts. cold, and less hot H_2O. (Chevenix.)

100 pts. H_2O dissolve at:

0°	20°	40°	60	80°	100°
22.8	37.0	52.1	77.5	98.0	126.4 pts. $Ba(ClO_3)_2$.

100 grams sat. $Ba(ClO_3)_2$+Aq at t° contain grams anhydrous $Ba(ClO_3)_2$.

t°	Grams $Ba(ClO_3)_2$	t°	Grams $Ba(ClO_3)_2$
Eutectic point.			
−2.749 ±0.004	15.28	50	36.69
0	16.90	60	40.05
+10	21.23	70	43.04
20	25.26	80	45.90
25	27.53	90	48.70
30	29.43	99.1	51.17
40	33.16	*104.6	52.67

* 104.6° is bpt. at 740 mm. pressure= 105.0° at 760 mm. pressure.

(Anschütz, Z. phys. Ch. 1906, **56.** 238.)

Solubility of $Ba(ClO_3)_2$ in H_2O.

t°	g. $Ba(ClO_3)_2$ in 100 g. H_2O	Sp. gr.
0	25.5	1.195
20	39.3	1.274
40	55.9	1.355
60	74.1	1.433
80	92.1	1.508
100	113.2	1.580
105.6 *	120.	1.600

* Bpt. of sat. solution.

(Carlson, Dissert. **1910.**)

Only slight traces dissolve in absolute alcohol. (Wächter, J. pr. **30.** 334.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethylacet ate (Naumann, B. 1910, **43.** 314.)

Bismuth chlorate.

Known only in solution, which decomp. on evaporation.

Cadmium chlorate, $Cd(ClO_3)_2+2H_2O$.

Very deliquescent; sol. in H_2O and alcohol. Melts in crystal H_2O at 80°. (Wächter, J. pr. **30.** 321.)

Solubility in H_2O.

Sat. solution contains at:

−20°	−15°	0°	+18°	49°	65°
72.18	72.53	74.95	76.36	80.08	82.95% $Cd(ClO_3)_2$.

Sp. gr. of solution containing 76.36% $Cd(ClO_3)_2$ at 18° = 2.284. (Meusser, B. 1902, **35.** 1422.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Cadmium chlorate ammonia, $Cd(ClO_3)_2$, $6NH_3$.

Ppt. (Ephraim, B. 1915, **48.** 49.)

Cæsium chlorate, $CsClO_3$.

100 g. H_2O dissolve at:

0°	8°	19.8°	30°	42.2°	50°	77°	99°
2.46	3.50	6.28	9.53	14.94	19.40	41.65	76.5 g. $CsClO_3$.

(Calzolari, Acc. Sc. med. di Ferrara, 1911, **85.** 150.)

Calcium chlorate, $Ca(ClO_3)_2+2H_2O$.

Deliquescent; very sol. in H_2O and alcohol. (Wächter, J. pr. **30.** 323.)

Melts in its water of crystallization at over 100°.

Sp. gr. of solution sat. at 18° = 1.729, containing 64% $Ca(ClO_3)_2$. (Mylius B. 1897, **30.** 1718.)

Sol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37.** 4328.)

Chromic chlorate.

Easily sol. in H_2O. (Prudhomme, C. C. **1890**, 1. 668.)

Cobaltous chlorate, $Co(ClO_3)_2+2H_2O$. (Meusser, B. 1902, **35.** 1418.)

$+4H_2O$. Solubility in H_2O.

Sat. solution contains at:

18°	21°	35°	47°	61°
64.19	64.39	67.09	69.66	76.12% $Co(ClO_3)_2$.

Sp. gr. of solution containing 64.19% $Co(ClO_3)_2$ at 18° = 1.861. (Meusser, B. 1902, **35.** 1418.)

$+6H_2O$. Very deliquescent. Sol. in H_2O and alcohol. Melts in crystal H_2O at 50°. (Wächter, J. pr. **30.** 321.)

Solubility in H_2O.

Sat. solution contains at:

−21°	−19°	0°	+10.5°
53.30	53.61	57.45	61.83% $Co(ClO_3)_2$.

(Meusser, B. 1902, **35.** 1418.)

Cupric chlorate, basic, $Cu(ClO_3)_2, 3Cu(OH)_2$.

Insol. in H_2O. Very sol. in dil. acids. Sol. in warm conc. $Cu(ClO_3)_2$+Aq, the solubility increasing with the conc. and temp. (Bourgeois, Bull. Soc. 1898, (3) **19.** 950.)

Cupric chlorate, $Cu(ClO_3)_2+4H_2O$.

Solubility in H_2O.

Sat. solution contains at:

−31°	−21°	+0.8°	18°	45°
54.59	57.12	58.51	62.17	66.17

59.6°	71°
69.42	76.9% $Cu(ClO_3)_2$.

Sp. gr. of the solution containing 62.17% $Cu(ClO_3)_2$ at 18° = 1.695. (Meusser, B. 1902, **35.** 1420.)

$+6H_2O$. Very deliquescent. Easily sol. in H_2O and alcohol. Melts in its crystal H_2O at 65°. (Wächter, J. pr. **30.** 321.)

Sp. gr. of $Cu(ClO_3)_2$+Aq at 15°.

% $Cu(ClO_3)_2$	2.106	4.778	6.945
Sp. gr.	1.01620	1.03857	1.05714

% $Cu(ClO_3)_2$	10.016	14.387
Sp. gr.	1.0844	1.12531

(Traube, Gm.-K. **5.** 1, 921.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Cupric chlorate ammonia, $Cu(ClO_3)_2, 4NH_3$. Ppt. Not hydroscopic. Insol. in alcohol.

$Cu(ClO_3)_2,6NH_3$. Not hydroscopic. (Ephraim, B. 1915, **48.** 46.)

Erbium chlorate, $Er(ClO_3)_3+8H_2O$.

Deliquescent. Sol. in H_2O and alcohol.

Glucinum chlorate.

Known only in aqueous solution, which decomposes on evaporation.

Ferrous chlorate.

Known only in solution.

Ferric chlorate, $Fe(ClO_3)_3$.

Sol. in H_2O.

Basic salt. Insol. in H_2O.

Lanthanum chlorate, $La(ClO_3)_3$.

Deliquescent. (Cleve.)

Lead chlorate, $Pb(ClO_3)_2+H_2O$.

Deliquescent; easily sol. in H_2O and alcohol. (Wächter, J. pr. **30.** 321.)

Sp. gr. of solution sat. at 18° = 1.947 and contains 60.2% $Pb(ClO_3)_2$. (Mylius, B. 1897, **30.** 1718.)

100 g. H_2O dissolve 440 g. $Pb(ClO_3)_2$ at 18°; sp. gr. of sat. solution = 1.63. (Carlson, Dissert. **1910.**)

Lithium chlorate, $LiClO_3+\frac{1}{2}H_2O$.

Very deliquescent and sol. in H_2O. Very easily sol. in alcohol. Melts at 50° in its crystal water. (Wächter, J. pr. **30.** 321.)

$LiClO_3$+Aq sat. at 18° contains 75.8% $LiClO_3$. Sp. gr. = 1.815. (Mylius, B. 1897, **30.** 1718.)

483 g. $LiClO_3$ dissolve in 100 g. H_2O at 15°; sp. gr. of solution = 1.82. (Carlson, Dissert. **1910.**)

Contains $3H_2O$, and is not deliquescent. (Lagorio, Zeit. f. Kryst. **15.** 80.)

Salt is anhydrous. (Retgers, Z. phys. Ch. **5.** 449.)

Magnesium chlorate, $Mg(ClO_3)_2$.

128.1 g. $Mg(ClO_3)$ dissolve in 100 g. H_2O at 19°; sp. gr. of solution = 1.59. (Carlson, Dissert. **1910.**)

Sp. gr. of solution containing 56.5% $Mg(ClO_3)_2$ at 18° = 1.564. (Meusser, *l.c.*)

Sp. gr. of solution sat. at 18° = 1.594, containing 56.3% $Mg(ClO_3)_2$. (Mylius, B. 1897, **30.** 1718.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. in acetone. (Eidmann, C. C. **1899**, II. 1014.)

$+2H_2O$. Solubility in H_2O.

Sat. solution contains at:

39.5°	61°	68°	93°
65.37	69.46	70.69	73.71% $Mg(ClO_3)_2$.

(Meusser, B. 1902, **35.** 1416.)

$+4H_2O$. Solubility in H_2O.
Sat. solution contains at:

42°	65.5°
63.82	69.12% $Mg(ClO_3)_2$.

(Meusser, *l.c.*)

$+6H_2O$. Very deliquescent and sol. in H_2O. Very easily sol. in alcohol. Melts at 40° in its crystal water. (Wächter, J. pr. **30.** 325.)
Solubility in H_2O.
Sat. solution contains at:

−18°	0°	+18°	29°	35°
51.64	53.27	56.50	60.23	63.65% $Mg(ClO_3)_2$.

(Meusser)

Manganous chlorate, $Mn(ClO_3)_2$.

Known only in solution which decomposes on evaporation. (Wächter.)

Mercurous chlorate, $Hg_2(ClO_3)_2$.

a. Easily sol. in alcohol and H_2O. (Wächter, J. pr. **30.** 321.)
β. Insol. in H_2O; easily sol. in $HC_2H_3O_2$+Aq. (Wächter.) Decomp. by boiling H_2O.

Mercuric chlorate, $2HgO, Cl_2O_5+H_2O$.

Deliquescent. Decomp. by H_2O into oxide and an acid salt. (Wächter.)
Sol. in 4 pts. cold H_2O. (Chevenix, **1802.**)

Nickel chlorate, $Ni(ClO_3)_2+4H_2O$.

Solubility in H_2O.
Sat. solution contains at:

48.5°	55°	65°	79.5°
67.60	68.78	69.05	75.50% $Ni(ClO_3)_2$.

(Meusser, B. 1902, **35.** 1419.)

$+6H_2O$. Deliquescent. Easily sol. in H_2O and alcohol. Melts in crystal H_2O at 80°. (Wächter, J. pr. **30.** 321.)
Solubility in H_2O.
Sat. solution contains at:

−18°	−8°	0°	+18°	40°
49.55	51.52	52.66	56.74	64.47% $Ni(ClO_3)_2$.

Sp. gr. of solution containing 56.74% $Ni(ClO_3)_2$ at 18° = 1.661.
Goes over into $4H_2O$ salt at 39°. (Meusser.)
156 g. $Ni(ClO_3)_2$ dissolve in 100 g. H_2O at 16°; sp. gr. of solution = 1.76. (Carlson, Dissert. **1910.**)

Nickel chlorate ammonia, $Ni(ClO_3)_2, 6NH_3$.

Ppt. (Ephraim, B. 1915, **48.** 47.)

Potassium chlorate, $KClO_3$.

Sol. in H_2O with absorption of heat.

Sol. in about 16 pts. cold, and in much less hot H_2O. (Chevenix, **1802.**)
Sol. in 30.03 pts. H_2O at 0°; 17.85 pts. at 13.3°; and in 1.66 pts. at 104.78°. (M. R. and P.)

Sol. in 16 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O at 15.5° dissolve 6.2 pts.; at 100°, 40 pts. (Ure's Dict.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°—

t°	28	35	40	47	65
Pts. $KClO_3$	9.5	12.3	14.4	18.3	29.1

(Gerardin.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
0	3.33	35.0	12.05
13.32	5.60	49.08	18.96
15.37	6.03	74.89	35.40
24.43	8.41	104.78	60.24

(Gay-Lussac, A. ch. **11.** 314.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
0	3.3	130	88.5
100	56.5	180	190

(Tilden and Shenstone, Roy. Soc. Proc. **35.** 345.)

100 pts. H_2O dissolve pts. $KClO_3$ at t°.

t°	Pts. $KClO_3$	t°	Pts. $KClO_3$
120	73.7	160	148
136	98.9	190	183

(Tilden and Shenstone, Phil. Trans. **1884. 23.**)

Coefficient of solubility is $3.2+0.109t+0.0043t^2$ between 0° and 35°. (Blarez, C. R. **112.** 1213.)

Sat. $KClO_3$+Aq contains % $KClO_3$ at t°.

t°	% $KClO_3$	t°	% $KClO_3$
−0.5	2.6	92	31.2
−0.3	2.4	106	37.2
+4.5	3.5	130	47.0
4.5	2.9	171	59.8
11	4.7	180	62.1
19	6.1	190	63.1
29	8.9	200	64.2
36	9.9	207	66.0
42	11.4	300	87.0
56	15.1	330	96.7
58	16.6		

(Étard, A. ch. 1894, (7) **2.** 528.)

Solubility in H_2O.

Temp.	% $KClO_3$ in a sat. sol.	Pts. sol. in 100 pts. H_2O	Pts. H_2O to 1 pt. $KClO_3$
0°	3.06	3.14	31.8
5	3.67	3.82	26.2
10	4.27	4.45	22.5
15	5.11	5.35	18.5
20	6.76	7.22	13.6
25	7.56	8.17	12.2
30	8.46	9.26	10.8
35	10.29	11.47	8.7
40	11.75	13.31	7.5
45	13.16	14.97	6.6
50	15.18	17.95	5.6
55	16.85	20.27	4.9
60	18.97	23.42	4.2
65	20.32	25.50	3.9
70	22.55	29.16	3.4
75	24.82	32.99	3.0
80	26.97	36.93	2.6
85	29.25	41.35	2.4
90	31.36	46.11	2.1
95	33.76	51.39	1.9
100	35.83	55.54	1.8

(Pawlewski, B. 1899, **32.** 1041.)

1 l. $KClO_3$+Aq at 25° contains 675 millimols. $KClO_3$. (Calvert, Z. phys. Ch. 1901, **38.** 541.)

100 g. H_2O dissolve at:

	0°	20°	40°	60°
	3.3	7.4	13.8	24.0 g. $KClO_3$
Sp. gr.	1.021	1.045	1.073	1.115

	80°	100°	104° *
	37.7	56.5	59.9 g. $KClO_3$,
Sp. gr.	1.165	1.219	1.230

* Bpt. of sat. solution.

(Carlson, Dissert. **1910**.)

100 g. H_2O dissolve at:

8°	19.8°	30°	99°
4.48	7.15	10.27	57.3 g. $KClO_3$.

(Calzolari, Acc. Sc. med. di Ferrara, 1911, **85.** 150.)

Sat. $KClO_3$+Aq contains at:

53°	68°	81°	86° (?)
17.37	23.25	23.53	30.46% $KClO_3$.

(Tschugaeff, Z. anorg. 1914, **86.** 161.)

Sp. gr. of $KClO_3$+Aq, according to Kremer's experiments (Pogg. **96.** 62), and Gerlach's calculations. (Z. anal. **8.** 290.)

% $KClO_3$	Sp. gr.	% $KClO_3$	Sp. gr.
1	1.007	6	1.039
2	1.014	7	1.045
3	1.020	8	1.052
4	1.026	9	1.059
5	1.033	10	1.066

Sp. gr. of $KClO_3$+Aq at 20° containing 1 mol. $KClO_3$ to 100 mols. H_2O=1.04122. (Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of $KClO_3$+Aq at 15° containing 5% $KClO_3$=1.0316. (Kohlrausch, W. Ann. **1879.** 1.)

B.-pt. of $KClO_3$+Aq containing pts. $KClO_3$ to 100 pts. H_2O.

Pts. $KClO_3$	B.-pt.	Pts. $KClO_3$	B.-pt.
6.5	100.5°	41.6	103.0°
13.2	101.0	53.4	103.5
20.2	101.5	62.2	104.0
27.8	102.0	69.2	104.4
35.8	102.5	....	...

(Gerlach, Z. anal. **26.** 450.)

Saturated solution boils at 105°. (Kremers.)

Saturated solution boils at 104.2°, and contains 61.5 pts. $KClO_3$ to 100 pts. H_2O. (Legrand.)

Saturated solution boils at 103.3°, and contains 66.6 pts. $KClO_3$ to 100 pts. H_2O. (Griffiths.)

Saturated solution boils at 104.4°. (Gerlach, Z. anal. **26.** 427.)

Sol. in pure HNO_3 without decomp., but decomp. at once by HNO_3 containing NO_2. (Millon, A. ch. (3) **6.** 92.)

Sol. in sat. NH_4Cl+Aq without causing pptn.

1 mol. (=129 pts.) $KClO_3$ dissolves in 2493 vols. H_2O; in 2208 vols. H_2O when 1 mol. (=59 pts.) NaCl is added; in 2060 vols. H_2O with 2 mols. (=118 pts.) NaCl; and in 1910 vols. H_2O with 4 mols. (=236 pts.) NaCl. (Gladstone, Chem. Soc. **15.** 302.)

$KClO_3$ is sol. in about—

29.50 pts. H_2O.

35.50 pts. NH_4OH+Aq conc.

39.00 pts. dil. NH_4OH+Aq (1 vol. conc.: 3 vols. H_2O).

30.50 pts. HNO_3+Aq (1 vol. conc. HNO_3: 5 vols. H_2O).

33.0 pts. HCl+Aq (1 vol. conc. HCl: 4 vols. H_2O).

48.00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial $HC_2H_3O_2$:1 vol. H_2O).

31.50 pts. NH_4Cl+Aq (1 pt. NH_4Cl:10 pts. H_2O).

18.00 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3:10 pts. H_2O).

34.00 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH+Aq+dil. $HC_2H_3O_2$+Aq).

32.50 pts. $NaC_2H_3O_2$+Aq (commercial $HC_2H_3O_2$+Na_2CO_3, diluted with 4 vols. H_2O).

31.50 pts. $Cu(C_2H_3O_2)_2$+Aq. (*See* Stolba, Z. anal. **2.** 390.)

33.50 pts. cane-sugar (1 pt. cane-sugar : 10 pts. H_2O).

36.50 pts. grape-sugar (1 pt. grape-sugar: 10 pts. H_2O). (Pearson, Zeit. Chem. **1869.** 662.)

Addition of K salts to sat. $KClO_3$+Aq ppts. $KClO_3$ in such a way, that the sum of the

$KClO_3$ remaining in solution and the K in the salt added, is a constant, which constant is equal to the solubility of $KClO_3$, so that the following formula represents the coefficiency of solubility of $KClO_3$ after addition of a K salt, $3.2+0.109t+0.0043t^2$ – K of salt added. (Blarez, C. R. **112.** 1213.)

Solubility of $KClO_3+TlClO_3$.

100 g. H_2O dissolve g. salts

t°	g. $TlClO_3$	g. $KClO_3$
0	2.8	3.3
15	10	1.5
50	12.67	16.2
100	57.3	48.2

(Rabe, Z. anorg. 1902, **31.** 156.)

Solubility of $KClO_3$ in KNO_3+Aq.

t°	g. per l.	
	KNO_3	$KClO_3$
19.85	0.00	69.88
	12.65	64.86
	25.29	60.33
	101.19	45.85
	202.38	40.20
23.87	0.00	79.09
	50.59	63.14

(Arrhenius, Z. phys. Ch. 1893, **11.** 397.)

Solubility in KCl+Aq at 20° C.

G. KCl in 1 litre	G. $KClO_3$ in 1 litre	Sp. gr.
0	71.1	1.050
10	58	1.050
20	49	1.050
30	43	1.050
40	39.5	1.054
50	36.5	1.058
60	34	1.064
70	32	1.070
80	30	1.075
90	28	1.081
100	27	1.086
110	25.5	1.091
120	24.5	1.098
130	23.5	1.103
140	22.5	1.108
150	21.5	1.113
160	21.0	1.119
170	20.5	1.124
180	20.0	1.130
190	20.0	1.135
200	20	1.140
210	20	1.145
220	20	1.150
230	20	1.156
240	20	1.161
250	20	1.168

(Winteler, Z. Elektrochem. 1900, **7.** 361.)

Solubility in KOH+Aq at 25°.

KOH+Aq	Millimols $KClO_3$ per litre of the solution
1/8-normal	624
1/4-normal	573

(Calvert, Z. phys. Ch. 1901, **38.** 541.)

Solubility in H_2O_2 at 25°.

Concentration of H_2O_2 millimols per litre	Millimols $KClO_3$ per litre of the solution
1260	730
1310	737

(Calvert, *l.c.*)

Solubility in ¼ normal KOH+Aq in presence of H_2O_2 at 25°.

Concentration of H_2O_2 millimols per litre	Millimols $KClO_3$ per litre of the solution
15	578
276	584
954	616
1073	673

(Calvert, *l.c.*)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Neither dissolved nor attacked by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Sol. in 120 pts. alcohol of 83% at 16°. (Wittstein.)

Sol. in 120 pts. alcohol of 77.1%. (Pohl, W. A. B. **6.** 595.)

Insol. in absolute alcohol. (Gerardin.)

Solubility of $KClO_3$ in dil. alcohol. D=sp. gr. of alcohol; S=solubility in **100** pts. alcohol at t°.

D=0.9904		D=0.9848		D=0.9793	
t°	S	t°	S	t°	S
13	4.9	14	4.7	14	3.2
21	6.3	26	7.1	26	5.4
25	7.5	39	9.3	38	7.9
30	9.1	47	12.8	46	10.8
35	10.2	55	16.1	51	12.2
44	13.6	65	22.3	63	17.5
50	16.2	66	22.5	65	19.0

D=0.9726		D=0.9573		D=0.9390	
t°	S	t°	S	t°	S
13	2.2	13	1.9	14.5	1.1
20	3.3	20	2.7	28	2.2
33	5.8	29	3.6	40	3.4
43	7.2	36	4.3	50	4.3
56	11.4	55	7.9	62	6.6
59	12.9	60	9.7	67	7.6
..	....	63	10.5	..	..

Solubility of $KClO_3$ in dil. alcohol—*Continued.*

D = 0.9111		D = 0.8967		D = 0.8429	
t°	S	t°	S	t°	S
13	0.74	12	6.46	25	0.03
25	1.08	31	1.28	34	0.12
32	1.78	43	1.95	56	0.24
52	3.35	58	3.10	64	0.32

(Gerardin, A. ch. (4) **5.** 148.)

Solubility of $KClO_3$ in alcohol + Aq.

wt. % alcohol	g. $KClO_3$ per 100 g. solution	
	t = 30°	t = 40°
0	9.23	12.23
5	7.72	10.48
10	6.44	8.84
20	4.51	6.46
30	3.21	4.67
40	2.35	3.41
50	1.64	2.41
60	1.01	1.41
70	0.54	0.78
80	0.24	0.34
90	0.06	0.12

(Taylor, J. phys. Ch. 1897, **1.** 301.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Solubility of $KClO_3$ in acetone + Aq.

wt. % acetone	g. $KClO_3$ per 100 g. solution	
	t = 30°	t = 40°
0	9.23	12.23
5	8.32	11.10
9.09	7.63	10.28
20	6.09	8.27
30	4.93	6.69
40	3.90	5.36
50	2.90	4.03
60	2.03	2.86
70	1.24	1.68
80	0.57	0.79
90	0.18	0.24

(Taylor, J. phys. Ch. 1897, **1.** 301.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
Solubility in glycol = 0.9% at ord. temp. (de Coninck, Belg. Acad. Bull. **1905.** 359.)
100 g. glycerol (sp. gr. 1.256) dissolve 3.54 g. $KClO_3$ at 15–16°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Potassium silver chlorate, $KClO_3$, $AgClO_3$.
(Pfaundler, W. A. B. **46,** **2.** 266.)

Rubidium chlorate, $RbClO_3$.
100 pts. H_2O dissolve 2.8 pts. at 4.7°; 3.9 pts. at 13°; 4.9 pts. at 18.2°; 5.1 pts. at 19°. (Reissig, A. **127.** 33.)
100 g. H_2O dissolve 3.1 $RbClO_3$ at 15°; sp. gr. of solution = 1.07. (Carlson, Dissert. **1910.**)

100 g. H_2O dissolve at:

0°	8°	19.8°	30°	
2.138	3.07	5.36	8.00	g. $RbClO_3$,
42.2°	50°	76°	99°	
12.48	15.98	34.12	62.8	g. $RbClO_3$.

(Calzolari, Acc. Sc. med. di Ferrara, 1911, **85.** 150.)

Scandium chlorate.
(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Silver chlorate, $AgClO_3$.
Sol. in 10–12 pts. cold H_2O (Vauquelin); in 8–10 pts. cold, and 2 pts. hot H_2O (Chevenix); in 5 pts. cold H_2O (Wächter). Sl. sol. in alcohol (Chevenix); easily sol. in alcohol (Wächter).

Silver chlorate ammonia, $AgClO_3$, $2NH_3$.
Easily sol. in H_2O or alcohol. (Wächter, **1843.**)

Sodium chlorate, $NaClO_3$.
Deliquescent.

Sol. in 3 pts. cold and less hot H_2O. (Wächter; Chevenix.)
Sol. in 3 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O dissolve 35.5 pts. $NaClO_3$. (Ure's Dict.)

100 pts. H_2O dissolve at:

0°	20°	40°	60°	
81.9	99	123.5	147.1	pts. $NaClO_3$,
80°	100°	120°		
175.6	232.6	333.3		pts. $NaClO_3$.

(Kremers, Pogg. **97.** 4.)

100 pts. H_2O dissolve 89.3 pts. $NaClO_3$ at 12°. (Schlösing.)

100 g. H_2O dissolve at:

	−15°	0°	20°	40°	
	72	79	101	126	pts. $NaClO_3$,
Sp. gr.	1.380	1.389	1.430	1.472	
	60°	80°	100°	122° *	
	155	189	230	286	pts. $NaClO_3$.
Sp. gr.	1.514	1.559	1.604	1.654	

* Bpt. of sat. solution.

(Carlson, Dissert. **1910.**)

100 g. $NaClO_3$+Aq contain at:

4.78°	19.85°	30.05°	35.10°	44.72°	
45.47	48.91	51.22	52.36	54.50	g. $NaClO_3$.

(Le Blanc and Schmandt, Z. phys. Ch. 1911, **77.** 614.)

Sp. gr. of $NaClO_3$+Aq, containing:

10	15	20	25	30	25% $NaClO_3$.
1.070	1.108	1.147	1.190	1.235	1.282

(Gerlach, Z. anal. **8.** 290.)

Sp. gr. of $NaClO_3$+Aq at 20° containing 1 mol. $NaClO_3$ in 100 mols. H_2O = 1.03844. (Nicol, Phil. Mag. (5) **16.** 122.)

$NaClO_3$+Aq containing 7.23% $NaClO_3$ has sp. gr. 20°/20° = 1.0496. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

Sat. solution boils at 132°, and temp. can be raised to 135° by supersaturation. (Kremers, Pogg. **97.** 4.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

$NaClO_3$+NaCl.

100 pts. H_2O dissolve 50.75 pts. $NaClO_3$+24.4 pts. NaCl at 12°; 100 pts. H_2O dissolve 249.6 pts. $NaClO_3$+11.5 pts. NaCl at 122°, and when cooled to 12° contain 68.6 pts. $NaClO_3$+11.5 pts. NaCl. (Schlösing, C. R. **73.** 1272.)

Solubility in NaCl+Aq at 20° C.

G. NaCl in 1 litre	G. $NaClO_3$ in 1 litre	Sp. gr.
5	668	1.426
10	661	1.424
15	653	1.423
20	645	1.421
25	638	1.419
30	630	1.418
35	622	1.417
40	615	1.415
45	607	1.414
50	599	1.412
55	590	1.411
60	582	1.409
65	574	1.408
70	566	1.406
75	559	1.405
80	551	1.404
85	544	1.402
90	537	1.401
95	529	1.399
100	522	1.398
105	514	1.396
110	507	1.394
115	499	1.392
120	491	1.391
125	484	1.389
130	476	1.387
135	467	1.385
140	459	1.383
145	451	1.381
150	442	1.379
155	432	1.377
160	423	1.374
165	414	1.372
170	403	1.369
175	393	1.365
180	382	1.362
185	371	1.359
190	360	1.355
195	349	1.350
200	338	1.345
205	326	1.340
210	315	1.335
215	302	1.330
220	287	1.324
225	271	1.319
230	257	1.313
235	243	1.307
240	228	1.301
245	211	1.295
250	197	1.289
255	184	1.283
260	170	1.276
265	150	1.270
270	135	1.263
275	120	1.256
280	105	1.249
285	91	1.241
290	78	1.235
295	67	1.226
300	55	1.217

(Winteler, Z. Elektrochem. 1900, **7.** 361.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in 34 pts. alcohol of 83% at 16° and in less hot alcohol. (Wittstein.)

Somewhat more easily sol. in alcohol than NaCl. (Berzelius.)

Solubility of $NaClO_3$ in alcohol.
(g. $NaClO_3$ per l. of solution.)

t°	Alcohol		
	90 %	75 %	50 %
20	16.1	110.8	311.3
40	22.9	133.5	321.8
60	29.0	155.8	326.8
70	....	161.3	....

(Carlson, Dissert. **1910.**)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

100 g. glycerol dissolve 20 g. $NaClO_3$ at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Strontium chlorate, $Sr(ClO_3)_2+5H_2O$.

Very deliquescent, and sol. in H_2O. (Topsoë, W. A. B. **66, 2.** 29.)

Sp. gr. of solution sat. at 18° containing 63.3% $Sr(ClO_3)_2$ = 1.839. (Mylius, B. 1897, **30.** 1718.)

Easily sol. in H_2O, less in alcohol, but more sol. in alcohol than $SrCl_2$. (Souchay, A **102.** 381.)

Insol. in absolute alcohol. (Wächter.)

Thallous chlorate, $TlClO_3$.

Sol. in H_2O, but decomp. by heating.

100 pts. H_2O dissolve at:

0°	20°	50°	80°	100°	
2.80	3.92	12.67	36.65	57.31	pts. $TlClO_3$.

(Muir, Chem. Soc. **29.** 857.)

1 l. $TlClO_3$+Aq sat. at 10° contains 25.637 g. $TlClO_3$. (Roozeboom, Z. phys. Ch. **8.** 532.)

1 l. H_2O dissolves 0.134 equivalents $TlClO_3$ at 20°; or 38.51 g. in 1 l. of the solution (mean of 10 experiments). (Noyes and Farrell, J. Am. Chem. Soc. 1911, **33.** 1657.)

Solubility in Tl_2SO_4+Aq at 20°.

G. equiv. per l.		Solid phase
$TlClO_3$	Tl_2SO_4	
0.1058	0.1366	$TlClO_3+Tl_2SO_4$

(Noyes and Farrell, *l.c.*)

Thallic chlorate, $Tl(ClO_3)_3+4H_2O$.

Very deliquescent; sol. in H_2O. Decomp. slowly in the air. (Gewecke, Z. anorg. 1912, **75.** 273.)

Ytterbium chlorate.

Sol. in H_2O. (Popp, A. **131.** 179.)

Yttrium chlorate, $Y(ClO_3)_3+8H_2O$.

Deliquescent. Easily sol. in alcohol. Sl. sol. in ether. (Cleve.)

Zinc chlorate, $Zn(ClO_3)_2+4H_2O$.

Solubility in H_2O.

Sat. solution contains at:

+18°	30°	40°	55°
66.52	67.66	69.06	75.44% $Zn(ClO_3)_2$.

Sp. gr. of solution containing 66.52% $Zn(ClO_3)_2$ at 18° = 1.916.

(Meusser, B. 1902, **35.** 1417.)

More sol. in H_2O than chlorates of Mg, Co, Ni or Cu; less sol. than chlorate of Cd; more sol. than $Zn(NO_3)_2$. (Meusser, *l.c.*)

$+6H_2O$. Very deliquescent. Easily sol. in H_2O and alcohol. Melts in crystal H_2O at 60°. (Vauquelin, A. ch. **95.** 113.)

Solubility in H_2O.

Sat. solution contains at:

−18°	0°	8°	15°
55.62	59.19	60.20	67.32% $Zn(ClO_3)_2$.

(Meusser, *l.c.*)

Sp. gr. of solution sat. at 18° containing 65% $Zn(ClO_3)_2$ = 1.914. (Mylius, B. 1897, **30.** 1718.)

Zinc chlorate ammonia, $Zn(ClO_3)_2$, $4NH_3$.

$Zn(ClO_3)_2$, $6NH_3$. Ppt. (Ephraim, B. 1915, **48.** 48.)

Perchloric acid

See **Perchloric acid.**

Chlorides.

Most chlorides are sol. in H_2O; a few, however, are insol. or nearly so therein, the chief of which are AgCl, Hg_2Cl_2, Cu_2Cl_2, $PtCl_2$, and AuCl. Several chlorides are decomp. into insol. basic salts or hydroxides, either by the addition of H_2O, as in the case of $BiCl_3$ and $SbCl_3$, or on evaporating the aqueous solution, as $AlCl_3$, $ZnCl_2$, $MgCl_2$, etc.

Some chlorides are sol. in alcohol or ether. *See* under each element.

Chlorine, Cl_2.

The maximum solubility of Cl in H_2O is at 10° (Schönfeld); at 8–10° (Gay-Lussac); at 9–10° (Pelouze).

Solubility decreases from 9–0°; at 100° the solubility = 0. (Gay-Lussac.)

Cl_2+Aq sat. at 6° has sp. gr. = 1.003. (Berthelot.)

1 vol. H_2O at t° absorbs vols. Cl reduced to 0° and 760 mm. pressure.

t°	Vols. Cl	t°	Vols. Cl
10	2.5852	26	1.9099
11	2.5413	27	1.8695
12	2.4977	28	1.8295
13	2.4543	29	1.7895
14	2.4111	30	1.7499
15	2.3681	31	1.7104
16	2.3253	32	1.6712
17	2.2828	33	1.6322
18	2.2405	34	1.5934
19	2.1984	35	1.5550
20	2.1565	36	1.5166
21	2.1148	37	1.4785
22	2.0734	38	1.4406
23	2.0322	39	1.4029
24	1.9912	40	1.3655
25	1.9504	..	...

(Schönfeld, A. **93.** 26.)

[1] 1 Vol. H_2O absorbs vols. Cl at t° (not corrected).

Vols. Cl	t°	Vols. Cl	t°	Vols. Cl	t°
1.43	0	3.04	8	1.19	50
1.52	3	3.00	10	0.71	70
2.08	6.5	2 37	17	0 15	100
2.17	7	1.61	35	....	...

(Gay-Lussac, A. ch. (3) **7.** 124.)

[1] 1 vol. H_2O at 8° absorbs 3.04 vols. Cl, which is the maximum of solubility. At 50°, 1.09 vols. are absorbed; and at 0°, 1.5 vols. (Pelouze and Fremy.)

1 vol. H_2O at t° dissolves vols. Cl (not corrected).

t°	Vols. Cl	t°	Vols. Cl	t°	Vols. Cl
0	1.75–1.80	12	2.50–2.60	40	1.55–1.60
9	2.70–2 75	14	2.45–2 50	50	1 15–1 20
10	2 70–2 75	30	2.00–2.10	70	0.60–0.65

(Pelouze, A. ch. (3) **7.** 188.)

1 vol. H_2O absorbs vols. Cl at t°.

t°	Vols. Cl	t°	Vols. Cl	t°	Vols. Cl
0	1.5 –1.6	9	2 65–2 70	14	2.6 –2 65
5	2.05–2.1	10	2.9 –3.0	16	2.35 2.4
8	2.5 –2 6	12	2 65–2 75	30	1 8 –1 85

(Riegel and Walz, Berz. J. B. **1846.** 72.)

Solubility in H_2O : α = coefficient of solubility.

t°	α	t°	α	t°	α
6.9	2.2931	10.1	2.8741	21.7	2.0422
8.4	2.5469	11.2	2.7267	32.1	1.5766
9.3	2.7135	13.7	2.5079	36.7	1.3802

(Goodwin, B. **15.** 3040.)

Goodwin also gives tables for solubility of Cl in HCl and various chlorides, but they do not show evidence of accurate work. (A.M.C.)

Cl_2+Aq contains at 760 mm. pressure:

1.44% Cl at 0°
1.07% " " 6°
0.95% " " 9°
0.87% " " 12°

(Roozeboom, R. t. c. 1884, **3.** 29.)

See also Cl_2+8H_2O.

Solubility of Cl_2 in H_2O.

β^1 = Vol. of Cl (reduced to 0° and 760 mm.) absorbed by 1 vol. H_2O under a total pressure of 760 mm.

q = g. Cl_2 absorbed by 100 g. H_2O under a total pressure of 760 mm.

t°	β^1	q	t°	β^1	q
10	3.095	0.980	25	1.985	0.630
11	2.996	948	26	1.937	615
12	2.900	918	27	1.891	600
13	2.808	889	28	1.848	587
14	2.720	861	29	1.808	574
15	2.635	835	30	1.769	562
16	2.553	809	35	1.575	501
17	2.474	784	40	1.414	451
18	2.399	760	45	1.300	415
19	2.328	738	50	1.204	386
20	2.260	716	60	1.006	324
21	2.200	698	70	0.848	274
22	2.143	680	80	0.672	219
23	2.087	662	90	0.380	125
24	2.035	646	100	0.000	000

(Winkler, Landolt and Börnstein, Tab. 4th Ed. **1912,** 597.)

1 l. HCl+Aq (38% HCl) dissolves 17.3 g. Cl; 1 l. HCl+Aq (33% HCl) dissolves 11 g. Cl; 1 l. HCl+Aq (3% HCl) dissolves 6.5 g. Cl. (Berthelot, C. R. **91.** 191.)

Solubility of Cl_2 in HCl+Aq at 20–21° and 759–761 mm. pressure.

g. HCl per l.	g. Cl_2 per l.	Coefficient of absorption	Solubility
0	7.23	2.1157	2.2799
3.134	5.30	1.5496	1.6698
6.248	4.94	1.4483	1.5607
9.402	4.76	1.3942	1.5013
12.540	4.85	1.4200	1.5292
15.670	5.10	1.4933	1.6092
31 340	5.81	1.6736	1.8033
62.680	6.38	1.8682	2.0131
94.020	7.19	2.1044	2.2677
125.360	7.76	2.2711	2.4473
156.700	8.58	2.5095	2.7043
188.040	9.23	2.7020	2.9117
219.380	9.93	2.9243	3.1312
250.720	10.68	3.1272	3.3677
282.060	11.87	3.3278	3.5859
313.401	12.03	3.5492	3.8224

(Mellor, Chem. Soc. 1901, **75.** 227.)

Solubility of Cl in NaCl+Aq. α = coefficient of solubility.

NaCl = 9.97%.

t°	α	t°	α
7.9	1.8115	18.8	1.2785
11.9	1.5879	22.6	1.0081
15.4	1.3684	....	....

Solubility of Cl in NaCl+Aq.—*Continued*

$NaCl = 16.01\%$.

t°	a	t°	a
6	1.5866	21.4	0.8732
11.6	1.2227	26.9	0.7017
16.4	1.0121	....	....

$NaCl = 19.66\%$.

t°	a	t°	a
0	1.6978	15.4	0.9511
9.2	1.2145	20.4	0.7758
9.3	1.2068	21.9	0.7385
14.8	0.9740	....	....

(Kumpf, W. Ann. Beibl. **6.** 276.)

Solubility of Cl in sat. NaCl+Aq at t° and 760 mm. pressure.

t°	Coefficient of absorption at 0° and 760 mm.	Solubility at 0° and 760 mm.
14.5	0.3607	0.3898
29.0	0.3125	0.3458
60.0	0.1332	0.1625
82.0	0.0586	0.0763

(Kohn and O'Brien, J. Soc. Chem. Ind. 1898, **17.** 1100.)

Sat. KCl+Aq absorbs 1/3 less Cl at 15° than pure H_2O. (Dettmer, A. **38.** 35.)

1 l. of a solution of $CaCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2.45 g. Cl at 12°.

1 l. of a solution of $MgCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2.33 g. Cl at 12°.

1 l. of a solution of $MnCl_2$ (1 pt. in 15 pts. H_2O) dissolves 2.00 g. Cl at 12°.

Sl. sol. in KOH+Aq. (Fremy.)

Somewhat sol. in liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

CCl_4 absorbs 10% of Cl_2 at 13°. (Perkins, Chem. Soc. 1894, **65.** 20.)

1 mol. $CrOCl_2$ dissolves at 0°, 0.70 atom Cl; at −14°, 1.24 atoms; at −21°, 2.31 atoms; and at −24, 3.00 atoms Cl. (Roozeboom, R. t. c. **4.** 379.)

Sulphuryl chloride absorbs 71 vols. Cl or 0.136 pt. Cl by weight at 0°. (Schulze, J. pr. (2) **27.** 168.)

Insol. in benzene. (Moride.)

Sl. sol. in chloral and iodal. (Dumas.)

Sol. in perchlorethylene. (Faraday.)

Sol. in a very large quantity of ether with decomp.

Coefficient of solubility of Cl_2 in organic liquids at 15°.

Substance	Coefficient of Solubility
Carbon tetrachloride	51.7
Acetic anhydride	39.6
Acetic acid (99.84%)	36.7
" (90 vol. %)	25.3
" (75 vol. %)	16.43
" (65 vol. %)	13.43

(Jones, Chem. Soc. 1911, **99.** 392.)

$+8H_2O$. Critical temp. of decomposition in open vessel = 9.6°; in closed vessel = 28.7°.

Solubility in H_2O.

% Cl_2 = % of Cl_2 in Cl_2+Aq sat. at t° and 760 mm. in presence of Cl_2+8H_2O.

t°	% Cl_2	t°	% Cl_2
0	0.505	12.5	1.10
3	0.64	20	1.82
6	0.709	28.5	3.50
9	0.900		

(Roozeboom, R. t. c. 1884, **3.** 57.)

Chlorine *mon*oxide, Cl_2O.

Sol. in H_2O. At 0°, H_2O absorbs at least 200 times its volume of Cl_2O gas.

Chlorine *tri*oxide, Cl_2O_3.

Decomp. on air at 57° with explosion.

H_2O absorbs 5–6 vols. Cl_2O_3. (Millon, A. ch. (3) **7.** 298.)

H_2O absorbs at 8.5° and 753 mm. press. 8.591 vols. Cl_2O_3. (Brandan.)

100 g. H_2O dissolve at:

8.5° and	752.9 mm. press.	4.7655 g. Cl_2O_3.
14° "	756.3 " "	5.0117 "
21° "	754 " "	5.4447 "
93° "	760 " "	5.6508 "

(Brandan, A. **151.** 340.)

Does not exist, and above data are for mixture of ClO_2 and Cl. (Garzarolli-Thurnlakh, A. **209.** 184.)

Chlorine *tetr*oxide, ClO_2.

H_2O at 4° absorbs about 20 vols. ClO_2 with formation of $HClO_2$ and $HClO_3$.

H_2SO_4 at −18° absorbs about 20 vols. ClO_2. (Millon, A. ch. (3) **7.** 285.)

Solubility of ClO_2 in H_2O.

t°	g. ClO_2 per l.
1	>108.6
10.7	116.7
14.0	>107.9

ray, Z. phys. Ch. 1906, **54.** 569.)

$+8H_2O$ ($\pm 1H_2O$).

Solubility in H_2O.

t°	g. ClO_2 per l.	t°	g. ClO_2 per l.
0.79*	26.98	10	60.06
0	27.59	15.3	60.06
1	29.48	18.2	107.9
5.7	42.10		

* Entectic.

(Bray.)

Chlorine oxide, Cl_6O_{17}.

Very easily decomp. (Millon, A. **46.** 281.) Probably a mixture of ClO_2 and O.

Chlorine *hept*oxide, Cl_2O_7.

Explosive; decomp. by H_2O; sol. in well cooled benzene with sl. decomp. (Michael, Am. Ch. J. 1909, **23.** 447.)

Chloriridi*di*amine chloride,

$Cl_2Ir\begin{matrix}NH_3NH_3Cl \\ NH_3NH_3Cl\end{matrix}$

Sl. sol. in cold, easily in hot H_2O. (Skoblikoff, A. **84.** 275.)

—— **nitrate,** $Cl_2Ir(N_2H_6NO_3)_2$.

Sol. in H_2O.

—— **sulphate,** $Cl_2Ir(N_2H_6)SO_4$.

Sl. sol. in cold, much more easily in hot H_2O.

Chloriridic acid.

Chloriridates.

Most of the chloriridates are very difficultly sol. in H_2O, but a little more sol. than the corresponding chloroplatinates. Insol. or nearly so in alcohol, but not so difficultly sol. as the chloroplatinates. (Rose.)

Ammonium chloriridate, $(NH_4)_2IrCl_6$.

Sol. in 20 pts. cold H_2O (Vauquelin); sl. sol. in cold, much more in hot H_2O (Claus); sol. in HCl+Aq (Soblewsky); insol. in cold NH_4Cl+Aq (Claus); insol. in alcohol (Berzelius).

100 pts. H_2O dissolve at:

14.4°	26.8°	39.4°	
0.699	0.905	1.226	pts. $(NH_4)_2IrCl_6$,
52.2°	61.2°	69.3°	
1.608	2.130	2.824	pts. $(NH_4)_2IrCl_6$.

(Rimbach and Korten, Z. anorg. 1907, **52.** 407.)

Cæsium chloriridate, Cs_2IrCl_6.

Only sl. sol. in H_2O. (Delépine, C. R. 1908, **146.** 1268.)

Lithium chloriridate, Li_2IrCl_6.

Somewhat deliquescent; very sol. in H_2O. (Antony, Gazz. ch. it. **23, 1.** 190.)

Potassium chloriridate, K_2IrCl_6.

Sl. sol. in cold H_2O; sol. in 15 pts. boiling H_2O; less sol. in H_2O containing HCl; insol. in alcohol or sat. KCl, and $CaCl_2$+Aq.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Rubidium chloriridate, Rb_2IrCl_6.

Very sl. sol. in H_2O. (Rimbach, Z. anorg. 1907, **52.** 408.)

Sodium chloriridate, $Na_2IrCl_6+6H_2O$.

Easily sol. in H_2O; sol. in alcohol of 0.837 sp. gr.

Thallium chloriridate, Tl_2IrCl_6.

Decomp. by hot HCl forming Tl_3IrCl_6. (Delépine, C. R. 1909, **149.** 1073.)

Chloriridium pentamine comps.

See **Irido*pent*amine chloro comps.**

Chloriridosulphurous acid.

Potassium chloriridosulphite, $K_4Ir_2Cl_2(SO_3)_4$, $4KCl+12H_2O$

Insol. in cold, decomp. by hot H_2O.

$K_4Ir_2Cl_2(SO_3)_4$, $2K_2SO_3$. Decomp. by H_2O.

$Cl_2Ir_2(SO_3)_2$, $8KCl+4H_2O$. Sol. in H_2O; insol. in alcohol. (Claus, J. pr. **42.** 354.)

Chloriridous acid.

Ammonium chloriridite, $(NH_4)_3IrCl_6$.

Decomp. by H_2O. (Delépine, C. R. 1908, **146.** 1268.)

$+1\frac{1}{2}H_2O$. Sol. in H_2O. (Claus.)

$IrCl_5(H_2O)(NH_4)_2$. (Delépine.)

Cæsium chloriridite, $IrCl_5(H_2O)Cs_2$.

(Delépine.)

Lithium chloriridite, $Li_3IrCl_6+12H_2O$.

Deliquescent; sol. in H_2O and alcohol. (Delépine, C. R. 1914, **158.** 1277.)

Lithium sodium chloriridite, $Li_2NaIrCl_6+12H_2O$.

Stable in aq. solution in the presence of excess of lithium salt. (Delépine, C. R. 1914, **158.** 1278.)

$LiNa_2IrCl_6+12H_2O$. Stable in aq. solution in the presence of excess of sodium salt. (Delépine, C. R. 1914, **158.** 1278.)

Potassium chloriridite, K_3IrCl_6.

Decomp. by H_2O. (Delépine.)

$+3H_2O$. Easily sol. in H_2O; insol. in alcohol; insol. in sat. KCl+Aq. (Berzelius.)

$IrCl_5(H_2O)K_2$. (Delépine.)

Rubidium chloriridite, $IrCl_6(H_2O)Rb_2$.
(Delépine.)

Silver chloriridite, Ag_3IrCl_6.
Insol. in H_2O or acids; sl. sol. in NH_4OH+Aq.
Ppt. (Delépine, Bull. Soc. 1910, (4), **7.** 55.)

Sodium chloriridite, $Na_3IrCl_6+12H_2O$.
Efflorescent; sol. in ½ pt. H_2O. Insol. in alcohol. Melts in crystal H_2O at 50°.

Thallium chloriridite, Tl_3IrCl_6.
Sol. in hot HCl; pptd. on cooling. (Delépine, C. R. 1909, **149.** 1073.)

Chloro*tetr*amine chromium comps.

See **Chlorotetramine chromium comps.**

Chloro-azoimide, N_3Cl.

Sl. sol. in H_2O. (Raschig, B. 1908, **41.** 4194.)

Chlorobromo comps:

See **Bromochloro comps.**

Chlorocarbonic acid.

See **Carbonyl chloride.**

Chlorochromic acid. $CrO_2{}^{OH}_{Cl}$.

Known only in its salts.
CrO_2Cl_2. *See* **Chromyl chloride.**

Ammonium chlorochromate, $NH_4CrO_3Cl = CrO_2{}^{Cl}_{ONH_4}$.
More sol. in H_2O than the K salt. (Peligot, A. ch. **52.** 283.)

Barium chlorochromate chloride, $Ba(CrO_3Cl)_2$, $BaCl_2$.
Deliquescent. Very sol. in H_2O. (Prätorius, A. **201.** 1.)
$+H_2O$. Not deliquescent.

Calcium chlorochromate, $Ca(CrO_3Cl)_2$.
Deliquescent. (Peligot.)
$+5H_2O$. Very deliquescent. (Prätorius.)

Chromous chlorochromate.
*See Tri***chromyl chloride.**

Cobalt chlorochromate, $Co(CrO_3Cl)_2+9H_2O$.
Deliquescent; melts at 40° in crystal H_2O. (Prätorius.)

Lithium chlorochromate, $LiCrO_3Cl$.
Sol. in H_2O acidified with HCl without decomp. (Löwenthal, Z. anorg. 1894, **6.** 357.)

Magnesium chlorochromate, $Mg(CrO_3Cl)_2$.
Deliquescent. (Peligot.)
$+9H_2O$. Less deliquescent than the other chlorochromates. (Prätorius, A. **201.** 1.)
Very hydroscopic; sol. in H_2O acidified with HCl without decomp. (Löwenthal, Z. anorg. 1894, **6.** 359.)

Nickel chlorochromate, $Ni(CrO_3Cl)_2+9H_2O$.
Deliquescent; melts in its crystal H_2O at 46–48°. (Prätorius.)

Potassium chlorochromate, $KCrO_3Cl = CrO_2(Cl)OK$.
Sol. in H_2O with decomp. Cryst. from H_2O containing HCl without decomp. (Peligot.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sodium chlorochromate, $NaCrO_3Cl$.
Deliquescent. (Peligot.)
$+2H_2O$. Deliquescent. (Prätorius.)

Strontium chlorochromate, $Sr(CrO_3Cl)_2+4H_2O$.
Deliquescent; melts in crystal H_2O at 72°. (Prätorius.)

Thallous chlorochromate, $TlCrO_3Cl$.
Decomp. by H_2O. (Lachaud and Lepierre, C. R. **103.** 198.)

Zinc chlorochromate, $Zn(CrO_3Cl)_2+9H_2O$.
Deliquescent; melts at 37.5° in crystal H_2O. (Prätorius.)
Very hydroscopic; very sol. in H_2O and acids. (Löwenthal, Z. anorg. 1894, **6.** 360.)

*Di*chlorochromium bromide, $[Cr(H_2O)_4Cl_2]Br$.

Very deliquescent. Sol. in fuming HBr, in a mixture of equal volumes ether and fuming HBr, in alcohol and in acetone. (Bjerrum, B. 1907, **40.** 2919.)

Chlorochromotetrammonium comps.

See **Chlorotetramine chromium comps.**

Chlorocolumbium bromide, $(Cb_6Cl_{12})Br_2+7H_2O$.

Sol. in a small quantity of cold H_2O. (Harned, J. Am. Chem. Soc. 1913, **35.** 1083.)

Chlorocolumbium chloride, $(Cb_6Cl_{12})Cl_2+7H_2O$.
Insol. in cold, sol. in boiling H_2O.
Not easily decomp. by boiling with NH_4OH. Conc. HNO_3 decomp. a boiling solution of this comp. Completely sol. in conc. alkalies. (Harned, J. Am. Chem. Soc. 1913, **35.** 1080.)

Chlorocolumbium hydroxide, $(Cb_6Cl_{12})(OH)_2+8H_2O$.

Insol. in H_2O. Sol. in acids and alkalies. (Harned, J. Am. Chem. Soc. 1913, **35.** 1082.)

Chloroctamine cobaltic carbonate, $Cl_4Co_2(NH_3)_8CO_3+2H_2O$.

Very sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2651.)

$Cl_2Co_2(NH_3)_8(CO_3)_2+H_2O$. (Vortmann and Blasberg.)

Chloroferrous acid.

Calcium chloroferrite, $CaO, CaCl_2, Fe_2O_3$.

Insol. in H_2O. (le Chatelier, C. R. **99.** 276.)

***Di*chlorofulminoplatinum,** $Pt_4N_4Cl_2O_{12}H_{22}(?)$.

Insol. in H_2O. (v. Meyer, J. pr. (2) **18.** 305.)

***Tri*chlorofulminoplatinum,** $Pt_4N_4Cl_3(OH)O_{12}H_{24}(?)$.

Insol. in H_2O; sol. in HCl+Aq. (v. Meyer.)

***Tetra*chlorofulminoplatinum,** $Pt_4N_4Cl_4O_{12}H_{24}(?)$

Insol. in H_2O. (v. Meyer.)

Chlorohydroxylonitritoplatin*semidi*amine nitrite, $(OH)ClNO_2Pt(NH_3)_2NO_2$.

Easily sol. in hot H_2O. (Cleve.)

Chlorohydroxyloplatin*di*amine bromide, $^{OH}_{Cl}Pt(N_2H_6Br)_2$.

Sl. sol. in H_2O.

—— **carbonate,** $^{OH}_{Cl}Pt(N_2H_6)_2CO_3$.

Insol. in H_2O. (Cleve.)

—— **chloride,** $^{OH}_{Cl}Pt(N_2H_6Cl)_2$.

Sl. sol. in H_2O. (Cleve.)

—— **chromate,** $^{OH}_{Cl}Pt(N_2H_6)_2CrO_4$.

Nearly insol. in H_2O.

—— ***di*chromate,** $^{OH}_{Cl}Pt(N_2H_6)_2Cr_2O_7$.

Ppt. (Cleve.)

—— **nitrate** (Raewsky's nitrate), $^{OH}_{Cl}Pt(N_2H_6NO_3)_2$.

Sl. sol. in cold, more easily in hot H_2O. (Gerhardt.)

Chlorohyposulphuric acid, $S_2O_3Cl_4$.

See **Sulphur oxy*tetra*chloride.**

Chloromanganic acid.

See **Manganic hydrogen chloride.**

Chloromercurosulphrous acid.

Ammonium chloromercurosulphite, NH_4SO_3HgCl.

Sol. in H_2O. (Barth, Z. phys. Ch. **9.** 205.)

Barium chloromercurosulphite, $Ba(SO_3HgCl)_2$.

Insol. in H_2O. (Barth.)

Potassium chloromercurosulphite, KSO_3HgCl.

Sol. in H_2O. (Barth.)

Sodium chloromercurosulphite, $NaSO_3HgCl+H_2O$.

Very sol. in H_2O. (Barth.)

Chloromolybdenum bromide, $Cl_4Mo_3Br_2+3H_2O$.

Insol. in H_2O and dil. acids; sol. in alcohol.

$+6H_2O$. At first easily sol. in H_2O, but a precipitate soon forms. Can be crystallized from dil. HBr+Aq. Sol. in alcohol and ether. (Blomstrand.)

Chloromolybdenum potassium bromide, $Cl_4Mo_3Br_2, 2KBr+2H_2O$.

Decomp. by H_2O. Can be cryst. from HBr+Aq. (Blomstrand.)

Chloromolybdenum chloride, $Cl_4Mo_3Cl_2$ = **molybdenum *di*chloride,** $MoCl_2$.

Insol. in H_2O; easily sol. in HCl+Aq or H_2SO_4+Aq; sl. sol. in HNO_3; sol. in NH_4OH+Aq, NaOH+Aq, or KOH+Aq, with separation of precipitate on boiling; sol. in alcohol and ether. (Blomstrand, J. pr. **77.** 96.)

Very sol. in conc. HCl. (Rosenheim and Kohn, Z. anorg. 1910, **66.** 2.)

$+3H_2O$. Insol. in H_2O.

$+4\frac{1}{2}H_2O$. Insol. in H_2O. (Liechti and Kempe, A. **170.** 351.)

$+6H_2O$. Sol. in H_2O, alcohol, or ether. (Blomstrand.)

Chloromolybdenum hydrogen chloride, $Mo_3Cl_6, HCl+4H_2O$.

Sol. in H_2O, but ppt. forms after a few minutes. (Rosenheim and Kohn, Z. anorg. 1910, **66.** 5.)

Chloromolybdenum potassium chloride, $Cl_4Mo_3Cl_2, 2KCl+2H_2O$.

Decomp. by pure H_2O; can be recrystallized from HCl+Aq. (Blomstrand, J. pr. **77.** 108.)

Chloromolybdenum hydroxide, $Cl_4Mo_3(OH_2)+2H_2O$.

Insol. in H_2O or alcohol. Easily sol. in strong acids if fresh, and washed only with cold H_2O. If washed with warm H_2O, it is less sol. in acids. If precipitated hot, is insol. in acids, even H_2SO_4 or fuming HNO_3. (Blomstrand, J. pr. **77.** 100.)

$+8H_2O$.

Chloromolybdenum iodide, $Cl_4Mo_3I_2+3H_2O$.

Precipitate.

$+6H_2O$. Sol. in H_2O and alcohol.

Chloromolybdenum potassium iodide, $Cl_4Mo_3I_2, 2KI+2H_2O$.

Decomp. by H_2O. Recryst. from HI+Aq. (Blomstrand.)

Chloromolybdenum oxybromide, $Cl_4Mo_3{}^{OH}_{Br}+2H_2O$.

Insol. in alcohol. (Blomstrand, J. pr. **77.** 116.)

Chlcromolybdic acid, $MoOCl_3(OH)+7H_2O$.

Very hydroscopic. (Weinland, B. 1904, **37.** 572.)

*Di*ammonium *tetra*chloromolybdate, $MoCl_4(ONH_4)_2+2H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies and ammonia. (Weinland, Z. anorg. 1905, **44.** 83.)

Cæsium chloro*tri*molybdate, acid, $Mo_6O_{11}Cl_{14}(Cs_2O)+22H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies, and ammonia. (Weinland, *l.c.*)

*Mono*cæsium *tri*chloromolybdate, $MoOCl_3(OCs)+H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies and ammonia. (Weinland.)

*Di*cæsium *tetra*chloromolybdate, $MoCl_4(OCs)_2$.

Hydroscopic. Sol. in H_2O with decomp. Sol. in dilute acids, alkalies, and ammonia. (Weinland, Z. anorg. 1905, **44.** 83.)

*Mono*potassium *tri*chloromolybdate, $MoOCl_3(OK)+H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

*Di*potassium *tetra*chloromolybdate, $MoCl_4(OK)_2+2H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

Potassium hydrogen chloro*tri*molybdate, $Mo_6O_{11}Cl_{14}, K_2O+6H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

*Mono*rubidium *tri*chloromolybdate, $MoOCl_3(ORb)+H_2O$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

*Di*rubidium *tetra*chloromolybdate, $MoCl_4(ORb)_2$.

Hydroscopic. Decomp. by H_2O. Sol. in dilute acid, alkalies, and ammonia. (Weinland.)

Chloronitratoplatinamine nitrite, ${}^{Cl}_{NO_3}Pt(NH_3NO_2)_2$.

Easily sol. in H_2O.

Chloronitratoplatin*di*amine nitrate, ${}^{Cl}_{NO_3}Pt(N_2H_6NO_3)$.

Decomp. by H_2O with formation of ${}^{Cl}_{OH}Pt[(NH_3)_2NO_3)]_2$.

—— **sulphate,** ${}^{Cl}_{NO_3}Pt(N_2H_6)_2SO_4+H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

Chloronitritotetramine cobaltic chloride, $Cl(NO_2)Co(NH_3)_4Cl$.

Not very sol. in cold H_2O. (Jörgensen, Z. anorg. **5.** 195.)

Chloronitritoplatin*semidi*amine chloride, $Cl_2(NO_2)Pt(NH_3)_2Cl$.

100 pts. solution in H_2O sat. at 18° contain 1.8 pts. salt; sat. at 100°, 6 pts.

Insol. in abs. alcohol or ether. Not decomp. by conc. HNO_3, HCl, or $H_2C_2O_4$+Aq, and by H_2SO_4 only at a high heat.

Formula given was $PtN_6H_{12}Cl_6O_5$. (Peyrone, J. B. **1855.** 421.)

—— **nitrite,** $Cl_2(NO_2)Pt(NH_3)_2NO_2$.

Sol. in H_2O. (Blomstrand.)

Chlorophosphatoplatin*di*amine phosphate,

$$\begin{array}{c} ClPt(N_2H_6)_2 \\ \diagdown \;\; \diagup \\ PO_4 \end{array} +2H_2O.$$

Nearly insol. in cold, and only very sl. sol. in hot H_2O. (Raewsky.)

Chloronitrous acid.

Iridium potassium chloronitrite, $Ir_2Cl_2(NO_2)_4, 6KCl$.

Ppt.; decomp. by boiling H_2O. Sol. in cold H_2O. (Leidié, C. R. 1902, **134.** 1583.)

$Ir_3K_{12}Cl_{16}(NO_2)_8+4H_2O$. Ppt. (Quennessen, C. R. 1905, **141**, 258.)

Chloropalladic acid.

Chloropalladates.

The chloropalladates are generally very sol. in H_2O, and sol. in alcohol. (v. Bonsdorff, Pogg. **17**. 264.)

Ammonium chloropalladate, $(NH_4)_2PdCl_6$.

Sl. sol. in H_2O. (Berzelius.)

Barium chloropalladate.

Sol. in H_2O and alcohol. (v. Bonsdorff.)

Cadmium chloropalladate.

As above.

Cæsium chloropalladate, Cs_2PdCl_6.

Nearly insol. in cold H_2O. Decomp. by boiling with H_2O or by hot conc. H_2SO_4. (Gutbier, B. 1905, **38**. 2386.)

Calcium chloropalladate.

Deliquescent; sol. in H_2O and alcohol. (v. Bonsdorff, **1829**.)

Glucinum chloropalladate, $GlPdCl_6+8H_2O$.

Very hydroscopic, and sol. in H_2O.

Magnesium chloropalladate, $MgPdCl_6+6H_2O$.

Deliquescent; sol. in H_2O.

***Nickel chloropalladate,** $NiPdCl_6+6H_2O$.

Extremely deliquescent.

Potassium chloropalladate, K_2PdCl_6.

Sl. sol. in cold H_2O. Decomp. by long boiling with H_2O. Sl. sol. in dil. HCl+Aq without decomp. Insol. in NH_4Cl, KCl, or NaCl +Aq. Insol. in alcohol. (Berzelius.)

Rubidium chloropalladate, Rb_2PdCl_6.

Insol. in cold H_2O. Decomp. by boiling with H_2O or by hot conc. H_2SO_4. (Gutbier, B. 1905, **38**. 2387.)

Zinc chloropalladate, $ZnPdCl_6+6H_2O$.

Very deliquescent. (v. Bonsdorff.)

Chloropalladous acid

Aluminum chloropalladite, $Al_2Pd_2Cl_{10}+20H_2O$.

Deliquescent. Sol. in H_2O, alcohol, or ether. (Welkow, B. **7**. 804.)

Ammonium chloropalladite, $(NH_4)_2PdCl_4+H_2O$.

Easily sol. in H_2O. Insol. in alcohol. Sol. in NH_4Cl+Aq. (Claus.)

Easily sol. in H_2O. (Gutbier, B. 1905, **38**. 2386.)

Barium chloropalladite.

Easily sol. in H_2O or alcohol.

Cadmium chloropalladite.

Not deliquescent.

Cæsium chloropalladite, Cs_2PdCl_4.

Can be cryst. from hot H_2O. (Gutbier, B. 1905, **38**. 2386.)

Calcium chloropalladite.

Deliquescent. Sol. in H_2O or alcohol.

Glucinum chloropalladite, $GlPdCl_4+6H_2O$.

Very hygroscopic; very sol. in H_2O, alcohol, or ether. (Welkow.)

Magnesium chloropalladite.

Deliquescent. Easily sol. in H_2O. (v. Bonsdorff.)

Manganese chloropalladite.

Sol. in H_2O and alcohol.

Nickel chloropalladite.

Sol. in H_2O.

Potassium chloropalladite, K_2PdCl_4.

Much more sol. in hot than cold H_2O. (Joannis, C. R. **95**. 295.) Sol. in NH_4OH+Aq. (Berzelius.) Sol. in cold sat. KCl+Aq. (Gibbs, Sill. Am. J. (2) **31**. 70.) Insol. in alcohol. (Wollaston.) Somewhat sol. in alcohol of 0.84 sp. gr., but insol. in absolute alcohol; decomp. on boiling (Berzelius.)

Rubidium chloropalladite, Rb_2PdCl_4.

Can be cryst. from hot H_2O. (Gutbier, B. 1905, **38**. 2387.)

Sodium chloropalladite.

Deliquescent. Sol. in H_2O and alcohol.

Zinc chloropalladite.

Very deliquescent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Chlorophosphoarsenioiridic acid, $2IrCl_3, 3H_3PO_3, 3H_3PO_4, 5H_3AsO_4$(?).

Very sol. in H_2O. (Geisenheimer.)

Lead chlorophosphoarsenioiridate, $4IrCl_3, 3Pb_2H_2(PO_3)_2, 3Pb_3(PO_4)_2, 5Pb_2H_2(AsO_4)_2$.

Insol. in H_2O.

Chlorophosphoiridic acid, $2IrCl_3, 3H_3PO_4, 3H_3PO_3$.

Very sol. in H_2O. Insol. in alcohol. (Geisenheimer, A. ch. (6) **23**. 254.)

$2IrCl_3, 3H_3PO_4$. Sol. in H_2O and alcohol.

Ammonium chlorophosphoiridate, $2IrCl_3$, $3(NH_4)_3PO_4$, $3(NH_4)_2HPO_3$.

Very deliquescent. Very sol. in H_2O. (Geisenheimer.)

Lead chlorophosphoiridate, $4IrCl_3$, $3Pb_3(PO_4)_2$, $3PbH_2(PO_3)_2$.

Insol. in H_2O or acetic acid; very sol. in dil. HNO_3+Aq. (Geisenheimer.)

Silver chlorophosphoiridate, $2IrCl_3$, $3AgH_2PO_4$, $3AgH_2PO_3$.

Insol. in H_2O. Sol. in HNO_3+Aq, and NH_4OH+Aq. (Geisenheimer.)

Chlorophosphoplatinic acid.

See **Chloroplatinophosphoric acid.**

Chlorophosphoric acid.

Thorium chlorophosphate, $3ThO_2, ThCl_4$, $2P_2O_5$.

Insol. in H_2O and acids; decomp. by boiling with H_2SO_4 and fusing with alkali carbonates. (Colani, C. R. 1909, **149.** 208.)

Chloroplatinamine chloride, $Cl_2Pt{NH_3Cl \atop NH_3Cl}$.

Sol. in about 700 pts. H_2O at 0°, and 33–34 pts. at 100°. Not attacked by boiling conc. HNO_3 or H_2SO_4. Sol. in boiling KOH+Aq with decomp. Sol. in NH_4OH+Aq. (Cleve, Sv. V. A. H. **10, 9.** 30.)

—— **nitrite,** $Cl_2Pt(NH_3NO_2)_2$.

Sl. sol. in cold, easily in hot H_2O.

—— **nitrite silver nitrite,** $Cl_2Pt(NH_3NO_2)_2$, $AgNO_2$.

Easily sol. in hot, sl. sol. in cold H_2O. (Cleve.)

—— **nitritochloride,** $Cl_2Pt{NH_3NO_2 \atop NH_3Cl}$.

Sol. in H_2O. (Cleve.)

Chloroplatin*di*amine bromide, $Cl_2Pt(N_2H_6Br)_2$.

Sl. sol. in hot H_2O. (Cleve.)

—— **chloride** (Gros' chloride), $Cl_2Pt(N_2H_6Cl)_2$.

Nearly insol. in cold, and only sl. sol. in hot H_2O. Sol. in hot conc. KOH+Aq, with decomp. (Grimm.)

Sol. in cold KOH+Aq without decomp. Nearly insol. in NH_4OH+Aq. (Buckton.)

+H_2O. (Raewsky.)

—— **chloroplatinate,** $NCl_2Pt(_2H_6Cl)_2$, $PtCl_4$.

Easily sol. in hot H_2O.

—— **chloroplatinite,** $Cl_2Pt(N_2H_6Cl)_2$, $PtCl_2$.

Sl. sol. in H_2O. (Cleve.)

Chloroplatin*di*amine chromate, $Cl_2Pt(N_2H_6)_2CrO_4$.

Nearly insol. in H_2O. (Cleve.)

—— ***di*chromate,** $Cl_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in cold, more sol. in hot H_2O. (Cleve.)

—— **nitrate** (Gros' nitrate), $Cl_2Pt(N_2H_6NO_3)_2$.

Much more easily sol. in hot than in cold H_2O. Sol. in hot KOH+Aq with decomp. Nearly insol. in conc. HNO_3+Aq.

—— **nitritochloride,** $Cl_2Pt{N_2H_6NO_2 \atop N_2H_6Cl}$.

Ppt. (Jörgensen.)

—— **phosphate.**

See **Chlorophosphatoplatin*di*amine phosphate.**

—— **sulphate,** $Cl_2Pt(N_2H_6)_2SO_4$.

Sl. sol. in both cold or hot H_2O. (Cleve.)

+xH_2O. Sl. sol. in cold, easily in hot H_2O. (Grimm.)

—— **sulphocyanide,** $Cl_2Pt(N_2H_6)_2(CNS)_2$ +H_2O.

Ppt. (Cleve.)

Chloroplatin*monodi*amine chloride, $Cl_2Pt{(NH_3)_2Cl \atop NH_3Cl}$.

Quite easily sol. in H_2O. (Cleve.)

Chloroplatin*semidi*amine carbonate chloride, $2Pt(NH_3)_2Cl_2$, $Pt_2(NH_3)_4Cl_2(CO_3)$.

Sl. sol. in H_2O; insol. in alcohol and ether. Decomp. by cold HCl+Aq. (Schon, Z. anorg. 1897, **13.** 37.)

Chloroplatin*semidi*amine chloride, $Cl_3Pt(NH_3)_2Cl$.

Sol. in 300 pts. H_2O at 0°, and 65 pts. at 100°. Not decomp. by conc. H_2SO_4. Sol. in KOH+Aq without decomp. (Cleve.)

Chloroplatinic acid, $H_2PtCl_6+6H_2O$.

Deliquescent. Sol. in H_2O, alcohol, or ether.

+$4H_2O$. Deliquescent. (Pigeon, C. R. **112.** 1218.)

$PtCl_4$, $HCl+2H_2O$. (Pigeon.)

Aluminum chloroplatinate, $AlCl_3$, $PtCl_4$+ $15H_2O$.

Very sol. in H_2O and alcohol. (Welkow, B. **7.** 304.)

Insol. in ether.

Ammonium chloroplatinate, $(NH_4)_2PtCl_6$.

Sl. sol. in cold, more easily in hot H_2O. (Fresenius.)

100 pts. H_2O dissolve 0.666 pt. at ord. temp. and 12.5 pts. at 100°. (Crookes, C. N. **9.** 37.)

Insol. in cold HCl+Aq. Separates out on cooling from solution in hot HCl, HNO_3, or H_2SO_4. (Fischer.)

Very sl. sol. in cold, easily in hot NH_4OH+Aq. (Fresenius.)

Conc. NH_4Cl+Aq ppts. it almost completely from aqueous solution. (Böttger.)

Sol. in NH_4 succinate+Aq. (Döpping.)

Less sol. in H_2PtCl_6+Aq than in H_2O. (Rogojski, A. ch. (3) **41.** 452.)

Sol. in $SnCl_2$+Aq. (Fischer.)

Very sol. with decomp. in KCNS+Aq. (Claus.)

At 15–20°, sol. in 26,535 pts. 97.5% alcohol, in 1476 pts. 76% alcohol, and in 665 pts. 55% alcohol. If free HCl is present, it is sol. in 672 pts. 76% alcohol. (Fresenius, A. **59.** 118.)

Insol. in absolute alcohol or ether.

Barium chloroplatinate, $BaPtCl_6+6H_2O$.

Permanent; sol. in H_2O; decomp. by alcohol. (v. Bonsdorff, Pogg. **17.** 250.)

Barium ***mono*****chloroplatinate,** $PtCl(OH)_5Ba+H_2O$.

Insol. in H_2O and in org. solvents. (Bellucci, C. C. **1903,** I. 131.)

Barium ***penta*****chloroplatinate,** $OH.PtCl_5Ba+H_2O$.

(Miolati, Chem. Soc. 1900, **78.** (2) 732.)

Cadmium chloroplatinate, $CdPtCl_6+6H_2O$.

Deliquescent, and easily sol. in H_2O. (v. Bonsdorff.)

Cæsium chloroplatinate, Cs_2PtCl_6.

100 pts. H_2O dissolve at:

0°	10°	20°	30°
0.024	0.050	0.079	0.110 pts. Cs_2PtCl_6,
40°	50°	60°	70°
0.142	0.177	0.213	0.251 pts. Cs_2PtCl_6,
80°	90°	100°	
0.291	0.332	0.377	pts. Cs_2PtCl_6.

(Bunsen, Pogg. **113.** 337.)

Sol. in 1308 pts. H_2O at 15°, and 261 pts. at 100°. (Crookes, C. N. **9.** 205.)

Calcium chloroplatinate, $CaPtCl_6+8H_2O$.

Deliquescent; easily sol. in H_2O. (v. Bonsdorff.)

Calcium ***mono*****chloroplatinate,** $PtCl(OH)_5Ca+H_2O$.

Insol. in H_2O and in org. solvents. (Bellucci, C. C. **1903,** I. 131.)

Cerium chloroplatinate, $CeCl_3, PtCl_4+13H_2O$.

Deliquescent; very sol. in H_2O or alcohol; insol. in ether. (Marignac.)

$4CeCl_3, 3PtCl_4+8H_2O$. Deliquescent; easily sol. in H_2O or alcohol; insol. in ether. (Holzmann, J. pr. **84.** 80.)

Chromium chloroplatinate, $CrCl_3, PtCl_4+10\frac{1}{2}H_2O$.

Deliquescent. (Nilson, B. **9.** 1056.)

$+10H_2O$. Very sol. in H_2O and alcohol Nearly insol. in acetone. (Higley, J. Am Chem. Soc. 1904, **26.**617.)

Cobalt chloroplatinate, $CoPtCl_6+6H_2O$.

Very deliquescent. (Jörgensen.)

Copper chloroplatinate, $CuPtCl_6+6H_2O$.

Deliquescent in moist air. (v. Bonsdorff.)

Didymium chloroplatinate, $DiCl_3, PtCl_4+13H_2O$.

Less deliquescent than the cerium salt (Marignac.)

$+10\frac{1}{2}H_2O$. Deliquescent. (Cleve, Bull Soc. (2) **43.** 361.)

Erbium chloroplatinate, $ErCl_3, PtCl_4+11H_2O$.

Very deliquescent. (Cleve.)

Gadolinium chloroplatinate, $GdCl_3, PtCl_4+10H_2O$.

Ppt. (Benedicko, Z. anorg. 1900, **22.** 204.)

Glucinum chloroplatinate, $GlPtCl_6+8H_2O$.

Deliquescent in moist air. Very sol. in H_2O, moderately in alcohol. Insol. in ether. (Welkow, B. **6.** 1288.)

Indium chloroplatinate, $2InCl_3, 5PtCl_4+36H_2O$.

Deliquescent. (Nilson.)

Iron (ferrous) chloroplatinate, $FePtCl_6+6H_2O$.

Deliquescent. (Topsoë.)

Iron (ferric) chloroplatinate, $FeCl_3, PtCl_4+10\frac{1}{2}H_2O$.

Deliquescent. (Nilson.)

Lanthanum chloroplatinate, $LaCl_3, PtCl_4+13H_2O$.

Deliquescent; extremely sol. in H_2O. (Cleve.)

Lead chloroplatinate, $PbPtCl_6+3H_2O$.

Easily sol. in H_2O and alcohol (Topsoë), with decomp. (Birnbaum, Zeit. Ch. **1867.** 520.)

Lead ***mono*****chloroplatinate,** $[PtCl(OH)_5]Pb, Pb(OH)_2$.

Ppt. (Bellucci, Chem. Soc. 1902, **82,** II. 155.)

Lead ***penta*****chloroplatinate, basic,** $PtCl_5(OH)Pb, Pb(OH)_2$.

(Miolati, Chem. Soc. 1900, **78.** (2) 732.)

Lithium chloroplatinate, $Li_2PtCl_6+6H_2O$.

Extremely deliquescent (Jörgensen); efflorescent. Easily sol. in H_2O, alcohol, or ether-alcohol; insol. in ether. (Scheibler.)

Lithium ***penta*****chloroplatinate,** $OH.PtCl_5Li_2$.

Very hydroscopic. (Miolati, Chem. Soc. 1900, **78** (2) **732.**)

Magnesium chloroplatinate, $MgPtCl_6+6H_2O$.

Sol. in H_2O and abs. alcohol.

$+12H_2O$. Sol. in H_2O.

Manganese chloroplatinate, $MnPtCl_6+6H_2O$.

Not deliquescent; sol. in H_2O.

$+12H_2O$. Sl. efflorescent.

Nickel chloroplatinate, $NiPtCl_6+6H_2O$.

Sol. in H_2O.

Potassium chloroplatinate, K_2PtCl_6.

100 pts. H_2O dissolve at:

0°	10°	20°	30°	40°	50°	
0.74	0.90	1.12	1.41	1.76	2.17	pts. K_2PtCl_6,
60°	70°	80°	90°	100°		
2.64	3.19	3.79	4.45	5.18		pts. K_2PtCl_6.

(Bunsen, Pogg. **113.** 337.)

100 pts. H_2O dissolve 0.926 pt. at 15°, and 5.26 pts. at 100°. (Crookes, C. N. **9.** 205.)

100 g. H_2O dissolve at:

2°	16°	25°	35°	48°	
0.4812	0.6718	0.8641	1.132	1.745	g. K_2PtCl_6,
59°	68°	78°	92°		
2.396	2.913	3.589	4.484		g. K_2PtCl_6.

(Archibald, J. Am. Chem. Soc. 1908, **30.** 752.)

Not attacked by cold conc. H_2SO_4. (Lassaigne.)

Sl. sol. in cold, more easily in hot dil. acids. Less sol. in KCl+Aq than in H_2O, and nearly insol. in sat. KCl+Aq. (Schrötter, W. A. B. **50, 2.** 268.)

Solubility in KCl+Aq at 20°.

G. mol. KCl per l. of KCl+Aq.	G. K_2PtCl_6 in 100 g. of solution.
0.00	0.7742
0.20	0.0236
0.25	0.0207
0.50	0.0109
1.00	0.0046
2.00	0.0045
3.00	0.0043
4.00	0.0042
sat.	0.0034

(Archibald, J. Am. Chem. Soc. 1908, **30.** 757.)

Solubility in NaCl+Aq at 16°.

G. mol. NaCl per litre of NaCl+Aq.	G. K_2PtCl_6 in 100 g. of solution
0.00	0.672
0.05	0.700
0.10	0.729
0.25	0.758
0.50	0.775
0.75	0.791
1.00	0.805
2.00	0.834

(Archibald, J. Am. Chem. Soc. 1908, **30.** 757.)

Sol. in KOH+Aq. Insol. in cold or hot alkali carbonates or bicarbonates+Aq. (Rose.) Easily sol. in warm $Na_2S_2O_3$+Aq. (Himly.)

Sol. in NH_4Cl+Aq. (Brett.)

Sol. in NH_4 succinate+Aq. (Döpping.)

At 15–20°, sol. in 12,083 pts. absolute alcohol, in 3775 pts. 76% absolute alcohol, and in 1053 pts. 55% absolute alcohol. (Fresenius.)

Sol. in 1835 pts. 76% alcohol containing HCl at 15–20°. (Fresenius.)

Nearly absolutely insol. in alcohol containing ether.

Sol. in 42,600 pts. absolute alcohol. (Precht, Z. anal. **18.** 509.)

1 l. methyl alcohol dissolves 0.072 g. at 20°. (Peligot, Monit. Sci. 1892, (4) **6.** I, 873.)

Solubility in methyl alcohol+Aq at 20°.

% alcohol by wt.	G. K_2PtCl_6 in 100 g. of solution
0	0.7742
5	0.5350
10	0.4120
20	0.2642
30	0.1831
40	0.1165
50	0.0625
60	0.0325
70	0.0182
80	0.0124
90	0.0038
100	0.0027

(Archibald, J. Am. Chem. Soc. 1908, **30.** 755.)

Solubility in ethyl alcohol+Aq at 20°.

% alcohol by wt.	G. K_2PtCl_6 in 100 g. of solution
0	0.7742
5	0.4910
10	0.3720
20	0.2180
30	0.1340
40	0.0760
50	0.0491
60	0.0265
70	0.0128
80	0.0085
90	0.0025
100	0.0009

(Archibald, J. Am. Chem. Soc. 1908, **30.** 755.)

Solubility in isobutyl alcohol+Aq at 20°.

% alcohol	g. K_2PtCl_6 in 100 g. of solution
0	0.7742
8.20	0.6250
sat.	0.3180

(Archibald, J. Am. Chem. Soc. 1908, **30.** 755.)

Potassium *penta*chloro*hydro*platinate, $K_2(PtCl_5OH)$.

Easily sol. in H_2O. (Ruff, B. 1913. **46.** 925.)

Praseodymium chloroplatinate, $PrCl_3$, $PtCl_4+12H_2O$.

Very sol. in H_2O. Sol. in conc. HCl. (von Scheele, Z. anorg. 1898, **18.** 353.)

Rubidium chloroplatinate, Rb_2PtCl_6.

100 pts. H_2O dissolve at:

0°	10°	20°
0.184	0.154	0.141 pts. Rb_2PtCl_6,
30°	40°	50°
0.145	0.166	0.203 pts. Rb_2PtCl_6,
60°	70°	80°
0.253	0.329	0.417 pts. Rb_2PtCl_6,
90°	100°	
0.521	0.634	pts. Rb_2PtCl_6.

(Bunsen, Pogg. **113.** 337.)

Sol. in 740 pts. H_2O at 15°, and 157 pts. at 100°. (Crookes, C. N. **9.** 205.)
Insol. in alcohol.

Samarium chloroplatinate, $SmCl_3$, $PtCl_4+10\frac{1}{2}H_2O$.

Deliquescent. Very sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 165.)

Silver chloroplatinate, Ag_2PtCl_6.

Ppt. Gradually decomp. by H_2O into AgCl and $PtCl_4$. (Jörgensen, J. pr. (2) **16.** 345.)
$Ag_2PtCl_4(OH)_2$. Ppt.

Silver *mono*chloroplatinate, $[PtCl(OH)_5]Ag_2$.

Ppt. (Bellucci, Chem. Soc. 1902, **82.** (2). 155.)

Silver *penta*chloroplatinate, $(OH)PtCl_5Ag_2$.

Ppt.; stable in boiling H_2O. (Miolati, Chem. Soc. 1900, **78** (2). 732.)

Silver chloroplatinate ammonia, Ag_2PtCl_6, $2NH_3$.

Insol. in H_2O. (Birnbaum.)

Sodium chloroplatinate, $Na_2PtCl_6+6H_2O$.

Easily sol. in H_2O. Sat. solution at 15° contains 39.77 g. Na_2PtCl_6 and has sp. gr. of 1.368. Sol. in NaCl+Aq. More sol. in absolute alcohol than in 95% alcohol. Sat. solution in abs. alcohol contains 11.90%; 95% alcohol, 6.34%. Mixture of equal parts of alcohol and ether dissolve 2.43%. Insol. in ether. (Precht, Z. anal. **18.** 502.)

Sodium *penta*chloroplatinate, $(OH)PtCl_5Na_2$.

Exists only in solution. (Miolati, *l.c.*)

Strontium chloroplatinate, $SrPtCl_6+8H_2O$.

Very sol. in H_2O.

Strontium *mono*chloroplatinate, $PtCl(OH)_5Sr+H_2O$.

Insol. in H_2O and org. solvents. (Bellucci, C. C. **1903,** I. 131.)

Thallium chloroplatinate, Tl_2PtCl_6.

Very sl. sol. in H_2O. Sol. in 15,585 pts. H_2O at 15°, and 1948 pts. at 100°. (Crookes.)

Thallium *mono*chloroplatinate, $[PtCl(OH)_5]Tl$.

Ppt. (Bellucci, Chem. Soc. 1902, **82.** (2). 155.)

Thallium *penta*chloroplatinate, $(OH)PtCl_5Tl_2$.

(Miolati, Chem. Soc. 1900, **78** (2). 732.)

Thorium chloroplatinate, $ThCl_4$, $PtCl_4+12H_2O$.

Very deliquescent. (Cleve, Bull. Soc. (2). **21.** 118.)

Tin (stannic) chloroplatinate, $SnCl_4$, $PtCl_4+12H_2O$.

(Nilson, B. **9.** 1142.)

Ytterbium chloroplatinate, $2YbCl_3$, $PtCl_4+22H_2O$, and $+35H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 137.)

Vanadyl chloroplatinate, $(VO)PtCl_4+10\frac{1}{2}H_2O$.

Sol. in H_2O; cryst. from $PtCl_4$+Aq. (Brauner, M. **3.** 58.)

Yttrium chloroplatinate, $4YCl_3$, $5PtCl_4+52H_2O$.

Very deliquescent. (Cleve.)
$2YCl_3$, $3PtCl_4+30H_2O$. (Nilson, B. **9.** 1059.)
$2YCl_3$, $PtCl_4+21H_2O$. (Nilson.)

Zinc chloroplatinate, $ZnPtCl_6+6H_2O$.

Deliquescent; sol. in H_2O and alcohol.

Zinc *tetra*chloroplatinate, $ZnPt(OH)_2Cl_4+5H_2O$.

Extremely sol. in H_2O and alcohol. (Miolati, Z. anorg. 1900, **22.** 458.)

Zirconyl chloroplatinate, $(ZrO)PtCl_6+12H_2O$.

(Nilson.)

Chloroplatinoanhydro*pyro*phosphoric acid, $ClPtP_2O_6H_4 = ClPt\begin{cases} P(OH)_2 \\ >O \\ PO(OH)_2 \end{cases}$.

Not deliquescent. Sol. in H_2O. (Schützenberger, Bull. Soc. (2) **18.** 154.)

Chloroplatinocyanhydric acid, $H_2Pt(CN)_4Cl_2$.

See **Perchloroplatinocyanhydric acid.**

Potassium chloroplatinocyanide, $5K_2Pt(CN)_4$, $K_2Pt(CN)_4Cl_2+21H_2O$.

Sol. in H_2O; insol. in alcohol.

Silver chloroplatinocyanide, $Ag_2(PtCl_2(CN)_4)_2$.

Ppt. (Miolati, C. C. **1901,** I. 500.)

Chloroplatinophosphoric acid, $Cl_2PtP(OH)_3$.

Very deliquescent, and sol. in H_2O. (Schützenberger, Bull. Soc. (2) **17.** 493.)

Lead chloroplatinophosphate, $Pb_3(Cl_2PtPO_3)_2+8H_2O$.

Ppt.

$Pb_3(Cl_2PtPO_3)_2$, $2PbO+4H_2O$. Ppt. (Schützenberger, Bull. Soc. (2) **17.** 494.)

Silver chloroplatinophosphate, Ag_2HPO_3, $PtCl_2$.

Ppt. (Schützenberger, Bull. Soc. (2) **17.** 494.)

Chloroplatino*di*phosphoric acid, $PtCl_2$, $P_2(OH)_6$.

Very deliquescent, and easily sol. in H_2O. (Schützenberger, Bull. Soc. (2) **18.** 153.)

Chloroplatino*pyro*phosphoric acid,

$$ClPt\begin{cases}P(OH)_2\\ >O\\ P(OH)_3.\end{cases}$$

Less deliquescent than chloroplatino*di*phosphoric acid.

Chloroplatinous acid, H_2PtCl_4.

Known only in solution.

Aluminum chloroplatinite, $AlPtCl_5+10\frac{1}{2}H_2O$.

Very deliquescent; sol. in H_2O. (Nilson, J. pr. (2) **15.** 260.)

Ammonium chloroplatinite, $(NH_4)_2PtCl_4$.

Sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. (Peyrone, A. **55.** 206.)

Barium chloroplatinite, $BaPtCl_4+3H_2O$.

Not deliquescent; sol. in H_2O. Very sl. sol. in 93% alcohol.

Cadmium chloroplatinite ammonia, $CdPtCl_4$, $4NH_3$.

Insol. in H_2O or NH_4OH+Aq. Sol. in HCl+Aq. (Thomsen, B. **2.** 668.)

Cæsium chloroplatinite, Cs_2PtCl_4.

Sl. sol. in cold, easily in hot H_2O.

100 pts. H_2O dissolve	3.4 pts. salt	at	20°
"	"	6.73 "	"	40°
"	"	8.68 "	"	60°
"	"	10.92 "	"	80°
"	"	12.10 "	"	100°.

(Godeffroy, A. **181.** 176.)

Cs_2PtCl_5. Ppt. Very sensitive to sunlight. Decomp. by H_2O into the higher and lower chlorides. (Wöhler, B. **1909, 42.** 4104.)

Calcium chloroplatinite, $CaPtCl_4+8H_2O$.

Deliquescent; sol. in H_2O.

Cerium chloroplatinite, $CeCl_3$, $2PtCl_2+10\frac{1}{2}H_2O$.

Deliquescent; easily sol. in H_2O. (Nilson, B. **9.** 1847.)

Chromium chloroplatinite, $Cr_2Pt_3Cl_{12}+18H_2O$.

Deliquescent.

Cobalt chloroplatinite, $CoPtCl_4+6H_2O$.

Sl. deliquescent in moist, efflorescent in dry air.

Copper chloroplatinite, $CuPtCl_4+6H_2O$.

Extremely deliquescent. (Topsöe.)

Copper chloroplatinite ammonia (cuprammonium chloroplatinite), $Cu(NH_3)_4PtCl_4$.

Insol. in H_2O or NH_4OH+Aq; easily sol. in H_2SO_4+Aq. (Millon and Commaille, C. R. **57.** 822.)

Didymium chloroplatinite, $DiCl_3$, $2PtCl_2+10H_2O$.

Deliquescent; very sol. in H_2O. (Nilson.)

$2DiCl_3$, $3PtCl_2+18H_2O$. As above. (Nilson.)

Erbium chloroplatinite, $ErPtCl_5+13\frac{1}{2}H_2O$.

Deliquescent.

$Er_2Pt_3Cl_{12}+24H_2O$. Deliquescent in moist air.

Glucinum chloroplatinite, $GlPtCl_4+5H_2O$.

Deliquescent in moist air. Sol. in H_2O in all proportions.

Iron (ferrous) chloroplatinite, $FePtCl_4+7H_2O$.

Deliquescent. Rather sl. sol. in cold, very sol. in hot H_2O. (Nilson.)

Lanthanum chloroplatinite, $La_2Pt_3Cl_{12}+18$, and $27H_2O$.

Deliquescent.

Lead chloroplatinite, $PbPtCl_4$.

Insol. in cold H_2O.

Lithium chloroplatinite, $Li_2PtCl_4+6H_2O$.

Sol. in H_2O.

Magnesium chloroplatinite, $MgPtCl_4+6H_2O$.

Not very deliquescent; very sol. in H_2O.

Manganese chloroplatinite, $MnPtCl_4+6H_2O$.
As the Mg salt.

Mercurous chloroplatinite.
Ppt.

Nickel chloroplatinite, $NiPtCl_4+6H_2O$.
As the Co salt.

Potassium chloroplatinite, K_2PtCl_4.
Moderately sol. in H_2O; insol. in alcohol.

Rubidium chloroplatinite, Rb_2PtCl_4.
Sl. sol. in cold; easily in hot H_2O.

Silver chloroplatinite, Ag_2PtCl_4.
Insol. in H_2O. NH_4OH+Aq dissolves out AgCl. (Lang.)
AgCl, $PtCl_2$(?). As above. (Commaille, Bull. Soc. (2) **6.** 262.)

Silver chloroplatinite ammonia, Ag_2PtCl_4, $4NH_3$.
(Thomsen.)

Sodium chloroplatinite, $Na_2PtCl_4+4H_2O$.
Deliquescent; very sol. in H_2O.

Strontium chloroplatinite, $SrPtCl_4+6H_2O$.
Deliquescent. Very sol. in H_2O.

Thallium chloroplatinite, Tl_2PtCl_4.
Very sl. sol. even in boiling H_2O.

Thorium chloroplatinite, $Th_2Pt_3Cl_{14}+24H_2O$.
Very deliquescent.

Yttrium chloroplatinite, $Y_2Pt_3Cl_{12}+24H_2O$.
Deliquescent.

Zinc chloroplatinite, $ZnPtCl_4+6H_2O$.
Sl. sol. in cold, more easily in hot H_2O; insol. in alcohol.

Zinc chloroplatinite ammonia, $ZnPtCl_4$, $4NH_3$.
Sl. sol. in H_2O; easily sol. in $HCl+Aq$. Insol. in alcohol. (Thomsen, J. B. **1868.** 278.)

Zirconyl chloroplatinite, $(ZrO)PtCl_4+8H_2O$.
(Nilson.)

***Tri*chloroplatinous acid,** $H_2Pt(OH)Cl_3$.
Sol. in H_2O. (Miolati, Z. anorg. 1902, **33.** 265.)
$+H_2O$. (Nilson, J. pr. (2) **15.** 260.)

Lead *tri*chloroplatinite, $PbPt(OH)Cl_3$.
Ppt. (Miolati.)

Silver *tri*chloroplatinite, $Ag_2Pt(OH)Cl_3$.
Ppt. (Miolati.)

Chloroplatosulphurous acid.

Ammonium chloroplatosulphite, acid, *$NH_4PtClSO_3$, $H_2SO_3+4H_2O$.*
Sol. in H_2O. (Birnbaum, A. ***152.*** *149.)*

Ammonium chloroplatosulphite chloride sulphite, $NH_4PtClSO_3$, $(NH_4)_2SO_3$, NH_4Cl.
Very deliquescent. (Birnbaum.)

Ammonium chloroplatosulphite sulphite, $NH_4ClPtSO_3$, $(NH_4)_2SO_3+3H_2O$.
Sol. in H_2O. (Birnbaum.)

Barium chloroplatosulphite chloride ammonium chloride, $Ba(ClPtSO_3)_2$, $Ba(PtClSO_3)Cl$, $6NH_4Cl+3H_2O$.
Sol. in H_2O. (Birnbaum.)

Potassium chloroplatosulphite ammonium chloride, $KPtClSO_3$, $2NH_4Cl$.
Very deliquescent. (Birnbaum, A. **152.** 142.)

Potassium chloroplatosulphite chloride, $KPtClSO_3$, $2KCl$.
Deliquescent; sol. in H_2O. (Birnbaum, A. **152.** 145.)

Potassium chloroplatosulphite ammonium potassium sulphite, $KPtClSO_3$, $(NH_4)KSO_3+3H_2O$.
Very deliquescent. (Birnbaum, A. **159.** 120.)

Sodium chloroplatosulphite ammonium chloride, $NaPtClSO_3$, $2NH_4Cl$.
Very deliquescent. (Birnbaum, A. **159.** 117.)

Chloroplumbic acid, H_2PbCl_6.
Decomp. in solution on standing. (Gutbier, J. pr. 1914, (2) **90.** 497.)

Ammonium chloroplumbate, $(NH_4)_2PbCl_6$.
Ppt. Difficultly sol. in a small amount of H_2O. Solution decomp. slowly when cold, more rapidly when warmed.
Decomp. by a large amount of H_2O. Sol. without decomp. in 20% HCl. Decomp. by dil. acids and alkalis. (Elbs, Z. Elektrochem. 1903, **9.** 778.)
Difficultly sol. in small amount of H_2O and solution decomp. slowly in the cold, more rapidly when warmed. Decomp. by a large amount of H_2O. (Gutbier, J. pr. 1914, (2) **90.** 498.)
Sol. in cold HNO_3 without decomp. (Friedrich, M. 1893, **14.** 511.)
Insol. in conc. NH_4Cl+Aq. (Nikoljukin, B. **18.** 370 R.)
$5NH_4Cl$, $2PbCl_4$. Not hygroscopic. Decomp. by H_2O with pptn. of PbO_2. Sol. in $HCl+Aq$ and in cold HNO_3+Aq without

decomp. (Classen and Zahorski, Z. anorg. **4.** 100.)

Composition is $2NH_4Cl$, $PbCl_4$. (Friedrich, W. A. B. **102, 2b.** 527.)

Cæsium chloroplumbate, Cs_2PbCl_6.

Nearly absolutely insol. in conc. CsCl+Aq in presence of Cl. (Wells, Z. anorg. **4.** 335.)

1 ccm. conc. HCl+Aq containing $PbCl_4$ dissolves 0.000049 g. Cs_2PbCl_6. (Wells, Z. anorg. **4.** 341.)

Reacts with H_2O as the corresponding ammonium salt. (Gutbier, J. pr. 1914, (2) **90.** 500.)

Potassium chloroplumbate, K_2PbCl_6.

Decomp. by H_2O; sol. in KCl+Aq. (Wells, Z. anorg. **4.** 335.)

Readily decomp. in the air. (Gutbier, J. pr. 1914, (2) **90.** 499.)

Rubidium chloroplumbate, Rb_2PbCl_6.

Decomp. by H_2O; sl. sol. in conc. RbCl+Aq. (Wells, Z. anorg. **4.** 335.)

1 ccm. conc. HCl+Aq. containing $PbCl_4$ dissolves 0.003 g. Rb_2PbCl_6. (Wells, Z. anorg. **4** 341.)

Reacts with H_2O as the corresponding ammonium salt. (Gutbier, J. pr. 1914, (2) **90.** 499.)

Decomp. by conc. H_2SO_4. Insol. in 96% alcohol. (Erdmann, A. 1896, **294.** 76.)

Chloropurpureochromium bromide, $CrCl(NH_3)_5Br_2$.

Somewhat more easily sol. in H_2O than the chloride. (Jörgensen, J. pr. (2) **20.** 105.)

—— **chloride,** $CrCl(NH_3)_5Cl_2$.

Difficultly sol. in cold, and decomp. by hot H_2O.

1 pt. dissolves in 154 pts. H_2O at 16°. Insol. in conc. HCl+Aq. More sol. in dil. H_2SO_4+Aq than in H_2O. Sol. in NH_4OH+Aq without decomp. (Jörgensen, J. pr. (2) **20.** 105.)

—— **mercuric chloride,** $CrCl(NH_3)_5Cl_2$, $3HgCl_2$.

Very difficultly sol. in H_2O. (Jörgensen.)

—— **chloroplatinate,** $CrCl(NH_3)_5(PtCl_6)$.

Extremely difficultly sol. in H_2O. (Jörgensen.)

—— **chromate,** $CrCl(NH_3)_5(CrO_4)$.

Sl. sol. in H_2O; sl. more sol. than chloropurpureocobalt chromate. (Jörgensen.)

—— **dithionate,** $CrCl(NH_3)_5(S_2O_6)$.

Very sl. sol. in cold, but much more easily in hot H_2O. (Jörgensen.)

Chloropurpureochromium ferrocyanide, $[CrCl(NH_3)_5]_2Fe(CN)_6+4H_2O$.

Very difficultly sol. in cold H_2O. (Jörgensen.)

—— **fluosilicate,** $CrCl(NH_3)_5(SiF_6)$.

Very difficultly sol. in H_2O. Insol. in H_2SiF_6+Aq. (Jörgensen, J. pr. (2) **20.** 105.)

—— **mercuric iodide,** $CrCl(NH_3)_5I_2$, $2HgI_2$.

Decomp. by H_2O; sol. in alcohol and warm KCN+Aq.

$CrCl(NH_3)_5I_2$, HgI_2. Very difficultly sol. in cold H_2O; easily sol. in KCN+Aq. (Jörgensen, *l.c.*)

—— **nitrate,** $CrCl(NH_3)_5(NO_3)_2$.

Sol. in 71 pts. H_2O at 17.5°. Insol. in HNO_3+Aq. (Jörgensen.)

—— **oxalate,** $CrCl(NH_3)_5C_2O_4$.

Very sl. sol. in cold H_2O. (Jörgensen, *l.c.*)

—— **sulphate,** $CrCl(NH_3)_5SO_4+2H_2O$.

Sol. in H_2O; precipitated by alcohol. (Jörgensen.)

—— **sulphate, acid,** $[CrCl(NH_3)_5]_4SO_4(HSO_4)_6$.

Quite sol. in H_2O. (Jörgensen, J. pr. (2) **20.** 185.)

—— *penta***sulphide,** $CrCl(NH_3)_5S_5$.

Very sl. sol. in cold, easily sol. in warm H_2O. Decomp. by dil. HCl+Aq. Insol. in alcohol. (Jörgensen.)

Chloropurpureocobaltic bromide, $CoCl(NH_3)_5Br_2$.

Properties resemble the chloride very closely. Sol. in 214 pts. H_2O at 14.3° (Jörgensen, J. pr. (2) **18.** 205.)

—— **mercuric bromide,** $4CoCl(NH_3)_5Br_2$, $9HgBr_2$.

Ppt. (J.)

—— **bromoplatinate,** $CoCl(NH_3)_5Br_2$, $PtBr_4$.

Very sl. sol. in H_2O. (J.)

—— **carbonate,** $CoCl(NH_3)_5CO_3+4\frac{1}{2}H_2O$.

Efflorescent; very easily sol. in H_2O. (J.)

—— **chloride,** $CoCl(NH_3)_5Cl_2$.

Very sl. sol. in cold, more easily in hot H_2O. Sol. in 244 pts. H_2O at 15.5°. (Claudet, Phil. Mag. J. (4) **2.** 253.) In 287 pts. H_2O at 10.2° and 255 pts. at 11.5°. (Rose, Pogg. **20.** 152.) 100 pts. H_2O dissolve 0.232 pt. $CoCl_3$, $5NH_3$, at 0°, and 1.031 pts. at 46.6°. (Kurnakoff, J. Russ. Soc. **24.** 629.)

Sl. decomp. by cold, completely by boiling H_2O; decomp. prevented by a little HCl. Pptd. from aqueous solution by alcohol, HCl,

or sat. KCl or NaCl+Aq; not decomp. by boiling HCl+Aq. (Claudet, *l.c.*) Nearly insol. in cold, but sol. in hot H_2O, to which a few drops of HCl have been added. Less sol. in dil. HCl+Aq than luteocobaltic chloride. (Rogojski, A. ch. (3) **41.** 447.)

Insol. in alcohol. (Gibbs and Genth.)

Chloropurpureocobaltic antimony chloride, $2CoCl(NH_3)_5Cl_2, SbCl_3$.

Ppt. Decomp. by H_2O. (Gibbs.)

—— **bismuth chloride.**

Insol. in conc. HCl. Easily decomp. by H_2O. (Gibbs.)

—— **mercuric chloride,** $CoCl(NH_3)_5Cl_2, 3HgCl_2$.

Insol. in cold, less sol. in hot H_2O than chloropurpureocobaltic chloride. Insol. in cold fuming HCl+Aq; sl. sol. in hot HCl+Aq, separating on cooling; sl. sol. in hot aqua regia; moderately sol. in hot HNO_3+Aq; partly sol. in cold conc. H_2SO_4, wholly on warming. Easily sol. in warm $H_2C_2O_4$+Aq. Insol. in $HgCl_2$+Aq.

Moderately sol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq. (Carstanjen.)

$CoCl(NH_3)_5Cl_2, 2HgCl_2$. Sl. sol. in cold, but much more easily in hot H_2O. (Gibbs, Proc. Am. Acad. **10.** 33.)

—— **chloropalladite,** $CoCl(NH_3)_5Cl_2, PdCl_2$.

Sl. sol. in cold, moderately sol. in hot H_2O. (Carstanjen.)

—— **chloroplatinate,** $CoCl(NH_3)_5Cl_2, PtCl_4$.

Nearly insol. in cold. Very sl. sol. in hot H_2O. (Gibbs and Genth, Sill. Am. J. (2) **23.** 319.)

—— **chromate,** $CoCl(NH_3)_5CrO_4$.

Very sl. sol. in H_2O. (J.)

—— *di***chromate,** $CoCl(NH_3)_5Cr_2O_7$.

Much more easily sol. in H_2O than the neutral salt. (J.)

—— **dithionate,** $CoCl(NH_3)_5S_2O_6$.

Very sl. sol. in cold, more easily in hot H_2O. (J.)

—— **manganic fluoride.**

Ppt. Sl. sol. in dil. HF+Aq. (Christensen, J. pr. (2) **35.** 161.)

—— **fluosilicate,** $CoCl(NH_3)_5SiF_6$.

Very sl. sol. in HF+Aq.

—— **iodide,** $CoCl(NH_3)_5I_2$.

Much more sol. in H_2O than bromide or chloride. Sol. in 54.5 pts. H_2O at 15.6°, and 50 pts. at 19.3°. (J.)

Chloropurpureocobaltic mercuric iodide, $CoCl(NH_3)_5I_2, 2HgI_2$.

Sl. sol. in H_2O. (J.)

$CoCl(NH_3)_5I_2, HgI_2$. Very sl. sol. in cold H_2O. (J.)

—— **nitrate,** $CoCl(NH_3)_5(NO_3)_2$.

Sol. in 80 pts. H_2O at 15°. Rather easily sol. in hot H_2O. (Jörgensen, J. pr. (2) **18.** 209.)

—— **oxalate,** $CoCl(NH_3)_5C_2O_4$.

Sl. sol. in H_2O. (J.)

—— *pyro***phosphate,** $CoCl(NH_3)_5(H_2P_2O_7)$.

Sl. and very slowly sol. in cold, much more easily in warm H_2O. (J.)

$[CoCl(NH_3)_5]_2P_2O_7+xH_2O$. Quite easily sol. in H_2O.

—— *di***phospho***penta***molybdate,** $[CoCl(NH_3)_5]_2(5MoO_3, 2HPO_4)$.

Ppt. Nearly insol. in pure H_2O; more sol. in dil. H_2SO_4+Aq without decomp. (J.)

$[CoCl(NH_3)_5]_2(5MoO_3, 2NH_4PO_4)$. Ppt. As above.

—— **sulphate,** $CoCl(NH_3)_5SO_4$.

Anhydrous. Slowly sol. in 128–131.9 pts. H_2O at 16°.

$+2H_2O$. Sol. in 133.4 pts. H_2O at 17.3°. Rather easily sol. in hot H_2O, and much more rapidly than the anhydrous salt. (J.)

$[CoCl(NH_3)_5]_4SO_4(SO_4H)_6$. Decomp. by H_2O into neutral sulphate. Sol. in H_2SO_4.

—— **tartrate,** $CoCl(NH_3)_5(C_4H_5O_6)_2+2\frac{1}{2}H_2O$.

Moderately sol. in H_2O; insol. in alcohol.

—— **thiosulphate,** $CoCl(NH_3)_5S_2O_3$.

Nearly insol. in cold H_2O; very sl. sol. in boiling H_2O with partial decomp. (J.)

Chloropurpureoiridium comps.

See **Irido***pent***amine comps.**

Chloropurpureorhodium carbonate, $ClRh(NH_3)_5CO_3+H_2O$.

Easily sol. in H_2O. (Jörgensen.)

—— **chloride,** $ClRh(NH_3)_5Cl_2$.

Sol. in 179 pts. H_2O at 17°, and more easily in hot H_2O. Sol. in conc. H_2SO_4 or boiling NaOH+Aq without decomp. Very sl. sol. in cold dil. HCl+Aq (1 : 1). Sl. sol. in hot HCl+Aq. Insol. in alcohol. (Jörgensen, J. pr. (2) **27.** 433; **34.** 394.)

—— **rhodium chloride,** $3ClRh(NH_3)_5Cl_2, 2RhCl_3$.

Ppt. (Jörgensen, Z. anorg. **5.** 75.)

Chloropurpureorhodium chloroplatinate, $ClRh(NH_3)_5PtCl_6$.

Insol. in cold H_2O. (J.)

—— **fluosilicate,** $ClRh(NH_3)_5SiF_6$.

Very sl. sol. in cold H_2O. Sol. in NaOH + Aq as roseo salt. (J.)

—— **hydroxide,** $ClRh(NH_3)_5(OH)_2$.

Known only in solution. (J.)

—— **nitrate,** $ClRh(NH_3)_5(NO_3)_2$.

Sl. sol. in cold H_2O, but more easily than the chloride. Sol. in boiling NaOH+Aq as roseo salt. (J).

—— **sulphate,** $ClRh(NH_3)_5SO_4+2H_2O$.

Sl. sol. in cold, more easily in hot H_2O. (J.)

$4ClRh(NH_3)_5SO_4, 3H_2SO_4$. Sl. sol. in cold, more easily in hot H_2O. (J.)

Chlororhodous acid.

Ammonium chlororhodite, $(NH_4)_2RhCl_5+H_2O$.

(Gutbier, B. 1908, **41.** 213.)

Sol. in H_2O; insol. in alcohol. (Wollaston.) Not obtainable. (Leidié, A. ch. (6) **17.** 275.)

$(NH_4)_3RhCl_6+1\frac{1}{2}H_2O$. Sol. in H_2O, but less easily than Na salt; insol. in alcohol. Sol. in dil. NH_4Cl+Aq. (Claus, J. B. **1855.** 423.) (Gutbier, *l. c.*)

Ammonium chlororhodite nitrate, $(NH_4)_2Rh_2Cl_6, 2NH_4NO_3$.

Very sol. in H_2O. Decomp. by boiling with H_2O. Sl. sol. in HNO_3+Aq. (Leidié, C. R. **107.** 234.)

Barium chlororhodite, $Ba_3(RhCl_6)_2$.

Resembles the Na salt. (Bunsen, A. **146.** 276.)

Cæsium chlororhodite, $Cs_2RhCl_5+H_2O$.

Difficulty sol. in H_2O. (Gutbier, B. 1908, **41.** 214.)

Lead chlororhodite, $Pb_3(RhCl_6)_2$.

Ppt. Insol. in H_2O. (Claus.) Not obtainable. (Leidié.)

Mercurous chlororhodite, Hg_3RhCl_6.

Ppt. Insol. in H_2O. (Claus.) Not obtainable. (Leidié.)

Potassium chlororhodite, $K_2RhCl_5+H_2O$.

Not efflorescent. Sl. sol. in H_2O. Sl. sol. in KCl—Aq. (Gibbs.) Insol. or sl. sol. in alcohol. (Berzelius.)

Salt is anhydrous. (Leidié.)

Contains $1H_2O$. (Seubert and Kobbé, B. **23.** 2556.)

Can be cryst. from H_2O containing a little HCl. (Gutbier, B. 1908, **41.** 212.

$K_3RhCl_6+3H_2O$. Efflorescent. Sl. sol. in H_2O. Aqueous solution decomp. to above on standing. (Claus.)

Not obtainable. (Leidié.)

Also obtained by Seubert and Kobbé. (B. **23.** 2556.)

$+1\frac{1}{2}H_2O$. (Leidié, C. R. **111.** 106.)

Rubidium chlororhodite, $Rb_2RhCl_5+H_2O$.

Difficulty sol in H_2O. (Gutbier, B. 1908, **41,** 214.

Silver chlororhodite, Ag_3RhCl_6.

Ppt. Insol. in H_2O. (Claus.)

Not obtainable. (Leidié.)

Sodium chlororhodite, $Na_6Rh_2Cl_{12}+18H_2O$. $Na_3RhCl_6+9H_2O$.

Efflorescent. Sol. in 1.5 pts. H_2O. Melts in crystal H_2O at 50°. Insol. in alcohol. (Claus.)

$+12H_2O$. (Gutbier, B. 1908, **41.** 213.)

Chlororuthenic acid.

Ammonium chlororuthenate, $(NH_4)_2RuCl_6$.

Easily sol. in H_2O. (Claus.)

Formula is $(NH_4)_2Ru(NO)Cl_5$. (Joly, C. R. **107.** 994.)

Sol. in H_2O with decomp. Sol. in HCl. (Howe, J. Am. Chem. Soc. 1904, **26.** 549.)

Ammonium *aquo*chlororuthenate, $(NH_4)_2Ru(H_2O)Cl_5$.

Ppt. (Howe, J. Am. Chem. Soc. 1904, **26.** 548.)

Cæsium chlororuthenate, Cs_2RuCl_6.

Sl. sol. in H_2O. Sol. in hot dil. HCl+Aq. (Howe, J. Am. Chem. Soc. 1901, **23.** 784.)

Potassium chlororuthenate, K_2RuCl_6.

Very sol. in H_2O. Very sl. sol. in conc. NH_4Cl+Aq. Insol. in 70% alcohol. (Claus.)

Formula is $K_2Ru(NO)Cl_5$. (Joly.)

Very sl. sol. in cold H_2O. Insol. in presence of KCl.

Partially decomp. in hot aqueous solution. (Antony, Gazz. ch. it. 1899, **29.** (2), 82.)

Easily sol. in H_2O with rapid decomp. Sol. in HCl. (Howe, J. Am. Chem. Soc. 1904, **26.** 548.)

Potassium *aquo*chlororuthenate, $K_2Ru(OH_2)Cl_5$.

Sol. in H_2O. (Howe, J. Am. Chem. Soc. 1904, **26.** 547.)

Rubidium chlororuthenate, Rb_2RuCl_6.

Sl. sol. in H_2O; sol. in hot dil. HCl+Aq. (Howe, J. Am. Chem. Soc. 1901, **23.** 784.)

Chlororuthenious acid.

Ammonium chlororuthenite, $(NH_4)_4Ru_2Cl_{10}$.
Sl. sol. in H_2O. Insol. in NH_4Cl+Aq or alcohol. (Claus, J. pr. **80.** 282.)

Cæsium chlororuthenite, $Cs_2RuCl_5+H_2O$.
Sl. sol. in H_2O; sol. in HCl+Aq. (Howe, J. Am. Chem. Soc. 1901, **23.** 785.)

Potassium chlororuthenite, $K_4Ru_2Cl_{10}$.
Moderately sol. in cold, more easily in hot H_2O. Decomp. easily by heating. Insol. in conc. NH_4Cl+Aq. Insol. in 80% alcohol.

Rubidium chlororuthenite, $Rb_2RuCl_5+H_2O$.
Sl. sol. in H_2O; sol. in HCl+Aq. (Howe, J. Am. Chem. Soc. 1901, **23.** 786.)

Sodium chlororuthenite, $Na_4Ru_2Cl_{10}$.
Deliquescent. Sol. in H_2O or alcohol.

*Tri*chlorosilicomercaptane.

See **Silicon chlorohydrosulphide.**

Chlorosmic acid.

Ammonium chlorosmate, $(NH_4)_2OsCl_6$.
Sl. sol. in H_2O. Insol. in alcohol and H_2O containing HCl.

Potassium chlorosmate, K_2OsCl_6.
Properties as the NH_4 salt.

Potassium amino chlorosmate, $(NH_2)OsCl_3,2KCl$.
Ppt. (Brizard, A. ch. 1900, (7) **21.** 375.)

Potassium amino, chlorosmate hydrogen chloride, $(NH_2)OsCl_3,2KCl,HCl$.
Ppt. (Brizard, A. ch. 1900, (7) **21.** 378.)

Silver chlorosmate, Ag_2OsCl_6.
Insol. in H_2O or HNO_3+Aq. (Claus and Jacoby.)

Silver chlorosmate ammonia, $Ag_2OsCl_6, 2NH_3$.
Sol. in much H_2O. Sl. sol. in KOH+Aq. Easily sol. in KCN+Aq. (C. and J.)

Sodium chlorosmate, $Na_2OsCl_6+2H_2O$.
Easily sol. in H_2O or alcohol.

Chlorosmious acid.

Ammonium chlorosmite, $(NH_4)_4Os_2Cl_{10}+3H_2O$.
Easily sol. in H_2O and alcohol; insol. in ether. (Claus and Jacoby, J. pr. **90.** 65.)

Potassium chlorosmite, $K_6Os_2Cl_{12}+6H_2O$.
Very easily sol. in H_2O or alcohol. Insol. in ether. (C. and J.)

Chlorosmisulphurous acid.

Potassium hydrogen chlorosmisulphite, $OsCl_4(SO_3)_4K_6H_2$.
Ppt. (Rosenheim, Z. anorg. 1900, **24.** 422.)

Sodium chlorosmisulphite, $OsCl_2(SO_3)_4Na_6+10H_2O$.
Ppt. (Rosenheim, Z. anorg. 1900, **24.** 420.)

Chloro*pyro*selenious acid.

Ammonium chloro*pyro*selenite, $NH_4Cl, 2SeO_2+2H_2O$.
Sol. in H_2O. (Muthmann and Schäfer, B. **26.** 1008.)

Potassium chloro*pyro*selenite, $KCl, 2SeO_2+H_2O$.
As NH_4 salt. (M. and S.)

Rubidium chloro*pyro*selenite, $RbCl, 2SeO_2+2H_2O$.
As NH_4 salt. (M. and S.)

Chlorostannic acid, $SnO(OH)Cl$.

(Mallet, Chem. Soc. **35.** 524.)
$H_2SnCl_6+6H_2O$. Extremely deliquescent; sol. in H_2O. (Seubert, B. **20.** 793.)

Ammonium chlorostannate, $(NH_4)_2SnCl_6$ (*pink salt*).
Sol. in 3 pts. H_2O at 14.5°. Solution decomp. on boiling when dilute, but not when conc. (Bolley.)

Barium chlorostannate, $BaSnCl_6+5H_2O$.
Sol. in H_2O. (Lewy, A. ch. (3) **16. 308.**)

Cæsium chlorostannate, Cs_2SnCl_6.
Nearly insol. in conc. HCl+Aq. (Sharples, Sill. Am. J. (2) **47.** 178.)

Calcium chlorostannate, $CaSnCl_6+5H_2O$.
Very deliquescent. (Lewy, A. ch. (3) **16.** 308.)

Cerium chlorostannate, $CeSnCl_7+9H_2O$.
Deliquescent. Sol. in H_2O. (Cleve, Bull. Soc. (2) **31.** 197.)

Cobalt chlorostannate, $CoSnCl_6+6H_2O$.
Sol. in H_2O. (Jörgensen.)

Didymium chlorostannate, $DiCl_3, SnCl_4+10\frac{1}{2}H_2O$.
Sol. in H_2O. (Cleve.)

Glucinum chlorostannate, $GlSnCl_6+8H_2O$.
Deliquescent. Sol. in H_2O. (Atterberg, Sv. V. A. Handl. **12.** No. 4. 14.)

Lanthanum chlorostannate, $4LaCl_3, 5SnCl_4+45H_2O$.

Deliquescent. Sol. in H_2O. (Cleve.)

Lithium chlorostannate, $Li_2SnCl_6+8H_2O$.

Sol. in little H_2O without decomp., but decomp. by dilution. (Chassevant, A. ch. (6) **30.** 42.)

Magnesium chlorostannate, $MgSnCl_6+6H_2O$.

Very deliquescent. (Lewy.)

Manganous chlorostannate, $MnSnCl_6+6H_2O$.

Deliquescent in moist, efflorescent in dry air. (Jörgensen.)

Nickel chlorostannate, $NiSnCl_6+6H_2O$.

Sol. in H_2O. (Jörgensen.)

Potassium chlorostannate, K_2SnCl_6.

Sol. in H_2O.

Sodium chlorostannate, $Na_2SnCl_6+6H_2O$.

Easily sol. in H_2O. (Topsoë, Gm. K. Handb. 6te aufl. III. 149.)

Strontium chlorostannate, $SrSnCl_6+8H_2O$.

Sl. deliquescent, and easily sol. in H_2O. (Topsoë.)

Yttrium chlorostannate, $YCl_3, SnCl_4+8H_2O$.

Sol. in H_2O. (Cleve, Bull. Soc. (2) **31.**197.)

Zinc chlorostannate, $ZnSnCl_6+6H_2O$.

(Biron, C. C. 1904, II. **410.**)

Chlorosulphobismuthous acid.

Cuprous chlorosulphobismuthite, $2Cu_2S, Bi_2S_3, 2BiSCl$.

Stable in air and insol. in H_2O at ord. temp.

Decomp. by boiling H_2O.

Decomp. by mineral acids with evolution of H_2S. (Ducatte, C. R. 1902, **134.** 1212.)

Lead chlorosulphobismuthite, $PbS, Bi_2S_3, 2BiSCl$.

Stable in the air. Insol. in H_2O; decomp. by boiling H_2O; sol. in dil. acids with decomp. and evolution of H_2S. (Ducatte.)

Chlorosulphonic acid, $HClSO_3$.

See **Sulphuryl hydroxyl chloride.**

Chloro*pyro*sulphonic acid.

Ammonium chloro*pyro*sulphonate, $ClS_2O_6NH_4$.

Fumes in the air.

Decomp. by H_2O and alcohol. (Traube, B. 1913, **46.** 2519.)

Sodium chloro*pyro*sulphonate, ClS_2O_6Na.

Fumes in the air.

Decomp. by H_2O and alcohol. (Traube.)

Chlorosulphuric acid, HSO_3Cl.

See **Sulphuryl hydroxyl chloride.**

SO_2Cl_2. *See* **Sulphuryl chloride.**

Aluminum chlorosulphate, $Al(SO_4)Cl+6H_2O$.

Very sol. in H_2O. Nearly insol. in abs. alcohol. (Recoura, Bull. Soc. 1902, (3) **27.** 1155.)

Chromium chlorosulphate, $CrClSO_4+5H_2O$.

Green. (Weinland, Z. anorg. 1905, **48.** 253.) (Recoura, C. R. 1902, **135.** 164.)

Violet. (Weinland, Z. anorg. 1905, **48.** 254.)

Very sol. in H_2O. Insol. in a mixture of alcohol and acetone. (Recoura, C. R. 1902, **135.** 164.)

$+8H_2O$. Two isomeric modifications:

(a) *Green needles.* Easily sol. in H_2O. (Weinland, Z. anorg. 1906, **48.** 251.)

(b) *Violet plates.* Easily sol. in H_2O. (Weinland.)

Chlorosulphurous acid.

Ammonium palladious *tri*chlorosulphite, $(NH_4)_3PdCl_3SO_3+H_2O$.

Easily sol. in H_2O. (Rosenheim, Z. anorg. 1900, **23.** 30.

Chlorotelluric acid.

Ammonium chlorotellurate, $(NH_4)_2TeCl_6$.

Sol. without decomp. in a small amt. of H_2O, but decomp. by much H_2O or alcohol.

Cæsium chlorotellurate, Cs_2TeCl_6.

Decomp. by H_2O. Sol. in dil. HCl+Aq.

100 pts. HCl+Aq (sp. gr. 1.2) dissolve 0.05 pt. at 22°.

100 pts. HCl+Aq (sp. gr. 1.05) dissolve 0.78 pt. at 22°.

Insol. in alcohol. (Wheeler, Sill. Am. J. **145.** 267.)

Potassium chlorotellurate, K_2TeCl_6.

Deliquescent; decomp. by H_2O and absolute alcohol. (Berzelius.)

The most sol. in H_2O of the chloro- or bromo-tellurates. Easily sol. in dil. HCl+Aq; conc. HCl+Aq ppts. KCl. (Wheeler, Sill. Am. J. **145.** 267.)

Rubidium chlorotellurate, Rb_2TeCl_6.

Decomp. by H_2O. Much more sol. in dil. HCl+Aq than Cs_2TeTl_6.

100 pts. HCl+Aq (sp. gr. 1.2) dissolve 0.34 pt. at 22°.

100 pts. HCl+Aq (sp. gr. 1.05) dissolve, 13.99 pts. at 22°.

Sl. sol. in alcohol. (Wheeler.)

Chlorotetramine chromium bromide, $ClCr(NH_3)_4(OH_2)Br_2$.

Very easily sol. in H_2O. (Cleve, **1861**, (Jörgensen, J pr. (2) **42.** 210.)

——**chloride,** $ClCr(NH_3)_4(OH_2)Cl_2$.

Sol. in H_2O, but decomp. by boiling. Sol. in HCl+Aq, and this solution may be boiled without decomp. (Cleve.)

Sol. in 15.7 pts. H_2O at 15°. (Jörgensen, J. pr. **42.** 208.)

——**chromate,** $ClCr(NH_3)_4(OH_2)CrO_4$.

Precipitate. (Cleve.)

——**fluosilicate,** $ClCr(NH_3)_4(OH_2)SiF_6$.

Sl. sol. in H_2O. (Jörgensen, J. pr. (2) **42.** 218.)

——**hydroxide,** $ClCr(NH_3)_4(OH)_2$.

Known only in solution. (Cleve.)

——**iodide,** $ClCr(NH_3)_4(OH_2)I_2$.

Easily sol. in H_2O. (Cleve.)

——**nitrate,** $ClCr(NH_3)_4(OH_2)(NO_3)_2$.

Very easily sol. in H_2O. (Cleve); (Jörgensen, J. pr. (2) **42.** 209.)

——**sulphate,** $ClCr(NH_3)_4(OH_2)SO_4$.

Very difficulty sol. in cold, more easily in hot H_2O. (Cleve.)

Chlorotetramine cobaltic bromide, $ClCo(NH_3)_4(OH_2)Br_2$.

More sol. in H_2O than chloride. Nearly insol. in HBr+Aq (1:1). (Jörgensen, J. pr. (2) **42.** 215.)

——**chloride,** $ClCo(NH_3)_4(OH_2)Cl_2$.

Sol. in about 40 pts. H_2O, and is identical with octamine cobaltic purpureochloride of Vortmann. (Jörgensen, J. pr. (2) **42.** 211.)

——**chloroplatinate,** $ClCo(NH_3)_4(OH_2)PtCl_6+2H_2O$.

Sl. sol. in H_2O. (Jörgensen.)

——**chromate,** $ClCo(NH_3)_4(OH_2)CrO_4$.

Easily sol. in cold H_2O. (Jörgensen, J. pr. (2) **42.** 216.)

——**fluosilicate,** $ClCo(NH_3)_4(OH_2)SiF_6$.

Sl. sol. in H_2O. Nearly insol. in H_2SiF_6+Aq. (Jörgensen, J. pr. (2) **42.** 219.)

——**sulphate,** $ClCo(NH_3)_4(OH_2)SO_4$.

Sol. in H_2O. (Jörgensen, J. pr. (2) **42.** 214.)

Chlorotitanic acid, $TiCl_4,2HCl=H_2TiCl_6$.

Known only in solution. (Kowalewsky, Z. anorg. 1900, **25.** 192.)

Chlorous acid, $HClO_2$.

Known only in aqueous solution. 100 g. H_2O at 8.5° and 753 mm. pressure dissolve 4.7 g. Cl_2O_3. Hydrate with 50.07–67.43% H_2O, perhaps $HClO_2+H_2O$, separates out at 0°. (Brandan, A. **151.** 340.)

Pure $HClO_2$ is not known even in solution. (Garzarolli-Thurnlakh, A. **209.** 184.)

Chlorites.

All chlorites are easily sol. in H_2O and alcohol, with gradual decomp.

Ammonium chlorite.

Known only in aqueous solution, which decomposes on evaporation or long standing.

Barium chlorite, $Ba(ClO_2)_2$.

Deliquescent; easily sol. in H_2O. Solution decomp. on evaporation. Easily sol. in alcohol. (Millon, A. ch. (3) **7.** 298.)

Lead chlorite, $Pb(ClO_2)_2$.

Nearly insol. in cold H_2O, and only sl. sol. in hot H_2O. Sol. in KOH+Aq. (Garzarolli and Hayn, A. **209.** 203.)

Lead chlorite chloride, $6Pb(ClO_2)_2,4PbCl_2,PbO$.

Rather difficulty sol. in H_2O. (Schiel, A. **109.** 317.)

Potassium chlorite, $KClO_2$.

Very deliquescent and sol. in H_2O. Sol. in alcohol of 38°. (Millon, A. ch. (3) **7.** 323.)

Sol. in $HClO_2$+Aq.

Silver chlorite, $AgClO_2$.

Sol. in hot, less in cold H_2O. Easily decomp. by heating above 100°. Decomp. by weakest acids. (Millon, A. ch. (3) **7.** 329.)

Sodium chlorite, $NaClO_2$.

Very deliquescent, and sol. in H_2O.

Strontium chlorite, $Sr(ClO_2)_2$.

Deliquescent and sol. in H_2O. Decomp. by slow evaporation. (Millon, A. ch. (3) **7.** 327.)

Chloroxyfulminoplatinum, $Pt_4N_4Cl(OH)O_{12}H_{22}$.

Insol. in H_2O; sol. in HCl+Aq. (v. Meyer, J. pr. (2) **18.** 305.)

Chloruranic acid, HUO_3Cl+2H_2O.

Sol. in H_2O; sl. sol. in alcohol. (Mylius, B. 1901, **34.** 2776.)

Chromacichloride, CrO_2Cl_2.

See **Chromyl chloride.**

Chromatoiodic acid.

See **Chromoiodic acid.**

Chromic acid, H_2CrO_4.

Very sol. in H_2O. (Moissan, C. R. **98.** 1851.)

Does not exist except in solution. (Field, Chem. Soc. **61.** 405.)

The composition of the hydrates formed by H_2CrO_4 at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by H_2CrO_4 and of the conductivity and sp. gr. of H_2CrO_4+Aq. (Jones, Am. Ch. J. 1905, **34.** 333.)

See also **Chromium** ***tri*****oxide.**

Chromates.

Chromates of the alkali metals and of Ca, Mg, and Sr are sol. in H_2O; the others are generally insol. or sl. sol. in H_2O, but sol. in HNO_3+Aq.

Aluminum chromate, basic, Al_2O_3, CrO_3+$7H_2O$.

Easily sol. in NH_4OH+Aq, alum, or acetic acid+Aq. Insol. in NH_4Cl+Aq. (Farrie, Chem. Soc. **4.** 300.)

Insol. as such as H_2O, but easily decomp. into H_2CrO_4 and a basic insol. comp. Sol. in alkaline solutions and acids. Decomp. by many salts. (Eliot and Storer, Proc. Am. Acad. **5.** 214.)

Aluminum sodium chromate silicate, $4Al_2O_3,5Na_2O,CrO_3,7SiO_2$.

(Weyberg, C. B. Miner. **1904.** 727.)

Ammonium chromate, basic, $5(NH_4)_2O$, $4CrO_3$(?).

Easily sol. in cold H_2O. (Pohl, W. A. B. **6.** 592.)

Ammonium chromate, $(NH_4)_2CrO_4$.

Very sol. in H_2O; pptd. from aqueous solution by alcohol. (Malaguti and Sarzeau.)

100 g. H_2O dissolve 40.46 g. at 30°. (Schreinemakers, Chem. Weekbl. 1905, **1.** 395.)

Sol. in H_2O without decomp. (Schreinemakers, C. C. **1905,** II. 1067.)

Sp. gr. of $(NH_4)_2CrO_4$+Aq at t°/4°.

t°	13°	13.7°	19.6°
% $(NH_4)_2CrO_4$	10.52	19.75	28.04
Sp. gr.	1.0633	1.1197	1.1727

(Slotte, W. Ann. 1881, **14.** 18.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Difficulty sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium ***di*****chromate,** $(NH_4)_2Cr_2O_7$.

Less sol. in H_2O than $(NH_4)_2CrO_4$. (Moser.)

100 g. H_2O dissolve 47.17g at 30°. (Schreinemakers, Chem. Weekbl. 1905, **1.** 395.)

Sp. gr. of $(NH_4)_2Cr_2O_7$+Aq at t°/4°.

t°	12°	10.5°	12°
% $(NH_4)_2Cr_2O_7$	6.85	13.00	19.93
Sp. gr.	1.0393	1.0782	1.1258

(Slotte, W. Ann. 1881, **14.** 18.)

Sol. in alcohol. (Ranitzer, Zeit. angew. ch. 1913, **26.** 456.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium ***tri*****chromate,** $(NH_4)_2Cr_3O_{10}$.

Not deliquescent, but very sol. in H_2O. (Siewert.)

Decomp. by H_2O into chromic acid and dichromate. (Jäger and Krüss, B. **22.** 2036.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium ***tetra*****chromate,** $(NH_4)_2Cr_4O_{13}$.

Deliquescent. Decomp. by H_2O. (Jäger and Krüss, B. **22.** 2037.)

Ammonium ***hexa*****chromate,** $(NH_4)_2Cr_6O_{19}$+$10H_2O$ (?)

Very efflorescent. (Rammelsberg, Pogg. **94.** 516.)

Ammonium barium chromate, $BaCrO_4,(NH_4)_2CrO_4$.

Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 414.)

Ammonium cadmium chromate, $(NH_4)_2O$, $4CdO$, $4CrO_3+3H_2O$.

Ppt. Decomp. by boiling H_2O. (Gröger, M. 1904, **25.** 533.

Ammonium cadmium chromate ammonia, $(NH_4)_2CrO_4,CdCrO_4,\frac{1}{2}NH_3+1\frac{1}{2}H_2O$.

Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 418.)

$(NH_4)_2Cd(CrO_4)_2$, $2NH_3$. Insol. in cold, decomp. by hot H_2O.

Sol. in dil. acids or in NH_4OH+Aq. (Briggs, Chem. Soc. 1903, **83.** 395.)

Ammonium chromous chromate(?), $(NH_4)_2CrO_4,CrCrO_4=(NH_4)_2Cr(CrO_4)_2$.

Difficultly sol. in H_2O. Insol. in alcohol, ether, chloroform, or glacial acetic acid. Easily sol. in conc. acids, from which it is separated on dilution. Decomp. by NaOH+Aq. (Heintze, J. pr. (2) **4.** 220.)

Ammonium chromyl chromate, $3(NH_4)_2O$, $2CrO_2,3CrO_3$.

Nearly insol. in H_2O. (Pascal, C. R. **1909,** **148.** 1465.)

Ammonium cobaltous chromate. $(NH_4)_2Co(CrO_4)_2+6H_2O$.

Ppt. Easily decomp. (Briggs, Z. anorg. 1907, **56.** 247.)

$(NH_4)_2O$, $4CoO$, $4CrO_3+3H_2O$. Insol. in H_2O. Sol. in cold dil. H_2SO_4. (Gröger, Z. anorg. 1906, **49.** 202.)

Ammonium cobaltous ***di*****chromate,** $CoCr_2O_7,(NH_4)_2Cr_2O_7+2H_2O$.

Sl. hydroscopic; sol. in H_2O, insol. in alcohol. (Krüss, Z. anorg. 1895, **8.** 454.)

Ammonium cobaltous chromate ammonia, $3CoCrO_4,(NH_4)_2CrO_4, 2NH_3+3H_2O$.

Ppt.; decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 422.)

Ammonium cupric ***di*****chromate,** $2CrCr_2O_7,3(NH_4)_2Cr_2O_7+6H_2O$.

Sol. in H_2O. (Krüss, Z. anorg. 1895, **8.** 455.)

Ammonium cupric chromate ammonia, $(NH_4)_2CrO_4,CuCrO_4,2NH_3$.

Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 420.)

Insol. in cold, decomp. by hot H_2O. Sol. in dil. acids or in NH_4OH+Aq. (Briggs, Chem. Soc. 1903, **83.** 394.)

Ammonium iron (ferric) chromate, $(NH_4)_2CrO_4,Fe_2(CrO_4)_3+4H_2O$.

More easily decomp. by H_2O than K_2CrO_4, $Fe_2(CrO_4)_3+4H_2O$. (Hensgen, B. **12.** 1300.)

$6CrO_3$, $5Fe_2O_3$, $6(NH_4)_2O$, and $4CrO_3$, $Fe_2O_3,(NH_4)_2O+4H_2O$. Ppts. (Lepierre, C. R. 1894, **119.** 1217.)

Ammonium lithium chromate, $NH_4LiCrO_4+2H_2O$.

Not deliquescent. (Rammelsberg.)

Ammonium lead chromate, $(NH_4)_2CrO_4$, $PbCrO_4$.

Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 424.)

Ammonium magnesium chromate, $(NH_4)_2CrO_4$, $MgCrO_4+6H_2O$.

Much more sol. in H_2O than the corresponding sulphate. (v. Hauer.)

Sol. in H_2O. (Gröger, Z. anorg. 1908, **58.** 416.)

Ammonium manganous chromate, $(NH_4)_2CrO_4$, $2MnCrO_4$.

Sol. in H_2O. (Hensgen, R. t. c. **3.** 433.)

Ammonium nickel chromate, $(NH_4)_2CrO_4$, $NiCrO_4+6H_2O$.

Sol. in H_2O. (Gröger, Z. anorg. 1906, **51.** 353.)

Can be cryst. from H_2O under 40°. (Briggs, Chem. Soc. 1903, **83.** 392.)

Ammonium nickel chromate ammonia, $(NH_4)_2CrO_4,NiCrO_4,NH_3+H_2O$.

Decomp. by H_2O. (Gröger, Z. anorg. 1906, **51.** 354.)

$(NH_4)_2Ni(CrO_4)_2$, $2NH_3$. Insol. in cold H_2O. Decomp. by hot H_2O. Sol. in dil. acids or in NH_4OH+Aq. (Briggs, Chem. Soc. 1903, **83.** 393.)

$+6H_2O$. (Briggs, Proc. Chem. Soc. 1902, **18.** 254.)

Ammonium potassium chromate, NH_4KCrO_4.

Sol. in H_2O. (E. Kopp, C. N. **11.** 16.)

$+H_2O$. (Étard, C. R. **85.** 443.)

$2(NH_4)_2CrO_4$, $3K_2CrO_4$. Very sol. in H_2O. (Zehenter, M. 1897, **18.** 51.)

Ammonium silver chromate, $(NH_4)_2CrO_4$, $3Ag_2CrO_4$.

Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 423.)

Ammonium sodium chromate, $NH_4NaCrO_4+2H_2O$.

Very sol. in H_2O. (Zehenter, M. 1897, **18.** 54.)

Ammonium strontium chromate, $(NH_4)_2CrO_4$, $SrCrO_4$.

Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 415.)

Ammonium uranyl chromate, $(NH_4)_2CrO_4$, $2(UO_2)CrO_4+6H_2O$.

Decomp. by boiling with H_2O. Sol. in acidulated H_2O. (Formánek, A. **257,** 106.)

$+3H_2O$. (Formánek.)

Ammonium zinc chromate, $(NH_4)_2O$, $2ZnO$, $2CrO_3+H_2O$.

Decomp. by hot H_2O. (Gröger, M. 1904, **25.** 520.)

Ammonium zinc chromate ammonia, $(NH_4)_2Zn(CrO_4)_2$, $2NH_3$.

Insol. in cold, decomp. by hot H_2O. Sol. in dil. acids or in NH_4OH+Aq. (Briggs, Chem. Soc. 1903, **83.** 394.)

$4ZnCrO_4$, $2(NH_4)_2CrO_4$, $3NH_3+3H_2O$. Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 416.)

Ammonium ***di*****chromate chloride mercuric chloride,** $(NH_4)_2Cr_2O_7,2NH_4Cl,4HgCl_2+2H_2O$.

Ppt. Sol. in cold, more sol. in warm H_2O. (Strömholm, Z. anorg. 1912, **75.** 280.)

Ammonium ***di*****chromate chloride mercuric cyanide,** $(NH_4)_2Cr_2O_7$, $4NH_4Cl$, $6Hg(CN)_2+4H_2O$.

(Strömholm, Z. anorg. 1913, **80.** 157.)

Ammonium chromate chromyl fluoride, $(NH_4)_2CrO_4, CrO_2F_2$.

Sol. in H_2O. (Varenne, C. R. **91.** 989.)

Ammonium chromate iodate.

See **Chromoiodate, ammonium.**

Ammonium *di*chromate mercuric chloride, $(NH_4)_2Cr_2O_7, HgCl_2$.

Cannot be recryst. from H_2O or $HgCl_2$+Aq, but from $(NH_4)_2Cr_2O_7$+Aq. (Jäger and Krüss, B. **22.** 2044.)

$+H_2O$. (Richmond and Abel, Chem Soc. Q. J. **3.** 199.)

Cannot be made to crystallize with H_2O. (Jäger and Krüss.)

$3(NH_4)_2Cr_2O_7, HgCl_2$. Decomp. by H_2O. (J. and K.)

$4(NH_4)_2Cr_2O_7, HgCl_2$. Decomp. by H_2O. (J. and K.)

$(NH_4)_2Cr_2O_7, 3HgCl_2$. (J. and K.)

$(NH_4)_2Cr_2O_7, 4HgCl_2$. (J. and K.)

Ammonium chromate phosphate.

See **Phosphochromate, ammonium.**

Ammonium chromate tellurate.

See **Chromotellurate, ammonium.**

Barium chromate, $BaCrO_4$.

Extremely sl. sol. in H_2O.

Calculated from electrical conductivity of $BaCrO_4$+Aq, 1 l. H_2O dissolves 3.8 mg. $BaCrO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

When not ignited, $BaCrO_4$ is sol. in 86,957 pts. H_2O; 22,988 pts. NH_4Cl+Aq (0.5% NH_4Cl); 3670 pts. $HC_2H_3O_2$+Aq (5% $HC_2H_3O_2$); 1986 pts. $HC_2H_3O_2$+Aq (10% $HC_2H_3O_2$); 1813 pts. H_2CrO_4+Aq(10% CrO_3). When ignited, 160,000 pts. H_2O are necessary for solution. (Schweitzer, by Fresenius, Z. anal. **29.** 414.)

Sol. in 23,000 pts. boiling H_2O. (Mescherzerski, Z. anal. **21.** 399.)

3.5 mg. $BaCrO_4$ are dissolved in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Easily sol. in HNO_3,HCl, or chromic acid+Aq, from which it is precipitated by NH_4OH, or by dilution with H_2O. (Bahr.)

Insol. in $K_2Cr_2O_7$+Aq. (Schweitzer.)

Sol. in 49,381 pts. $NH_4C_2H_3O_2$+Aq (0.75% salt) at 15°; in 23,355 pts. $NH_4C_2H_3O_2$+Aq (1.5% salt) at 15°; in 45,162 pts. NH_4NO_3+Aq (0.5% salt) at 15°. (Fresenius, Z. anal. **29.** 418.)

Easily sol. in alkali tartrates, or citrates + Aq. (Fleischer, J. pr. (2) **5.** 326.)

0.22×10^{-4} g. equiv. $BaCrO_4$ are dissolved in 1 l. of 45% alcohol at ord. temp. (Guerini, Dissert, **1912.**)

Insol. in acetic acid and in $M_2Cr_2O_7$+Aq. Partly sol. in a mixture of the two, except in presence of $MC_2H_3O_2$. (Caron and Raquet, Bull. Soc. 1906, (3) **35.** 1064.)

Not completely insol. in acetic acid. (Baubigny, Bull. Soc. 1907, (4) **1.** 58.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Barium *di*chromate, $BaCr_2O_7+2H_2O$.

Decomp. by H_2O with separation of $BaCrO_4$. Sol. in H_2CrO_4+Aq. (Bahr, J. B. **1853.** 358.)

Sol. in cold H_2O with formation of $BaCrO_4$ and CrO_3.

Insol. in glacial acetic acid. (Mayer, B. 1903, **36.** 1742.)

Barium calcium chromate, $BaCa(CrO_4)_2$.

(Bourgeois Bull. Soc. Min. 1879, **2.** 124.)

Barium potassium chromate, $BaK_2(CrO_4)_2$.

Decomp. by H_2O. (Gröger, Z. anorg. 1907, **54.** 186.)

Decomp. by H_2O. Stable in K_2CrO_4+Aq, containing:

2.181 pts. K_2CrO_4 per 100 pts. H_2O at	11.5°
3.395 " " " " " " "	27.5°
5.120 " " " " " " "	50.0°
7.119 " " " " " " "	76.0°
9.036 " " " " " " "	100.0°

(Barre, C. R. 1914, **158.** 497.)

Barium potassium *tri*chromate, $Ba_2K_2(Cr_3O_{10})_3+3H_2O$.

Extremely deliquescent. (Bahr.)

Bismuth chromates, basic.

These comps. are insol. in H_2O even in presence of H_2CrO_4; sol. in HCl or HNO_3+Aq. (Löwe, J. pr. **67.** 288.)

100 pts. H_2O dissolve 0.00008 pt. "bismuth chromate"; 100 pts. acetic acid dissolve 0.00021 pt. "bismuth chromate"; 100 pts. HNO_3+Aq (sp. gr. = 1.038) dissolve 0.00024 pt. "bismuth chromate"; 100 pts. KOH+Aq (sp. gr. = 1.33) dissolve 0.00016 pt. "bismuth chromate." (Pearson, Phil. Mag. (4) **11.** 206.)

Not insol. in dil. HNO_3+Aq unless K_2CrO_4 is present. Less sol. in hot NaOH+Aq than $PbCrO_4$. (Storer.)

"Bismuth chromate" is insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$3Bi_2O_3, 2CrO_3 = 2(BiO)_2CrO_4, Bi_2O_3$. Insol. in H_2O; sol. in HNO_3+Aq.

$Bi_2O_3, CrO_3 = (BiO)_2CrO_4$. Insol. in H_2O; easily sol. in dil. HCl+Aq, less in dil. HNO_3 or H_2SO_4+Aq. (Muir.)

$Bi_2O_3, 2CrO_3 = (BiO)_2Cr_2O_7$. Insol. in H_2O.

$+H_2O$.

$5Bi_2O_3, 11CrO_3+6H_2O$. (Muir, Chem. Soc. **31.** 24.)

$3Bi_2O_3, 7CrO_3$. Insol. in H_2O; easily sol. in mineral acids, especially HCl+Aq. Partly sol. in KOH+Aq.

Bismuth chromate, acid, $Bi_2O_3, 4CrO_3+H_2O$.
Insol. in hot or cold H_2O. Sol. in dil. HCl or HNO_3+Aq. (Muir, Chem. Soc. **30.** 17.)

Bismuth potassium chromate, $Bi_2(CrO_4)_3, K_2CrO_4$.
Insol. in H_2O. Decomp. with hot H_2O.
$Bi_2O_3, K_2O, 6CrO_3+H_2O$. (Preis and Raymann, J. B. **1880.** 336.)

Bromomolybdenum chromate.
(Atterberg.)

Cadmium chromate, basic, $2CdO, CrO_3+H_2O$.
Very sl. sol. in H_2O; very slowly sol. in NH_4OH+Aq with combination. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)
Composition as above. (Freese, B. **2.** 478.)

Cadmium chromate, $CdCrO_4$.
Insol. in H_2O; sol. in acids; decomp. by heating with H_2O. (Schulz, Z. anorg. 1895, **10.** 153.)
Sol. in hot conc. $CdSO_4$+Aq. (Briggs, Z. anorg. 1907, **56.** 253.)
$+2H_2O$. Decomp. by boiling H_2O. (Schulz, Z. anorg. 1895, **10.** 153.)

Cadmium *di*chromate, $CdO,2CrO_3+H_2O$.
Easily sol. in H_2O without decomp; hydroscopic. (Schulz, Z. anorg. 1895, **10.** 152.)
Easily sol. in H_2O but decomp. on evaporation. (Gröger, Z. anorg. 1910, **66.** 11.)

Cadmium *tri*chromate, $CdCr_3O_{10}+H_2O$.
Deliquescent. (Gröger, Z. anorg. 1910, **66.** 12.)

Cadmium chromate ammonia, $CdCrO_4, 4NH_3+3H_2O$.
Efflorescent. Decomp, by H_2O. Sol. in NH_4OH+Aq; insol. in alcohol and ether. (Malaguti and Sarzeau.)

Cadmium potassium chromate, $CdK_2(CrO_4)_2+2H_2O$.
Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1907, **54.** 189.)
$3CdO, K_2O, 3CrO_3+3H_2O$. Ppt. (Preis and Raymann, Sitzungsb. böhms. Gesell. **1880.**)
$4CdO, K_2O, 4CrO_3+3H_2O$. Ppt. Slowly decomp. by H_2O. (Groger, M. 1904, **25.** 533.)

Cadmium potassium *di*chromate, $CdCr_2O_7,K_2Cr_2O_7+2H_2O$.
Sol. in H_2O; sl. hydroscopic. (Krüss, Z. anorg. 1895, **8.** 454.)

Cadmium *di*chromate mercuric cyanide, $CdCr_2O_7, 2Hg(CN)_2+7H_2O$.
Sol. in H_2O without decomp. (Krüss, Z. anorg. 1895, **8.** 460.)

Cæsium chromate, Cs_2CrO_4.
(Chabrié, C. R. 1901, **132.** 680.)
Aq. solution sat. at 30° contains 47%. (Schreinemakers, C. C. **1909,** I. 11.)

Cæsium *di*chromate, $Cs_2Cr_2O_7$.
(Chabrié, C. R. 1901, **132.** 680.)
Much more sol. in hot H_2O, than in cold. (Fraprie, Am. J. Sci. 1906, (4) **21.** 309.)
Aq. solution sat. at 30° contains 5.2°. (Schreinemakers, C. C. **1909,** I. 11.)

Cæsium *tri*chromate, $Cs_2Cr_3O_{10}$.
Decomp. by H_2O. (Schreinemakers, Chem. Weekbl. 1908, **5.** 811.)
Sol. in H_2O. (Fraprie, Am. J. Sci. 1906, (4) **21.** 315.)

Cæsium *tetra*chromate, $Cs_2Cr_4O_{13}$.
Sol. in H_2O with decomp. (Schreinemakers, Chem. Weekbl. 1908, **5.** 811.)

Cæsium cobaltous chromate, $Cs_2Co(CrO_4)_2+6H_2O$.
(Briggs, Z. anorg. 1907, **56.** 248.)

Cæsium magnesium chromate, $Cs_2Mg(CrO_4)_2+6H_2O$.
(Briggs, Chem. Soc. 1904, **85,** 680.)

Cæsium nickel chromate, $Cs_2Ni(CrO_4)_2+6H_2O$.
Sol. in cold H_2O without much change, but decomp. by warm H_2O. (Briggs, Chem. Soc. 1904, **85.** 679.)

Calcium chromate basic, $Ca_2CrO_5+3H_2O$.
Sol. in 230 pts. H_2O without decomp. (Mylius and Wrochem, Gm. K. **3.** I, 1385.)

Calcium chromate, $CaCrO_4$.
Anhydrous. Very sl. sol. in H_2O. (Siewert, J. B. **1862.** 148.)
Aq. solution sat. at 18° contains 2.3% $CaCrO_4$; sp. gr. = 1.023. (Mylius and Wrochem, B. 1900, **33.** 3688.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
$+\frac{1}{2}H_2O$. Aq. solution sat. at 18° contains 4.4% $CaCrO_4$; sp. gr. = 1.044. (Mylius and Wrochem, B. 1900, **33.** 3688.)

$+H_2O$. Solubility in H_2O at t°.

t°	0°	8°	13°	18°	25°
% $CaCrO_4$	11.5	10.8	10.3	9.6	9.1

t°	40°	60°	75°	90°	100°
% $CaCrO_4$	7.8	5.7	4.6	3.6	3.1

(Mylius and Wrochem, Gm.-K. **3.** I, 1386.)

Sp. gr. of solution containing 9.6% by wt. $CaCrO_4$ at 18° = 1.096. (Mylius and Wrochem, B. 1900, **33**, 3688.)

$+2H_2O$. Sol. in 241.3 pts. H_2O at 14°. (Siewert.)

Sol. in 34 pts. H_2O. (Schwarz, Dingl. **193.** 159.)

Solubility of two modifications in H_2O at t°.

α modification.

t°	0°	20°	30°	45°
% $CaCrO_4$	14.75	14.22	13.89	12.53

β modification.

t°	0°	14°	18°	19.5°	30°	40°
% $CaCrO_4$	9.8	10	10.3	10.4	10.4	10.4

(Mylius and Wrochem. Gm.-K. **3.** I, 1387.)

α modification. Sp. gr. of the solution containing 14.3% by wt. $CaCrO_4$ at 18° = 1.149. (Mylius and Wrochem, B. 1900, **33.** 3688.)

β modification. Sp. gr. of the solution containing 10.3% by wt. $CaCrO_4$ at 18° = 1.105. (Mylius and Wrochem, B. 1900, **33.** 3688.)

Easily sol. in H_2O containing CrO_3.

Insol. in absolute alcohol.

50 cc. of alcohol (29%) dissolve 0.608 g. $CaCrO_4$; 50 cc. of alcohol (53%) dissolve 0.44 g. $CaCrO_4$. (Fresenius, Z. anal. **30.** 672.)

Sol. in acids and in dilute alcohol. (Caron and Raquet, Bull. Soc. 1906, (3) **35.** 1064.)

Calcium *di*chromate, $CaCr_2O_7+3H_2O$.

Very deliquescent. (Bahr, J. pr. **60.** 60.)

In sat. solution at 18°, 61% $CaCr_2O_7$ is present. (Mylius and Wrochem, Gm.-K. 3. I, 1387.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Calcium potassium chromate, $CaCrO_4$, K_2CrO_4

(Barre, C. R. 1914, **158.** 495.)

$+H_2O$. Easily sol. in H_2O. (Duncan.) Insol. in H_2O when ignited.

$+2H_2O$. Easily sol. in H_2O, even after ignition. Insol. in alcohol. (Duncan, J. B. **1850.** 313.)

Formed below 45°. (Barre, C. R. 1914, **158.** 495.)

Sol. in cold H_2O. Sl. sol. in sat. K_2CrO_4+Aq. (Gröger, Z. anorg. 1907, **54.** 187.)

Two modifications. Solubility of α modification is somewhat less than that of the β modification. (Wyrouboff, Bull. Soc. Min. 1891, **14.** 255.)

Solubility of two modifications in H_2O at t°.

t°	0°	15°
Solubility of α	23.06	25.06
" " β	23.01	24.45

(Rakowski, C. C. **1909,** I. 133.)

$4CaCrO_4$, K_2CrO_4.

$5CaCrO_4$, K_2CrO_4. Sol. in much H_2O. (Bahr.)

Calcium chromate potassium sulphate, $CaCrO_4$, $K_2SO_4+H_2O$.

Decomp. by H_2O. (Hannay, Chem. Soc. **32.** 399.)

$CaCrO_4$, K_2SO_4, K_2CrO_4. As above. (H.)

Cerous chromate.

Insol in H_2O

Calcium strontium chromate, $CaSr(CrO_4)_2$.

(Bourgeois, Bull. Soc. Min. 1879, **2.** 123.)

Ceric *di*chromate, CeO_2, $2CrO_3+2H_2O$.

Insol. in H_2O; sol. in acids; decomp. completely by boiling H_2O. (Bricout, C. R. 1894, **118.** 145.)

Chromic chromate, $CrO_2 = Cr_2O_3$, CrO_3.

Insol. as such in H_2O, but decomp. thereby into CrO_3 and Cr_2O_3; decomp. by alkaline and many saline solutions. Easily sol. in dil. acids if recently pptd, but with difficulty if dried at a high temp. (Eliot and Storer, Proc. Am. Acad. **5.** 207.)

$Cr_5O_{12} = Cr_2O_3$, $3CrO_3$. Sol. in HCl+Aq. Very slowly sol. in HNO_3+Aq. Slowly decomp by H_2SO_4 or NH_4OH+Aq. Easily decomp. by KOH+Aq.

Does not exist. (Eliot and Storer, *l.c.*)

$Cr_8O_{15} = 3Cr_2O_3$, $2CrO_3$. Easily sol. in HCl or HNO_3+Aq; difficulty sol. in acetic acid. Easily sol. in KOH+Aq. (Traube, A. **66.** 108.)

Existence doubtful.

$Cr_5O_9 = 2Cr_2O_3$, CrO_3. Insol. in all acids, even aqua regia; slowly attacked by a boiling conc. solution of alkali hydroxides. (Geuther and Merz, A. **118.** 62.) Cr_3O_5, according to Wöhler.

Chromic cupric chromate, $CuCr_4O_9$, $Cr_2O_3+12H_2O$.

Insol. in H_2O and H_2SO_4. Sol. in HCl and HNO_3. (Rosenfeld, B. 1879, **12.** 957.)

$6CuO$, Cr_2O_3, CrO_3+9H_2O. Insol. in H_2O. Sol. in acids. (Rosenfeld, B. 1879, **12.** 958.)

Chromic potassium chromate, $Cr_2H_2(CrO_4)_2$, K_2CrO_4(?).

Insol. in H_2O, alcohol, or acetic acid. Not attacked by cold HNO_3+Aq; sl. oxidized when hot. Insol. in cold, easily sol. in hot H_2SO_4. Sl. sol. in SO_2+Aq. Sol. in conc. HCl+Aq. (Tommasi, Bull. Soc. (2) **17.** 396.)

Chromous potassium chromate, $K_2CrO_4(CrO_2)_2 = K_2Cr(CrO_4)_2$(?).

Sat. cold solution in H_2O contains 9% of the salt. Insol. in alcohol and ether. (Heintze, J. pr. (2) **4.** 212.)

Cobaltous chromate, basic, $3CoO, CrO_3+4H_2O$.

Ppt. Decomp. by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)

True formula is $2CoO, CrO_3+2H_2O$. (Freese, Pogg. **140.** 252.)

$4CoO, 3CrO_3+2H_2O$.

Decomp. by H_2O. (Gröger, Z. anorg. 1906, **49.** 203.)

Cobaltous chromate, $CoCrO_4$.

Much more sol. in H_2O than $NiCrO_4$. Easily sol. in hot dil. HNO_3+Aq. (Briggs, Z. anorg. 1909, **63.** 327.)

$+2H_2O$. Ppt. (Briggs, Z. anorg. 1909, **63.** 328.)

Cobaltous *di*chromate, $CoCr_2O_7+H_2O$.

Deliquescent. Very sol. in H_2O. (Briggs, Z. anorg. 1907, **56.** 247.)

Cobaltous potassium chromate, basic. $K_2O, 4CoO, 4CrO_3+3H_2O$.

Sol. in cold dil. H_2SO_4+Aq. (Gröger, Z. anorg. 1906, **49.** 199.)

Cobaltous potassium chromate, $K_2Co(CrO_4)_2+2H_2O$.

Decomp. by H_2O. (Gröger, Z. anorg. 1906, **49.** 200.)

Cupric chromate, basic, $3CuO, CrO_3+2H_2O$.

Insol. in H_2O. Easily sol. in dil. HNO_3+Aq and in NH_4OH+Aq. Decomp. by KOH +Aq. (Malaguti and Sarzeau, A. ch. (3) **9.** 434.)

$7CuO, 2CrO_3+5H_2O$. Ppt. (Rosenfeld, B. **13.** 1469.)

$7CuO, CrO_3+5H_2O$. Ppt. (R.)

Cobaltous *di*chromate mercuric cyanide, $CoCr_2O_7, 2Hg(CN)_2+7H_2O$.

Very stable. Sol. in H_2O. (Krüss, Z. anorg. 1895, **8.** 458.)

Cupric chromate, $CuCrO_4$

Insol. in H_2O; very sol. in chromic acid and in other acids; decomp. by boiling with H_2O. (Schulz, Z. anorg. 1895, **10.** 152.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Cupric *di*chromate, basic, $CuCr_2O_7, 2CuO$. (Stanley, C. N. **54.** 194.)

Cupric *di*chromate, $CuCr_2O_7+2H_2O$.

Deliquescent. Very easily sol. in H_2O, NH_4OH+Aq, and alcohol. (Dröge, A. **101.** 39.)

Aqueous solution is decomp. by boiling. (Malaguti and Sarzeau, A. ch. (3) **9.** 456.)

Very hygroscopic. Very sol. in H_2O without decomp. (Schulz, Z. anorg. 1895, **10.** 150.)

Cupric *tetra*chromate, $CuCr_4O_{13}+2H_2O$.

Deliquescent. Decomp. when its solution in H_2O is concentrated. (Gröger, Z. anorg. 1910, **66.** 15.)

Cupric lead chromate, $2(PbCrO_4, PbO), (2CuCrO_4, CuO)$.

Min. *Vauquelinite.* Sol. in acids.

Cupric potassium chromate, basic, $KCu_2(OH)(CrO_4)_2+H_2O$.

Ppt. (Gröger, M. 1903, **24.** 485.)

$3CuO, K_2O, 3CrO_3+2H_2O$. Nearly insol. in H_2O. Sol. in NH_4OH or $(NH_4)_2CO_3$+Aq. (Knop, A. **70.** 52.)

Does not exist. (Rosenfeld, B. **13.** 1472.)

$4CuO, K_2O, 4CrO_3+H_2O$. Decomp. by boiling H_2O. (Gerhardt.)

$+3H_2O$. Decomp. by boiling H_2O. (Gröger, Dissert. **1880.**)

Cupric potassium chromate ammonia, $K_2Cu(CrO_4)_2, 2NH_3$.

Very sol. in dil. NH_3+Aq.: decomp. by H_2O. (Briggs, Chem. Soc. 1904, **85.** 672.)

Cupric chromate ammonia, $CuCrO_4, 4NH_3$.

Decomp. by H_2O. Sol. in dil. NH_4OH+Aq. (Parravano and Pasta, Gazz. ch. it. 1907, **37.** (2), 255.)

$4CuCrO_4, 3NH_3+5H_2O$. Sol. in HCl and NH_4OH+Aq.; insol. in organic solvents; easily sol. in $AgNO_3$+Aq. (Schuyten, C. C. **1900,** I. 399.)

$2CuCrO_4, 7NH_3+H_2O$. Decomp. by H_2O. Very sol. in dil. NH_4OH+Aq. (Briggs, Chem. Soc. 1904, **85.** 673.)

$3CuO, 2CrO_3, 10NH_3+2H_2O$. Decomp. by H_2O; sl. sol. or insol. in alcohol, ether, or NH_4OH+Aq. (Malaguti and Sarzeau.)

Decomp. by hot H_2O; insol. in alcohol. (Böttger.)

Cupric *di*chromate ammonia, $CuCr_2O_7, 4NH_3+2H_2O$.

Decomp. by H_2O. Sol. in dil. NH_4OH+Aq. (Parravano and Pasta, Gazz. ch. it. 1907, **37.** (2) 255.)

Cupric *di*chromate mercuric cyanide, $CuCr_2O_7, Hg(CN)_2+5H_2O$.

Not hygroscopic. Sol. in H_2O. (Krüss, Z. anorg. 1895, **8.** 461.)

Didymium chromate, $Di_2(CrO_4)_3$.

Sl. sol. in H_2O, easily in dil. acids. (Frerichs and Smith, A. **191.** 353.)

$+7H_2O$. (Cleve.)

Didymium potassium chromate, $Di_2(CrO_4)_3, K_2CrO_4$.

Precipitate. Decomp. by H_2O. (Cleve.)

Dysprosium chromate, $Dy_2(CrO_4)_3 + 10H_2O$.

Very sl. sol. in H_2O. 1.0002 pt. is sol. in 100 pts. H_2O at 25°. (Jantsch, B. 1911, **44.** 1276.)

Glucinum chromate, basic, $GlCrO_4$, $13GlO + 23H_2O$.

Ppt. Insol. in H_2O. (Creuzberg, Dingl. **163.** 449.)

$GlCrO_4$, $6Gl(OH_2)$. Ppt. Insol. in H_2O. (Glassmann, B. 1907, **40.** 2603.)

Glucinum chromate, $GlCrO_4 + H_2O$.

Decomp. by H_2O with separation of the basic chromate. (Glassmann, B. 1907, **40.** 2603.)

Gold (auric) chromate, $Au_2(CrO_4)_3, CrO_3$.

Ppt. (Orloff, Ch. Z. 1907, **31.** 1182.)

Indium chromate.

Ppt. (Meyer.)

Indium *di*chromate.

Very sol. in H_2O. Known only in solution

Iron (ferric) chromate, basic.

Decomp. by H_2O. (Maus.)

Fe_2O_3, CrO_3. Insol. in H_2O, but decomp. thereby, or by saline solutions; easily sol. in acids. Sol. in H_2CrO_4+Aq. (Eliot and Storer, Proc. Am. Acad. **5.** 216.)

Iron (ferric) *di*chromate.

Sol. in H_2O and alcohol. (Maus, Pogg. **9.** 132.)

Iron (ferric) potassium chromate, basic,

$2CrO_3$, $6Fe_2O_3$, $3K_2O$.
$4CrO_3$, $3Fe_2O_3$, $4K_2O$.
$10CrO_3$, $6Fe_2O_3$, $7K_2O$.
$11CrO_3$, $3Fe_2O_3$, $4K_2O + 9H_2O$.
$9CrO_3$, $2Fe_2O_3$, $6K_2O + 6H_2O$.
$9CrO_3$, $2Fe_2O_3$, $6K_2O + 10H_2O$.
$10CrO_3$, $3Fe_2O_3$, $6K_2O + 5H_2O$.
$7CrO_3$, $2Fe_2O_3$, $2K_2O + 7H_2O$.
$4CrO_3$, Fe_2O_3, $K_2O + 4H_2O$.
$6CrO_3$, $2Fe_2O_3$, $3K_2O$.
$16CrO_3$, $4Fe_2O_3$, $5K_2O + 8H_2O$.

Above compounds are ppts., insol. in H_2O, alcohol and ether. (Lepierre, C. R. 1894, **119,** 1215–18.)

Iron (ferric) potassium chromate, $Fe_2(CrO_4)_3$, $K_2CrO_4 + 4H_2O$.

Decomp. by much H_2O, conc. HCl, or NH_4OH+Aq. Not decomp. by alcohol. (Hensgen, B. **12.** 1300.)

Iron (ferric) sodium chromate, basic, $5CrO_3$, $7Fe_2O_3$, $4Na_2O$.

Ppt. (Lepierre, C. R. 1894, **119,** 1217.)

Lanthanum chromate, $La_2(CrO_4)_3$.

Sl. sol. in cold, more easily in hot H_2O; easily sol. in acids. (Frerichs and Smith, A. **191,** 355.)

$+8H_2O$. Ppt. (Cleve.)

Lanthanum potassium chromate.

(Cleve.)

Lead chromate, basic, $2PbO$, CrO_3 (*chrome red*).

Insol. in H_2O; acetic acid dissolves out ½ the PbO Sol. in KOH+Aq. (Badams, Pogg. **3.** 221.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$3PbO$, CrO_3. (Hermann, Pogg. **28.** 162.)

$+H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 443.)

Min. *Melanochroite, Phœnicocroite.* Sol. in acids.

PbO, $PbCrO_4$. Ppt. (S.)

Lead chromate, $PbCrO_4$.

Insol. in H_2O. Pptd. from $Pb(NO_3)_2$ in presence of 70,000 pts. H_2O. (Harting.)

Calculated from electrical conductivity of $PbCrO_4$+Aq, 1 l. H_2O dissolves 0.2 mg. $PbCrO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

1 l. H_2O dissolves 1.2×10^{-5} g. $PbCrO_4$ at 25°. (Hevesy, Z. anorg. 1913, **82.** 328.)

Sol. in dil. H_2SO_4+Aq (Storer); sl. sol. in dil. HNO_3+Aq.

Sol. in 560 pts. HNO_3+Aq of 1.12 sp. gr.; in 150 pts. HNO_3+Aq of 1.225 sp. gr.; in 130 pts. HNO_3+Aq of 1.265 sp. gr.; in 80 pts. HNO_3+Aq of 1.395 sp. gr. (Storer's Dict.)

Solubility of $PbCrO_4$ in HNO_3+Aq. at 18°.
(Millimols. per l.)

0.1N	0.2N	0.3N	0.4N
0.506	0.844	1.13	1.44

(Beck and Stegmüller, *l.c.*)

Easily decomp. by hot HCl+Aq. (Fresenius.)

Solubility of $PbCrO_4$ in HCl+Aq.
(Millimols. per l.)

t°	0.1N	0.2N	0.3N	0.4N	0.5N	0.6N
18	0.186	0.393	0.654	1.07	1.56	2.25
25	0.239	0.485	0.839	1.32	4.06	2.95
37	0.357	0.744	1.31	2.10	3.28	4.69

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34.** 446.)

Insol. in $HC_2H_3O_2$+Aq.

Easily sol. in KOH, or NaOH+Aq. 1 l. KOH+Aq (½ normal) dissolves 11.9 g. $PbCrO_4$ at 15°; 16.2 g. at 60°; 26.1 g. at 80°;

38.5 g. at 102. (Lachaud and Lepierre, Bull. Soc. (3) **6.** 230.)

Insol. in NH_4Cl+Aq. (Brett, **1837.**)

Sol. in $K_2Cr_2O_7$+Aq; almost completely insol. in $NH_4C_2H_3O_2$, or NH_4NO_3+Aq.

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Min. *Crocoite.* Sol. in hot HCl+Aq; difficultly sol. in HNO_3+Aq; sol. in KOH+Aq.

Lead *di*chromate, $PbCr_2O_7$.

Decomp. by H_2O.

$+2H_2O$. As above. (Preis and Raymann, B. **13. 340.**)

Lead lithium chromate, $PbCrO_4$, Li_2CrO_4.

(Lachaud and Lepierre, C. R. **110.** 1035.)

Lead potassium chromate, $PbCrO_4$, K_2CrO_4.

Insol. in hot or cold H_2O or in alcohol. Dil. acids dissolve out K_2CrO_4. (Lachaud and Lepierre, C. R. **110.** 1035.)

Decomp. by H_2O. Stable in contact with solutions containing:

8.950 pts. K_2CrO_4 per 100 pts. H_2O at	10°
8.077 " " " " " " "	27.5°
7.629 " " " " " " "	37.5°
7.150 " " " " " " "	50.0°
6.145 " " " " " " "	76.0°
4.940 " " " " " " "	100.0°

(Barre, C. R. 1914, **158.** 497.)

Lead sodium chromate, $PbCrO_4$, $NaCrO_4$.

Sol. in H_2O(?). (Lachaud and Lepierre.)

$PbCrO_4$, 2PbO, Na_2CrO_4. (L. and L.)

Lithium chromate, Li_2CrO_4.

100 cc. of solution sat. at 18° contain 85 g. anhydrous salt. (Kohlrausch, B. A. B. **1897.** 90.)

99.94 pts. are sol. in 100 pts. H_2O at 30°. (Schreinemakers, C. C. **1905.** II, 1486.)

$+2H_2O$. Very easily sol. in H_2O. (Rammelsberg, Pogg. **128.** 323.)

100 g. H_2O dissolve 111 g. salt at 20°. (Von Weimarn, C. C. **1911.** II, 1300.)

Sp. gr. of solution sat. at 18°=1.574, and contains 52.6% $LiCrO_4$. (Mylius and Wrochem, B. 1897, **30.** 1718.)

Lithium *di*chromate, $Li_2Cr_2O_7$.

130.4 pts. are sol. in 100 pts. H_2O at 30°. (Schreinemakers, C. C. **1905.** II, 1486.)

$+2H_2O$. Deliquescent. Sol. in H_2O. (Rammelsberg.)

Lithium potassium chromate, K_2CrO_4, $Li_2CrO_4+\frac{1}{2}H_2O$.

Hydroscopic. (Zehenter, M. 1897, **18.** 54.)

Magnesium chromate, $MgCrO_4$.

Sol. in H_2SO_4, and HCl; insol. in HNO_3. (Dufau, C. R. 1896, **123.** 888.)

Sp. gr. of $MgCrO_4$+Aq sat. at t°/4°.

t°	13.6°	14.5°	13.6°
% $MgCrO_4$	12.31	21.86	27.71
Sp. gr.	1.0886	1.1641	1.2170

(Slotte, W. Ann. 1881, **14.** 19.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+7H_2O$. Easily sol. in H_2O. (Vauquelin.)

100 cm. of solution sat. at 18° contain 60 g. $MgCrO_4$. (Kohlrausch, B. A. B. **1897.** 90.)

Sp. gr. of solution sat. at 18 =1.422, and contains 42% $MgCrO_4$. (Mylius and Wrochem, B. 1897, **30.** 1718.)

$+5H_2O$. Very sol. in H_2O. (Wyrouboff, Bull. Soc. Min. **12.** 60.)

Magnesium *di*chromate, $Mg_2Cr_2O_7$.

Sol. in H_2O.

Sl. sol. in alcohol. (Reinitzer, Zeit. angew. 1913, **26.** 456.)

Magnesium potassium chromate, $MgCrO_4$, $K_2CrO_4+2H_2O$.

100 pts. H_2O dissolve 28.2 pts. at 20°; 34.3 pts. at 60°. (Schweitzer.)

Sol. in H_2O. Sl. sol. in sat. K_2CrO_4+Aq. (Gröger, Z. anorg. 1907, **54.** 188.)

Insol. in alcohol.

$+6H_2O$. Efflorescent. (Briggs, Chem. Soc. 1904, **85.** 679.

Magnesium rubidium chromate, $MgRb_2(CrO_4)_2+6H_2O$.

(Briggs, Chem. Soc. 1904, **85.** 679.) (Barker, Chem. Soc. 1911, **99.** 1327.)

Magnesium sodium chromate.

(Stanley, C. N. **54.** 194.)

Manganous chromate, 2MnO, CrO_3+H_2O.

Ppt. Sol. in dil. H_2SO_4, or HNO_3+Aq. (Warrington and Reinsch, Schw. J. **3.** 378.)

Manganous potassium chromate, $MnCrO_4$, $K_2CrO_4+2H_2O$.

Decomp. by H_2O. Sol. in dil. H_2SO_4. (Gröger, Z. anorg. 1905, **44.** 459.)

$2MnCrO_4$, $K_2CrO_4+4H_2O$. Sol. in H_2O. (Hensgen, R. t. c. **3.** 433.)

Mercurous chromate, basic, $4Hg_2O$, $3CrO_3$.

Very sl. sol. in cold, more in boiling H_2O. Sl. sol. in HNO_3+Aq. Decomp. by HCl+Aq. Sl. sol. in NH_4Cl+Aq or NH_4NO_3+Aq. (Brett.)

Does not exist. (Richter, B. **15.** 1489.)

$3Hg_2O$, CrO_3. Sol. in HNO_3+Aq. (Richter.)

$3Hg_2O, 2CrO_3$. Ppt. (Fichter, Z. anorg. 1912, **76.** 350.)

Mercurous chromate, Hg_2CrO_4.

Very sl. sol. in cold, more readily in hot H_2O. Sl. sol. in dil. HNO_3+Aq; sol. in conc. HNO_3; sol. in KCN+Aq; insol. in $Hg_2(NO_3)_2$+Aq. (Rose, Pogg. **53.** 124.)

Less sol. in K_2CrO_4+Aq. than in H_2O. (Fichter, Z. anorg. 1912, **76.** 349.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Mercuric chromate, basic, $2HgO, CrO_3$

Sol. in HCl, and in HNO_3+Aq. (Geuther.)

$3HgO, CrO_3$. Sl. sol. in H_2O. (Millon.)

The only true compound. All others are mixtures of HgO or $HgCrO_4$ with this compound. (Cox, Z. anorg. 1904, **40.** 155.)

$4HgO, CrO_3$. Sl. sol. in H_2O. (Millon, A. ch. (3) **18.** 365.)

$7HgO, 2CrO_3$. Easily sol. in warm HNO_3, when freshly precipitated. Easily sol. in HCl+Aq. (Geuther, A. **106.** 247.)

Does not exist. (Freese, B. **2.** 477.)

$5HgO, CrO_3$. Easily sol. in HCl+Aq. Very sl. sol. in HNO_3+Aq. Decomp. by H_2O into—

$6HgO, CrO_3$. Insol. in H_2O. (Jäger and Krüss, B. **22.** 2049.)

Mercuric chromate, $HgCrO_4$.

Decomp. by H_2O and acids into basic salt. (Geuther.)

Sol. in acids. Sol. in warm NH_4Cl, or NH_4NO_3+Aq. Sol. in $Hg(NO_3)_2$, or $HgCl_2$+Aq.

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Mercuric *di*chromate, $HgCr_2O_7$.

Ppt. (Gawalowski, C. C. **1906.** II, 1307.)

Mercurous potassium chromate, $Hg_2K_2(CrO_4)_2$.

Ppt.; decomp. by H_2O. (Gröger, Z. anorg. 1907, **54.** 191.)

Mercuric chromate, basic, ammonia, $12HgO, 3CrO_3, 2NH_3+3H_2O$.

(Gröger, Z. anorg. 1908, **58.** 420.)

Mercuric chromate ammonia, $HgCrO_4, 2NH_3+H_2O$.

(Gröger, Z. anorg. 1908, **58.** 419.)

Mercuric chromate sulphide, $2HgCrO_4$, HgS.

Not attacked by weak acids. (Palm, C. C. **1863.** 121.)

Nickel chromate, basic, $4NiO, CrO_3+6H_2O$.

Insol. in H_2O; easily sol. in NH_4OH+Aq. (Malaguti and Sarzeau, A. ch. (3) **9.** 451.)

$3NiO, CrO_3+6H_2O$. Insol. in H_2O; sol. in NH_4OH+Aq. (Freese, J. B. **1869.** 271.)

$2NiO, CrO_3+6H_2O$. As above. (Schmidt, A. **156.** 19.)

$5NiO, 2CrO_3+12H_2O$. As above. (Schmidt.)

Nickel chromate, $NiCrO_4$.

Not attacked by boiling H_2O.

Nearly insol. in hot dil. HNO_3. Slowly sol. in conc. HNO_3 and aqua regia.

Somewhat sol. in NH_3+Aq. (Briggs, Z. anorg. 1909, **63.** 326.)

Nickel *di*chromate, $2NiCr_2O_7+3H_2O$.

Slowly sol. in cold, rapidly sol. in hot H_2O.

Deliquescent. (Briggs, Z. anorg. 1907, **56.** 246.)

Nickel potassium chromate, $NiCrO_4, K_2CrO_4+2H_2O$.

Decomp. by H_2O. (Gröger, Z. anorg. 1906, **51.** 353.)

$+6H_2O$. Efflorescent. (Briggs, Chem. Soc. 1904, **85.** 678.)

Nickel rubidium chromate, $NiRb(CrO_4)_2+6H_2O$.

Sl. efflorescent at ord. temp. (Briggs, Chem. Soc. 1904, **85.** 678.)

Nickel chromate ammonia, $NiCrO_4, 6NH_3+4H_2O$.

Decomp. by H_2O. Quite easily sol. in NH_4OH+Aq of 0.96 sp. gr. (Schmidt.) Insol. in alcohol or ether.

Potassium chromate, K_2CrO_4, $K_2Cr_2O_7$, etc.

System: K_2O, CrO_3, H_2O at 0°

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
31.18	...	
26.06	0.54	K_2CrO_4
19.31	4.27	"
17.73	5.50	"
17.06	11.77	"
17.18	11.91	"
17.62	18.71	"
17.63	18.72	"
17.61	18.91	$K_2CrO_4+K_2Cr_2O_7$
17.79	19.10	"
17.80	19.10	"
10.90	11.93	$K_2Cr_2O_7$
8.07	8.93	"
1.87	3.13	"
1.41	3.00	"
1.42	3.01	"
0.97	3.94	"
0.78	22.38	"
1.02	38.83	"
1.26	40.10	"
1.36	40.41	"
1.22	41.70	"

System: K_2O, CrO_3, H_2O at 0°—*Continued*

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
1.28	41.75	$K_2Cr_2O_7$
1.40	42.10	“
1.23	42.11	“
1.33	42.16	“
1.31	42.28	“
1.38	42.48	“
1.40	42.68	“
1.47	42.93	$K_2Cr_2O_7+K_2Cr_3O_{10}$
1.47	42.95	“
1.47	43.09	“
1.25	44.52	$K_2Cr_3O_{10}$
1.27	44.95	“
1.18	45.84	“
1.17	46.84	“
1.36	47.22	$K_2Cr_3O_{10}+K_2Cr_4O_{13}$
1.36	47.31	“
1.40	47.67	“
1.24	48.23	$K_2Cr_4O_{13}$
1.35	51 66	“
1.10	53.81	“
1.08	55.63	“
1.16	56.93	“
0.96	57.63	“
1.16	59.46	“
0.91	59.87	“
0.81	60.16	“
0.70	61.76	$K_2Cr_4O_{13}+CrO_3$
0.62	61.77	“
0.57	61.78	“
0 67	61.86	“
...	61.51	CrO_3
...	61.52	“
...	61.55	“
...	61.57	“

(Koppel and Blumenthal, Z. anorg. 1907, **53**. 245.)

System: K_2O, CrO_3, H_2O at 20°

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
2.21	42.92	$K_2Cr_2O_7+K_2Cr_3O_{10}$
2.20	43.28	“
2.10	44.02	$K_2Cr_3O_{10}$
2.02	45.28	“
2.01	46.24	“
2.00	48.46	$K_2Cr_3O_{10}+K_2Cr_4O_{13}$
1.94	48.62	$K_2Cr_4O_{13}$
1.62	49.01	“
0.62	62.80	$K_2Cr_4O_{13}+CrO_3$

(Koppel and Blumenthal, Z. anorg. 1907, **53**. 243.)

System: K_2O, CrO_3, H_2O at 30°

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
46.8	...	KOH, $2H_2O$
26.89	0.94	K_2CrO_4
22.25	3.06	“
19.52	6.99	“
18.65	13.72	“
18.60	17.00	“
18.70	17.03	“
19.12	20.30	“
19.35	21.00	$K_2CrO_4+K_2Cr_2O_7$
15.04	16.85	$K_2Cr_2O_7$
14.77	16 51	“
12.28	14.57	“
11.20	13.11	“
4.98	10.48	“
3.07	19.34	“
2.42	28.21	“
2.35	33.77	“
2.30	36.78	“
2.30	40.41	“
2.50	44 50	$K_2Cr_2O_7+K_2Cr_3O_{10}$
2.25	49 95	$K_2Cr_3O_{10}+K_2Cr_4O_{13}$
1.35	53.39	$K_2Cr_4O_{13}$
0.69	62 81	$K_2Cr_4O_{13}+CrO_3$
..	62 52	CrO_3

(Koppel and Blumenthal, Z. anorg. 1907, **53**. 235.)

System: K_2O, CrO_3, H_2O at 60°

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
c. 50.0	...	KOH, H_2O
32.98	0 53	K_2CrO_4
21.05	9.15	“
20.70	8.99	“
20.25	14.43	“
20.32	16.56	“
20.67	21 94	“
20.72	22.00	“
20.68	23.49	$K_2CrO_4+K_2Cr_2O_7$
20.55	23.74	$K_2Cr_2O_7$
14.53	20.82	“
13.36	20.93	“
10.01	21.24	“
10.01	21.24	“
8.39	26.95	“
7.65	31.49	“
7.54	32 92	“
6.86	39.64	“
7.06	49.84	$K_2Cr_2O_7+K_2Cr_3O_{10}$
6.51	50.40	$K_2Cr_3O_{10}$
5.33	52.70	“
5.49	52.79	“
5.06	53.42	“
5.12	53.58	“
5.30	53.70	“

System: K_2O, CrO_3, H_2O at 60°—*Continued*

100 g. of the sat. solution contain		Solid phase
g. K_2O	g. CrO_3	
5.01	54.09	$K_2Cr_3O_{10}+K_2Cr_4O_{13}$
4.06	54.73	$K_2Cr_4O_{13}$
3.29	54.91	"
2.95	55.43	"
3.01	56.41	"
2.50	58.05	"
2.31	58.69	"
2.00	60.69	"
2.05	61.25	"
1.70	61.27	"
1.79	61.29	"
1.57	62.57	"
1.27	65.77	$K_2Cr_4O_{13}+CrO_3$
...	65.12	CrO_3

(Koppel and Blumenthal, Z. anorg. 1907, **53.** 240.)

System: K_2O, CrO_3, H_2O at the cryohydric pt.

Cryohydric pt.	100 g. of the solution contain		Solid phase
	g. K_2O	g. CrO_3	
−11.5°	17.18	18.11	$K_2CrO_4+K_2Cr_2O_7$
−30.0°	1 18	42.51	$K_2Cr_2O_7+K_2Cr_3O_{10}$
−39.0°	0.79	45.69	$K_2Cr_3O_{10}+K_2Cr_4O_{13}$

(Koppel and Blumenthal, Z. anorg. 1907, **53.** 263–5.)

B.-pt. of solutions of CrO_3+K_2O+Aq.

B. pt.	100 g. of the solution contain		Solid phase
	g. K_2O	g. CrO	
109°	30.01	11.92	K_2CrO_4
105.8	23.8	25.3	"
106.8	24.3	30.5	$K_2CrO_4+K_2Cr_2O_7$
104.8	16.4	35.6	$K_2Cr_2O_7$
114.0	16.8	59.2	$K_2Cr_2O_7+K_2Cr_3O_{10}$
127.0	...	71.2	CrO_3

(Koppel and Blumenthal, Z. anorg. 1907, **53.** 255.)

Potassium chromate, K_2CrO_4.

Easily sol. in H_2O.

Sol. in 2 pts. H_2O at 18.75°. (Abl.)

100 pts. H_2O at 15° dissolve 43.857 pts. K_2CrO_4, and solution has sp. gr. of 1.3032. (Michel and Krafft, A. ch. (3) **41.** 478.)

1 pt. dissolves in 2.07 pts. H_2O at 15.5°. (Thomson.)

1 pt. dissolves in 1.75 pts. H_2O at 17.5°, and in 1.67 pts. H_2O at 100°. (Moser.)

100 pts. H_2O dissolve at—

0°	10°	20°	30°
58.90	60.92	62.94	64.96 pts. K_2CrO_4,
40°	50°	60°	70°
66.98	69.00	71.02	73.04 pts. K_2CrO_4,
80°	90°	100°	
75.06	77.08	79.10	pts. K_2CrO_4.

(Alluard, C. R. **59.** 500.)

100 pts. H_2O dissolve at—

0°	10°	27.37°	42.1°
61.5	62.1	66.3	70.3 pts. K_2CrO_4,
63.6°	93.6°	106.1°	
74 9	79.7	81.8 pts. K_2CrO_4.	

(Nordenskjöld and Lindström, Pogg. **136.** 314.)

100 pts. K_2CrO_4+Aq sat. at 10–12° contain 37.14 pts. salt. (v. Hauer, J. pr. **103.** 114.)

100 pts. H_2O at 19.5° dissolve 62.3 pts. K_2CrO_4, and solution has sp. gr. of 1.3787. (Schiff, A. **109.** 326.)

Sat. K_2CrO_4+Aq contains at—

34°	53°	79°
39.7	40.3	41.8% K_2CrO_4.
96°	120°	157°
42.6	44.0	45.4% K_2CrO_4.

(Étard, A. ch. 1894, (7) **2.** 550.)

100 cc. sat. K_2CrO_4+Aq. contain 53 g. K_2CrO_4 at 18°. (Kohlrausch, B. A. B. **1897.** 90.)

100 pts. H_2O dissolve 64.91 pts. K_2CrO_4 at 30°, or 100 g. of solution contain 39.36 g. K_2CrO_4. (Schreinemakers, Chem. Weekbl. 1905, **1.** 837.)

100 g. H_2O dissolve:

54.57 g. K_2CrO_4 at −11.37° (cryohydric pt.)
57.11 g. " " 0°
65.13 g. " " 30°
74.60 g. " " 60°
88.80 g. " " 105.8° (b-pt. of sat. sol.)

(Koppel, Z. anorg. 1907, **53.** 262.)

64.62 g. K_2CrO_4 are sol. in 100 g. H_2O at 25°. (Amadori, Real. Att. Linc. 1912, (5) **21,** I. 667.)

Sp. gr. of K_2CrO_4+Aq at 19.5°.

% K_2CrO_4	Sp. gr.	% K_2CrO_4	Sp. gr.	% K_2CrO_4	Sp. gr.
1	1.0080	15	1.1287	28	1.2592
2	1.0161	16	1.1380	29	1.2700
3	1.0243	17	1.1474	30	1.2808
4	1.0325	18	1.1570	31	1.2921
5	1.0408	19	1.1667	32	1.3035
6	1.0492	20	1 1765	33	1.3151
7	1.0576	21	1.1864	34	1.3268
8	1.0663	22	1.1964	35	1.3386
9	1.0750	23	1 2066	36	1.3505
10	1.0837	24	1.2169	37	1.3625
11	1.0925	25	1 2274	38	1.3746
12	1.1014	26	1.2379	39	1.3868
13	1.1104	27	1.2485	40	1.3991
14	1.1195	...	....	..	....

(Kremers, and Schiff, calculated by Gerlach, Z. anal. **8.** 288.)

K_2CrO_4 dissolved in 2 pts. H_2O has sp. gr., 1.28; 3 pts., 1.21; 4 pts., 1.18; 5 pts., 1.15; 6 pts., 1.12; 7 pts., 1.11; 8 pts., 1.10. (Moser.)

Sp. gr. of sat. solution at 8° = 1.368. (Anthon, **1837.**)

Sp. gr. of sat. K_2CrO_4+Aq containing 24.26% K_2CrO_4 = 1.2335 at 18°/4°. (Slotte, W. Ann. 1881, **14.** 18.)

Sp. gr. of K_2CrO_4+Aq at 25°.

Concentration of K_2CrO_4+Aq.	Sp. gr.
1-normal	1.0935
1/2- "	1.0475
1/4- "	1.0241
1/8- "	1.0121

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sat. K_2CrO_4+Aq boils at 107°. (Kremers.)

Sat. K_2CrO_4+Aq boils at 104.2° under 718 mm. pressure. (Alluard.)

Freezing point of sat. K_2CrO_4+Aq = −12.5°. (Rüdorff.)

By dissolving K_2CrO_4 in 2 pts. H_2O, the temp. is lowered 10°. (Moser.)

100 pts. sat. solution of K_2CrO_4 and K_2SO_4 contain 37.14 pts. of the two salts at 10–12°. (v. Hauer, J. pr. **103.** 114.)

Solubility of K_2CrO_4+K_2SO_4 in H_2O at 25°. (G. per 100 g. H_2O.)

K_2CrO_4	K_2SO_4	K_2CrO_4	K_2SO_4
63.09	0.76	20.83	5.75
61.39	1.17.	14.65	7.12
58.40	1.84	7.81	8.98
51.81	2.36	4.36	10.25
40.93	3.33	1.94	10.86
27.36	4.82	....	....

(Amadori, Real. Att. Linc. 1912, (5) **21,** I. 667.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

100 g. sat. solution in glycol at 15.4° contain 1.7 g. K_2CrO_4. (de Coninck, C. C. **1905,** II. 183.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899.** II, 1014.)

$+4H_2O$. Easily sol. in H_2O and in NH_4OH +Aq. (Wesch, Dissert. **1909.**)

Potassium *di*chromate, $K_2Cr_2O_7$.

Sol. in H_2O, with slight absorption of heat. Less sol. in H_2O than K_2CrO_4.

Sol. in 9.6 pts. H_2O at 17.3°. (Thompson)
" 10 " " " 18.7°. (Moser.)

100 pts. H_2O at 15° dissolve 9.126 pts. $K_2Cr_2O_7$, and solution has sp. gr. = 1.0618. (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve pts. $K_2Cr_2O_7$. A = according to Alluard (C. R. **59.** 500); K = according to Kremers (Pogg. **92.** 497).

t°	A	K	t°	A	K
0	4 6	4.97	60	45.0	50.5
10	7.4	8.5	70	56.7	...
20	12.4	13.1	80	68 6	73.0
30	18.4	...	90	81.1	....
40	25.9	29.1	100	94 1	102 00
50	35 0	...	.	...	....

Solubility in H_2O at high temperatures. 100 pts. H_2O dissolve pts. $K_2Cr_2O_7$ at t°.

t°	Pts. $K_2Cr_2O_7$	t°	Pts. $K_2Cr_2O_7$
117	128 3	148	200.6
129	153 8	180	262 7

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Solubility of $K_2Cr_2O_7$ in H_2O at t°.

t°	% $K_2Cr_2O_7$	t°	% $K_2Cr_2O_7$
−1	4 1	92	42.8
+1	4.3	97	44.0
6	5.6	104	48.0
7	6.1	120	52.0
12	7.2	130	54.4
15	8.5	150	60.8
20	10.4	157	62.8
29	14.2	178	66.6
36	16.6	215	76.9
57	28.2	291	89.7
61	30.2	312	91.8
65	32.0	360	97.4
70	34.4	...	....

(Étard, A. ch. 1894, (7) **2.** 550.)

100 g. H_2O dissolve 10.1 g. $K_2Cr_2O_7$ at 15.5°. (Greenish and Smith, Pharm. J. 1901, **66.** 774.)

100 pts. H_2O at 30° dissolve 18.12 pts. $K_2Cr_2O_7$. (Schreinemakers, Chem. Weekbl. 1905 **1.** 837.)

100 g. H_2O dissolve:

4.50 g. $K_2Cr_2O_7$ at −0.63° (cryohydric pt.)
4.64 g. " " 0°
18.13 g. " " 30°
45.44 g. " " 60°
108.2 g. " " 104.8° (b-pt. of sat. sol.)

(Koppel, Z. anorg. 1907, **53.** 263.)

100 c.c. sat. solution contain 11.43 g. $K_2Cr_2O_7$ at 20°. (Sherrill and Eaton, J. Am. Chem. Soc. 1907, **29.** 1643.)

100 g. sat. $K_2Cr_2O_7$ contain:

5.52 g. $K_2Cr_2O_7$ at 4.81°
15.17 " " 30.10°
17.77 " " 35.33°

(Le Blanc and Schmandt, Z. phys. Ch. 1911, **77.** 614.)

100 g. sat. $K_2Cr_2O_7$+Aq. at 35.03° contains 17.72 g. $K_2Cr_2O_7$. (Le Blanc, Z. phys. Ch. 1913, **86.** 335.)

$K_2Cr_2O_7$+Aq sat. at 8° has sp. gr. 1.065. (Anthon, **1837.**)

Sp. gr. of $K_2Cr_2O_7$+Aq at 19.5°.

% $K_2Cr_2O_7$	Sp. gr.	% $K_2Cr_2O_7$	Sp. gr.
1	1.007	9	1.065
2	1.015	10	1.073
3	1.022	11	1.080
4	1.030	12	1.085
5	1.037	13	1.097
6	1.043	14	1.102
7	1.050	15	1.110
8	1.056	..	...

(Kremers, calculated by Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $K_2Cr_2O_7$+Aq containing 4.71% $K_2Cr_2O_7$ = 1.0325 at 11°/4°; containing 6.97% $K_2Cr_2O_7$ = 1.0493 at 10.6°/4°. (Slotte, W. Ann. 1881, **14.** 18.)

Sat. $K_2Cr_2O_7$+Aq boils at 104° (Kremers); 103.4°. (Alluard).

Insol. in alcohol.

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol. (Reinitzer, Zeit. angew. Ch. 1913, **26.** 456.)

100 g. sat. solution in glycol contain 6 g. $K_2Cr_2O_7$. (de Coninck, Bull. acad. roy. Belg. **1905,** 257.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899.** II, 1014.)

Potassium *tri*chromate, $K_2Cr_3O_{10}$.

Easily sol. in H_2O and alcohol. (Bothe, J. pr. **46.** 184.)

Not deliquescent; decomp. by H_2O in chromic acid and $K_2Cr_2O_7$. (Jäger and Krüss, B. **22.** 2041.)

Potassium *tetra*chromate, $K_2Cr_4O_{13}$.

Very deliquescent, and easily sol. in H_2O. (Schwarz, Dingl. **186.** 31.)

Not deliquescent. Decomp. by H_2O. (Jäger and Krüss, B. **22.** 2042.)

Potassium samarium chromate, $K_2Sm_2(CrO_4)_4+6H_2O$.

Precipitate. (Cleve.)

Insol in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Potassium sodium chromate, $3K_2CrO_4$, Na_2CrO_4.

Sol. in H_2O. (v. Hauer, J. pr. **83.** 359.)

64.2 pts. are sol. in 100 pts. H_2O at 14°. (Zehenter, M. 1897, **18.** 49.)

Potassium strontium chromate, $K_2Sr(CrO_4)_2$.

Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1907, **54.** 187.)

Decomp. by H_2O. Stable in contact with solutions containing:

at 11.5°, 2.914 pts. K_2CrO_4 per 100 pts. H_2O.
at 27.5°, 4.123 " " " " " "
at 50°, 5.942 " " " " " "
at 76°, 7.920 " " " " " "
at 100°, 9.784 " " " " " "

(Barre, C. R. 1914, **158.** 496.)

Potassium thallium chromate, K_2CrO_4, Tl_2CrO_4.

(Lachaud and Lepierre, Bull. Soc. (3) **6.** 232.)

$+2H_2O$. Rapidly hydrolyzed by H_2O unless a large excess of the CrO_4 ion is present.

Readily sol. in dil. mineral acids.

Difficulty sol. in $K_2Cr_2O_7$+Aq. (Hawley, J. Am. Chem. Soc. 1907, **29.** 304.)

Potassium uranyl chromate, K_2CrO_4, $2(UO_2)CrO_4+6H_2O$.

Decomp. by boiling with H_2O. Sol. in acidified H_2O. (Formánek, A. **257.** 103.)

K_2CrO_4, $(UO_2)CrO_4+H_2O$; $2K_2CrO_4$, $3(UO_2)CrO_4+7H_2O$; $3K_2CrO_4$, $4(UO_2)CrO_4+7H_2O$; and K_2CrO_4, $3(UO_2)CrO_4+14H_2O$. Precipitates. (Wiesner, C. C. **1882.** 777.)

Potassium ytterbium chromate, basic, $2KYb(CrO_4)_2+Yb(OH)_3+15\frac{1}{2}H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 151.)

Potassium yttrium chromate, K_2CrO_4, $Y_2(CrO_4)_3+xH_2O$.

Ppt. (Cleve.)

Potassium zinc chromate, basic, K_2O, $5ZnO$, $4CrO_3+6H_2O$, or K_2O, $4ZnO$, $3CrO_3+3H_2O$.

Slightly sol. in cold, decomp. by hot H_2O. (Wöhler.)

K_2O, $4ZnO$, $3CrO_3+3H_2O$. Insol. in cold, decomp. by hot H_2O. (Gröger, M. 1904, **25.** 520.)

Potassium zinc chromate, $K_2Zn(CrO_4)_2+2H_2O$.

Ppt. Decomp. by H_2O. (Gröger, Z. anorg. 1907, **54.** 189.)

Potassium *di*chromate chloride mercuric chloride, $K_2Cr_2O_7$,$2KCl$,$4HgCl_2+2H_2O$.

Solution in H_2O sat. at 20.5° contains 6.78% salt. Salt is much more sol. in hot H_2O. (Strömholm, Z. anorg. 1912, **75.** 278.)

Potassium chromate iodate.

See **Chromoiodate, potassium.**

Potassium chromate magnesium sulphate, K_2CrO_4, $MgSO_4+9H_2O$.

Sol. in H_2O. (Étard, C. R. **85.** 443.)

Potassium chromate mercuric chloride, K_2CrO_4, $2HgCl_2$.

Easily sol. in H_2O. Sol. in dil. HCl+Aq. (Darby.)

Potassium *di*chromate mercuric chloride, $K_2Cr_2O_7$, $HgCl_2$.

Ether or absolute alcohol dissolves out $HgCl_2$. (Millon, A. ch. (3) **18.** 388.)

Can be crystallized from H_2O. (Jäger and Krüss, B. **22.** 2046.)

Potassium chromate mercuric cyanide, $2K_2CrO_4$, $3Hg(CN)_2$.

Easily sol. in H_2O.

$+H_2O$. (Dexter.)

Formula is K_2CrO_4, $2Hg(CN)_2$. (Clarke and Sterne, Am. Ch. J. **3.** 352.)

Potassium *di*chromate mercuric cyanide, $K_2Cr_2O_7$, $Hg(CN)_2+2H_2O$.

Sol. in H_2O. (Wyrouboff, J. B. **1880.** 309.)

Potassium chromate phosphate.

See **Phosphochromate, potassium.**

Potassium chromate sulphate, K_2CrO_4, $6K_2SO_4$.

Easily sol. in H_2O. (Boutron-Chalard.)

Potassium chromate tellurate.

See **Chromotellurate, potassium.**

Rubidium chromate, Rb_2CrO_4.

Sol. in H_2O. (Piccard, J. pr. **86.** 455.)

Solubility in H_2O at t°.

t°	% Rb_2CrO_4
— 7	36.65
0	38.27
10 3	40.22
20	42.42
30	44.11
40	46.13
50	47.44
60.4	48 90

(Schreinemakers and Filippo, Chem. Weekbl. 1906, **3.** 157.)

Rubidium *di*chromate, $Rb_2Cr_2O_7$.

Sol. in H_2O. (Grandeau, A. ch. (3) **67** 227.)

Very sl. sol. in H_2O; 5% at 10°, 8% at 26°, 35% at 60°. (Wyrouboff, Bull. Soc. Min. 1881, **4.** 129.)

100 pts. H_2O dissolve 10.46 pts. $Rb_2Cr_2O_7$ at 30°. The solution contains 9.47% salt. (Schreinemakers and Filippo, Chem. Weekbl. 1906, **3.** 157.)

Two forms of crystals. Figures denote pts. salt per 100 pts. H_2O.

t°	14°	26°	43°
Monoclinic form	4.45	8.00	16.52
Triclinic form	4.40	7.91	16.57

(Wyrouboff, Bull. Soc. 1908, (4) **3.** 7.)

Solubility of monoclinic and triclinic forms.

Temp.	Pts. of salt in 100 pts. H_2O		Temp.	Pts. of salt in 100 pts. H_2O	
	Monoclinic	Triclinic		Monoclinic	Triclinic
18°	5.42	4.96	40°	13.22	12.90
24°	6 94	6.55	50°	18.94	18.77
30°	9 08	8.70	60°	28.1	27.3

(Stortenbeker, C. C. **1907,** II. 1588.)

Rubidium *di*chromate chloride mercuric chloride, $Rb_2Cr_2O_7$, $2RbCl$, $4HgCl_2+2H_2O$.

Sol. in H_2O.

Solution sat. at 20.5° contains 5.35% salt. (Strömholm, Z. anorg. 1912, **75.** 284.)

Silver (argentous) chromate, Ag_4CrO_4.

Sol. in dil. acids. (Wöhler and Rautenberg.)

Existence very doubtful.

Silver chromate, Ag_2CrO_4.

Absolutely insol. in H_2O. Sol. in acids, ammonia, and alkali chromates+Aq. (Warington, A. **27.** 12.)

Appreciably sol. in cold, and still more in hot H_2O. (Meineke, A. **261.** 341.)

100 ccm. H_2O dissolve 0.064 grain Ag_2CrO_4 at 100°; 100 ccm. H_2O containing 50 grains

of the following salts dissolve the given amts. of Ag_2CrO_4 at 100°: $NaNO_3$, 0.064 grain; KNO_3, 0.192 grain; NH_4NO_3, 0.320 grain; $Mg(NO_3)_2$, 0.256 grain. (Carpenter, J. S. C. I. **5.** 286.)

According to electrical conductivity of Ag_2CrO_4+Aq, 1 l. H_2O dissolves 28 mg. Ag_2CrO_4 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

1 l. H_2O dissolves 25 mg. Ag_2CrO_4 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

25 mg. are contained in 1 l. of sat solution at 18°. Solubility increases unusually rapidly with temp. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Sol. in 26,378 pts. cold H_2O and 9116 pts. H_2O at 100°. (Koninck and Nihoul, Zeit. angew. Ch. 1891, **5.** 295.)

1 l. H_2O dissolves 1.2×10^{-4} gram. atoms of silver at 25°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

1 l. H_2O dissolves 0.029 g. Ag_2CrO_4 at 25°. (Schäfer, Z. anorg. 1905, **45.** 310.)

1 l. H_2O dissolves 0.0256 g. Ag_2CrO_4 at 18°; 0.0341 g. at 27°; 0.0534 g. at 50°. (Whitby Z. anorg. 1910, **67.** 108.)

Sol. in hot NH_4OH+Aq of sp. gr. 0.94 (15.63% NH_3); sl. sol. in cold NH_4OH+Aq of sp. gr. 0.91 (24.99% NH_3). (Margosches, Z. anorg. 1904, **41.** 73.)

Solubility of Ag_2CrO_4 in NH_4OH+Aq at 25°.

Mols. NH_4OH per l.	Mols. $\times10^3$ Ag_2CrO_4 per l.
0.01	2.004
0.02	4.169
0.04	8.595
0.08	17.58

(Sherrill and Russ, J. Am. Chem. Soc. 1907, **29.** 1662.)

Sl. sol. in very conc. K_2CrO_4+Aq. Practically insol. in $AgNO_3$+Aq. (Margosches.)

Solubility of Ag_2CrO_4 in HNO_3+Aq at 25°.

Mols. HNO_3 per l.	Milliat. per l.		Solid Phase
	Cr	Ag	
0.01	3.157	6.315	Ag_2CrO_4
0.015	3.730	....	"
0.02	4.177	8.356	"
0.025	4.567	....	"
0.03	5.200	....	"
0.04	5.803	11.62	"
0.05	6.380	....	"
0.06	6.833	....	"
0.07	7.333	....	"
0.075	7.477	14.85	" $+Ag_2Cr_2O_7$
0.08	7.260	15.45	" "
0.10	5.647	19.01	" "
0.13	4.293	23.89	" "
0.14	3.948	25.63	" "

(Sherrill and Russ, J. Am. Chem. Soc. 1907, **29.** 1663.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

1 l. 65% alcohol dissolves 0.0129 g. Ag_2CrO_4 at ord. temp. (Guerini, Dissert. **1912.**)

Insol. in H_2O containing acetic acid in presence of large excess of $AgNO_3$. (Gooch and Weed, Am. J. Sci. 1908, (4) **26.** 85.)

Practically insol. in glacial acetic acid but somewhat sol. in dil. acetic acid. It behaves in a similar manner toward propionic, lactic and other organic acids. The red modification is more sol. than the greenish-black. (Margosches, Z. anorg. 1906, **51.** 233.)

Silver *di*chromate, $Ag_2Cr_2O_7$.

Sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. (Warington.)

Decomp. by boiling with H_2O into CrO_3 and Ag_2CrO_4. (Jäger and Krüss, B. **22.** 2050.)

Decomp. by cold H_2O. (Autenrieth, B. 1902, **35.** 2061.)

1 pt. is sol. in 12,000 pts. H_2O at 15°. (Mayer, B. 1903, **36.** 1741.)

Solubility in H_2O at 25° = 7.3×10^{-3} atoms Ag per l. Decomp. by HNO_3+Aq (less than 0.06 N) with separation of Ag_2CrO_4. (Sherrill and Russ, J. Am. Chem. Soc. 1907, **29.** 1674.)

Solubility of Ag_2CrO_7 in HNO_3+Aq at 25°.

Mols. HNO_3 per l.	Milliat. per l.		Solid Phase
	Cr	Ag	
0	32.20	5.390	Ag_2CrO_4+ Ag_2CrO_7
0.01	25.06	6.131	"
0.02	20.21	7.148	"
0.04	13.59	9.529	"
0.06	11.10	11.10	$Ag_2Cr_2O_7$
0.08	11.10	11.10	"
0.08+0.1$AgNO_3$	6.624	...	"

(Sherrill and Russ, J. Am. Chem. Soc. 1907, **29.** 1664.)

Silver uranyl chromate, $2Ag_2CrO_4$, UO_2CrO_4.

Ppt. (Formánek, A. **257.** 110.)

Silver chromate ammonia, Ag_2CrO_4, $4NH_3$.

Decomp. by H_2O. Sol. in warm conc. NH_4OH+Aq. (Mitscherlich, Pogg. **12.** 141.)

Silver *di*chromate mercuric cyanide, $Ag_2Cr_2O_7$, $Hg(CN)_2$.

Sol. in cold H_2O; very sol. in hot H_2O without decomp. (Krüss, Z. anorg. 1895, **8.** 456.)

$Ag_2Cr_2O_7$, $2Hg(CN)_2$. Scarcely sol. in cold, more readily in hot H_2O. Sol. in hot HNO_3+Aq, separating on cooling. (Darby, Chem. Soc. **1.** 24.)

Sodium chromate, basic, Na_4CrO_5+$13H_2O$.

Sol. without decomp. in H_2O.

Sat. solution at 30° contains 41.3%

Na_4CrO_5. (Schreinemakers, Z. phys. Ch. 1906, **55.** 93.)

Deliquescent.

Solubility in H_2O at t°.

t°	0°	10°	20.5°
% Na_4CrO_5	33.87	35.58	38.05

t°	27.7°	35°	37°
% Na_4CrO_5	40.09	44.09	45.13

(Mylius and Funk, Gm.-K. **3.** I, 1379.)

Na_4CrO_5+Aq sat. at 18° contains 37.50% Na_4CrO_5, and has sp. gr. = 1.446. (Mylius and Funk, B. 1900, **33.** 3688.)

Sodium chromate, Na_2CrO_4.

100 ccm. of solution sat. at 18° contain **54 g.** Na_2CrO_4. (Kohlrausch, B. A. B. **1897.** 90.)

Solubility in H_2O at t°.

t°	% Na_2CrO_4
70	55.15
80	55.53
100	55.74

(Mylius and Funk, Gm.-K. **3.** I, 1379.)

Na_2CrO_4+Aq sat. at 18° contains 40.10% Na_2CrO_4, and has sp. gr. = 1.432. (Mylius and Funk, B. 1900, **33.** 3686.)

See also +4, 6, and $10H_2O$.

Sp. gr. of Na_2CrO_4+Aq at t°/4°.

t°	17.4°	17.1°	20.7°
% Na_2CrO_4	5.76	10.62	14.81
Sp. gr.	1.0576	1.1125	1.1644

(Slotte, W. Ann. 1881, **14.** 18.)

$+4H_2O$. Sat. solution at 30° contains 46.62% Na_2CrO_4. (Schreinemakers, Z. phys. Ch. 1906, **55.** 93.)

Solubility in H_2O at t°.

t°	% Na_2CrO_4	t°	% Na_2CrO_4
25.6	46.08	49.5	50.93
31.5	47.05	54.5	52.28
36	47.98	59.5	53.39
40	48.97	65	55.23
45	50.20		

(Mylius and Funk, Gm.-K. **3.** I, 1379.)

Solubility in H_2O at t°.

t°	% Na_2CrO_4	Mols. H_2O to 1 mol anhydrous salt	Mols. anhydrous salt to 100 mols. H_2O
28.9	46.47	10.37	9.64
29.7	46.54	10.34	9.67
31.2	47.08	10.12	9.88

(Salkowski, B. 1901, **34.** 1948.)

$+6H_2O$.

Solubility in H_2O at t°.

t°	% Na_2CrO_4	Mols. H_2O to 1 mol. anhydrous salt	Mols. anhydrous salt to 100 mols. H_2O
17.7	43.65	11.60	8.62
19.2	44.12	11.40	8.77
21.2	44.64	11.16	8.96
23.2	45.27	10.88	9.19
24.7	45.75	10.77	9.37
26.6	46.28	10.45	9.57

(Salkowski, B. 1901, **34.** 1948.)

$+10H_2O$. Deliquescent. (Kopp, A. **42.** 99.) Easily sol. in H_2O. Melts in crystal H_2O at 23°. (Berthelot.)

Sp. gr. of solution sat. at 18° = 1.409, and contains 38.1% Na_2CrO_4. (Mylius and Funk, B. 1897, **30.** 1718.)

Solubility in H_2O at t°.

t°	% Na_2CrO_4
0	24.04
10	33.41
18.5	41.65
19.5	44.78
21	47.40

(Mylius and Funk, Gm.-K. **3.** I, 1379.)

Sp. gr. of solution at 18° containing 40.1% Na_2CrO_4 = 1.432. (Mylius, B. 1900, **33.** 3688.)

Sl. sol. in alcohol. (Moser.)

100 g. absolute methyl alcohol dissolve 0.345 g. Na_2CrO_4 at 25°. (de Bruyn, Z. phys. Ch. **10.** 783).

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Sodium *di***chromate,** $Na_2Cr_2O_7$.

More sol. in H_2O than Na_2CrO_4.

Solubility in H_2O at t°.

t°	% $Na_2Cr_2O_7$
93°	81.19
98°	81.25

(Mylius and Funk, Gm.-K. **3.** I, 1380.)

Sp. gr. of aqueous solution containing—

1	5	10	15	20	25% $Na_2Cr_2O_7$,
1.007	1.035	1.071	1.105	1.141	1.171

30	35	40	45	50 % $Na_2Cr_2O_7$.
1.208	1.245	1.280	1.313	1.343

(Stanley, C. N. **54.** 194.)

Sp. gr. of sat. solution containing 63.92% $Na_2Cr_2O_7$ at 18° = 1.745. (Mylius and Funk, B. 1900, **33.** 3688.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)
$+2H_2O$. Deliquescent.

100 pts. H_2O dissolve at—

0°	15°	30°	80°	100°	139°	
107.2	109.2	116.6	142.8	162.8	209.7	pts. salt.

(Stanley, C. N. **54.** 194.)

Solubility in H_2O at t°

t°	% $Na_2Cr_2O_7$
0	61.98
17	63.82
34.5	67.36
52	71.76
72	76.90
81	79.80

(Mylius and Funk, Gm.-K. **3.** I, 1380.)

100 g. H_2O at 30° dissolve 197.6 g. $Na_2Cr_2O_7$, or sat. solution at 30° contains 66.4% $Na_2Cr_2O_7$. (Schreinemakers, Z. phys. Ch. 1906, **55.** 97.)

100 ccm. of a solution of sodium dichromate in alcohol contain 5.133 g. $Na_2Cr_2O_7+2H_2O$ at 19.4°. The solution decomp. rapidly. (Reinitzer, Zeit. angew. Ch. 1913, **26.** 456.)

The composition of the hydrates formed by $Na_2Cr_2O_7$ at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by $Na_2Cr_2O_7$ and of the conductivity and sp. gr. of $Na_2Cr_2O_7$+Aq. (Jones, Am. ch. J. 1905, **34.** 317.)

Sodium *tri*chromate, $NaCr_3O_{10}$.

Deliquescent. Very sol. in H_2O. (Stanley, C. N. **54.** 194.)

$+H_2O$. Sat. solution at 30° contains 80% $Na_2Cr_3O_{10}$. (Schreinemakers, Z. phys. Ch. 1906, **55.** 94.)

Solubility in H_2O at t°.

t°	0°	15°	55°	99°
% $Na_2Cr_3O_{10}$	80.03	80.44	82.68	85.78

(Mylius and Funk, Gm.-K. **3.** I, 1380.)

Sp. gr. of sat. solution containing 80.6% $Na_2Cr_3O_{10}$ at 18° = 2.059. (Mylius and Funk, B. 1900, **33.** 3688.)

Sodium *tetra*chromate, $Na_2Cr_4O_{13}+4H_2O$.

Solubility in H_2O at t°.

t°	0°	16°	22°
% $Na_2Cr_4O_{13}$	72.19	74.19	76.01

(Mylius and Funk, Gm.-K. **3.** 1, 1380.)

Deliquescent.
Sat. solution at 18° contains 74.6% $Na_2Cr_4O_{13}$ and has sp. gr. = 1.926. (Mylius and Funk, B. 1900, **33.** 3688.)

Sodium uranyl chromate, Na_2CrO_4, $2(UO_2)CrO_4+10H_2O$.

Easily sol. in H_2O. (Formánek, A. **257.** 108.)

100 pts. of the solution in H_2O contain 52.52 pts. of the anhydrous salt at 20°. (Rimbach, B. 1904, **37.** 482.)

Sodium chromate silicate, Na_2O, Cr_2O_3, $2SiO_2+14H_2O$.

Not decomp. by HCl+Aq. (Singer, Dissert. **1910.**)

$2Na_2O$, $3Cr_2O_3$, $6SiO_2$. Not decomp. by boiling conc. acids except HF. (Weyberg, C. B. Miner, **1908.** 519.)

$5Na_2O$, $2Cr_2O_3$, $11SiO_2$. (Weyberg.)

$3Na_2O$, $2Cr_2O_3$, $9.5SiO_2$. (Weyberg.)

Strontium chromate, $SrCrO_4$.

Somewhat sol. in H_2O. Sol. in 840 pts. H_2O (Meschezerski, Z. anal. **21.** 399); sol. in 831.8 pts. H_2O at 15°. (Fresenius, Z. anal. **29.** 419.)

100 cc. H_2O dissolve 0.4651% at 10°; 1% at 20°; 2.417% at 50°; 3% at 100°. (Reichard, Ch. Z. 1903, **27.** 877.)

Easily sol. in HCl, HNO_3, or H_2CrO_4+Aq.
Sol. in 512 pts. 0.5% NH_4Cl+Aq at 15°.
Sol. in 63.7 pts. 1% $HC_2H_3O_2$+Aq at 15°.
Sol. in 348.8 pts. solution containing 0.75% $NH_4C_2H_3O_2$, 4 drops $HC_2H_3O_2$, and 6 drops $(NH_4)_2CrO_4$+Aq. (Fresenius.)

100 ccm. NH_4Cl+Aq sat. at bpt. dissolve 1 g. $SrCrO_4$. (Dumesnil, A. ch. 1900, (7) **20.** 125.)

50 ccm. alcohol (29%) dissolve 0.0066 g. $SrCrO_4$.

50 ccm. alcohol (53%) dissolve 0.001 g. $SrCrO_4$. (Fresenius, Z. anal. **30.** 672.)

Strontium *di*chromate, $SrCr_2O_7$.

Easily sol. in H_2O.

Strontium *tri*chromate, $SrCr_3O_{10}+3H_2O$.

Very deliquescent, and sol. in H_2O. (Preis and Raymann, B. **13.** 340.)

Strontium chromate mercuric hydrogen chloride, $SrCrO_4$, $2HgCl_2$, HCl.

According to Strömholm is $SrCl_2$, $SrCr_2O_7$, $4HgCl_2+H_2O$.

Recryst. from H_2O. (Imbert and Belugon, Bull. Soc., 1897, (3) **17.** 471.)

$2SrCrO_4$, $6HgCl_2$, HCl. (Imbert and Belugon.)

Thallous chromate, $TlCrO_4$.

100 pts. H_2O dissolve 0.03 pt. at 60°. (Rupp and Zimmer, Z. anorg. 1902, **33.** 157.)

Ppt. Insol. in cold moderately conc. $HC_2H_3O_2$+Aq, or in very dil. HNO_3+Aq, and very sl. sol. on boiling therewith. Dil. NH_4OH, and Na_2CO_3+Aq have the same action. Attacked by very dil. HCl+Aq. Sol. in hot conc. HCl+Aq. Decomp. by dil. H_2SO_4+Aq. (Carstanjen.)

1 l. KOH+Aq (112 g. per l.) dissolves about 3.5 g. Tl_2CrO_4 on boiling, which separates out on cooling.

Boiling conc. KOH+Aq (31% KOH) dissolves 18 g. Tl_2CrO_4 per litre. (Lepierre and Lachaud, C. R. **113.** 196.)

Thallous *di*chromate, $Tl_2Cr_2O_7$.

Insol. in H_2O, etc. Has the same properties as Tl_2CrO_4.

Thallous *tri*chromate, $Tl_2Cr_3O_{10}$.

Sol. in 2814 pts. H_2O at 15°, and 438.7 pts. at 100°. (Crookes.)

Thallic chromate.

Ppt.

Thorium chromate, basic, $Th(OH)_2CrO_4$.

Ppt.; unstable in solution. (Palmer, Am. Ch. J. 1895, **17.** 278.)

Thorium chromate, $Th(CrO_4)_2+H_2O$.

Ppt. Sol. in HCl and NH_4Cl+Aq. 1 pt. is sol. in 284 pts. H_2O at 22°. (Palmer, Am. Ch. J. 1895, **17.** 375 and 278.)

$+3H_2O$. Ppt. (Haber, M. 1897, **18.** 689.)

$+8H_2O$. Insol. in H_2O. (Chydenius, Pogg. **119.** 54.)

Tin (stannous) chromate.

Ppt. Sol. in dil. acids. (Berzelius.)

Tin (stannic) chromate.

Ppt. (Leykauf, J. pr. **19.** 127.)

Uranyl chromate, basic, UO_3, $2(UO_2)CrO_4+8H_2O$.

Ppt. (Orloff, Ch. Z. 1907, **31.** 375.)

UO_3, $(UO_2)CrO_4+6H_2O$. (Orloff.)

Uranyl chromate, $(UO_2)CrO_4+3H_2O$.

1 pt. is sol. in 13.3 pts. H_2O at 15°; slowly sol. in alcohol to give a solution which is decomp. on boiling. (Orloff, Ch. Z. 1907, **31.** 375.)

$+11H_2O$. Very sol. in H_2O. (Formánek, A. **257.** 108.)

Yttrium chromate.

Deliquescent. Easily sol. in H_2O. (Berlin.)

Zinc chromate, basic, 4ZnO, CrO_3+3H_2O.

(Gröger, Z. anorg. 1911, **70.** 135.)

$+5H_2O$. Insol. in H_2O; sol. in hot H_2CrO_4+Aq; slowly sol. in NH_4OH+Aq. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)

3ZnO, CrO_3+2H_2O. (Gröger.)

2ZnO, CrO_3+H_2O. (Briggs, Z. anorg. 1907, **56.** 254.)

$+1\frac{1}{2}H_2O$. Ppt. Insol. in H_2O. Sol. in hot H_2CrO_4+Aq. (Prüssen and Philipona, A. **149.** 92.)

$+2H_2O$. Ppt. Not wholly insol. in H_2O. (Prüssen and Phillipona.)

3ZnO, $2CrO_3+H_2O$. (Gröger.)

Zinc chromate, $ZnCrO_4$.

Insol. in H_2O; very sol. in acids; decomp. by boiling with H_2O. (Schulze, Z. anorg. 1895, **10.** 154.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+H_2O$. (Gröger, Z. anorg. 1911, **70.** 135.)

Zinc *di*chromate, $ZnCr_2O_7+3H_2O$.

Hygroscopic.

Very sol. in H_2O and sl. decomp. by boiling. (Schulze, Z. anorg. 1895, **10.** 153.)

Zinc *tri*chromate, $ZnCr_3O_{10}+3H_2O$.

Deliquescent; very sol. in H_2O. (Gröger, Z. anorg. 1910, **66.** 10.)

Zinc chromate ammonia, $ZnCrO_4$, NH_3+H_2O.

Decomp. by H_2O. (Gröger, Z. anorg. 1908, **58.** 417.)

$ZnCrO_4$, $4NH_3+5H_2O$. Decomp. by H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol and ether. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)

$+3H_2O$. Efflorescent. Decomp. by H_2O. Easily sol. in dil. acids and NH_4OH+Aq. (Bieler, A. **151.** 223.)

2ZnO, $3CrO_3$, $10NH_3+10H_2O$. Ppt. (Malaguti and Sarzeau.)

Zinc *di*chromate mercuric cyanide, $ZnCr_2O_7$, $2Hg(CN)_2+7H_2O$.

Very sol. in H_2O. Stable in aqueous solution at 100°. (Krüss, Z. anorg. 1895, **8.** 460.)

*Per*chromic acid

See **Perchromic acid.**

Chromicomolybdic acid, Cr_2O_3, $12MoO_3+28H_2O$.

Slowly sol. in H_2O. (Hall, J. Am. Chem. Soc. 1907, **29.** 708.)

Ammonium chromicomolybdate, $3(NH_4)_2O$, Cr_2O_3, $12MoO_3+20H_2O$.

Sol. in H_2O. (Strüve, J. pr. **61.** 457; Hall, J. Am. Chem. Soc. 1907, **29.** 695.)

$+26H_2O$. (Marckwald, Dissert, **1895.**)

Ammonium barium chromicomolybdate, $(NH_4)_2O$, 22BaO, Cr_2O_3, $12MoO_3+20H_2O$.

(Hall, J. Am. Chem. Soc. 1907, **29.** 707.)

Barium chromicomolybdate, $4BaO, Cr_2O_3, 12MoO_3+15H_2O$; $4BaO, Cr_2O_3, 12MoO_3+18H_2O$; $5BaO, Cr_2O_3, 12MoO_3+16H_2O$.

Ppts. (Hall, J. Am. Chem. Soc. 1907, **29.** 705.)

Lead chromicomolybdate, $4PbO, Cr_2O_3, 12MoO_3+22H_2O$, and $+24H_2O$.

Ppts. (Hall, J. Am. Chem. Soc. 1907, **29.** 706.)

Mercurous chromicomolybdate, $8Hg_2O, Cr_2O_3, 12MoO_3+16H_2O$.

Ppt. (Hall, J. Am. Chem. Soc 1907, **29.** 707.)

Potassium chromicomolybdate, $K_2O, Cr_2O_3, 3MoO_3$.

Sol. in HCl+Aq with evolution of Cl. (Bradbury, Z. anorg. 1894, **7.** 46.)

$3K_2O, Cr_2O_3, 12MoO_3+20H_2O$. Sol in 38.51 pts. H_2O at 17°. (Strüve; Hall.)

$+24H_2O$. (Hall.)

$4K_2O, Cr_2O_3, 12MoO_3+15H_2O$. (Hall, J. Am. Chem. Soc. 1907, **29.** 709.)

$7K_2O, 2Cr_2O_3, 24MoO_3+32H_2O$. (Hall.)

Silver chromicomolybdate, $5Ag_2O, Cr_2O_3, 12MoO_3+17H_2O$.

Ppt. (Hall.)

Sodium chromicomolybdate, $3Na_2O, Cr_2O_3, 12MoO_3+21H_2O$.

Efflorescent. Easily sol. in H_2O. (Strüve.)

Chromic sulphuric acid.

See **Sulphochromic acid.**

Chromicyanhydric acid,

$H_3Cr(CN)_6$(?).

Insol. in H_2O. (Kaiser, A. Suppl. **3.** 163.)

Ammonium chromicyanide, $(NH_4)_3Cr(CN)_6$.

Easily sol. in H_2O. (Kaiser, A. Suppl. **3.** 163.)

Cupric chromicyanide, $Cu_3[Cr(CN)_6]_2$.

Ppt. Insol. in dil. or conc. acids, except on heating. Insol. in NH_4OH, or KOH+Aq. (Kaiser.)

Lead chromicyanide, basic, $3Pb(CN)_2, 2Cr(CN)_3, Pb(OH)_2$.

Ppt. Sol. in HNO_3, NaOH+Aq, or Pb salts+Aq. (Kaiser.)

Potassium chromicyanide, $K_3Cr(CN)_6$.

Very sol. in H_2O.

100 pts. cold H_2O dissolve 30.9 pts. salt. Insol. in absolute alcohol, but somewhat sol. in dil. alcohol.

Sol. in conc. H_2SO_4 without decomp. (Kaiser, A. Suppl. **3.** 170.)

Silver chromicyanide, $Ag_3Cr(CN)_6$.

Insol. in all solvents, excepting KCN+Aq. (Kaiser.)

Sol. in large excess of HCl+Aq. Sl. sol. in cold easily sol. in hot conc. HNO_3. Very sol. in conc. H_2SO_4. Insol. in hot or cold acetic acid. (Cruser, Dissert. **1896.**)

Chromisulphocyanhydric acid.

$H_3Cr(SCN)_6$.

Known only in aqueous solution.

Ammonium chromisulphocyanide, $(NH_4)_3Cr(SCN)_6+4H_2O$.

Easily sol. in H_2O. (Rössler, A. **141.** 185.)

Barium chromisulphocyanide, $Ba_3[Cr(SCN)_6]_2+16H_2O$.

Deliquescent, and sol. in H_2O. (R.)

Lead chromisulphocyanide, $Pb_3[Cr(SCN)_6]_2, 4PbO_2H_2+8H_2O$.

Insol. in H_2O, but decomp. thereby into— $Pb_2[Cr(SCN)_5]_2, 4PbO_2H_2+5H_2O$. Insol. in H_2O.

Potassium chromisulphocyanide, $K_6Cr(SCN)_6+4H_2O$.

Sol. in 0.72 pt. H_2O, and 0.94 pt. alcohol.

Silver chromisulphocyanide, $Ag_6Cr(SCN)_6$.

Insol. in H_2O or conc. HNO_3+Aq. Insol. in NH_4OH+Aq. Sol. in KCN+Aq.

Sodium chromisulphocyanide, $Na_6Cr(SCN)_6+7H_2O$.

Deliquescent; sol. in H_2O.

Chromium,

Two modifications—(α) Not attacked by H_2O. Easily sol. in cold HCl+Aq. Sl. sol. in dil. H_2SO_4+Aq. (Deville.) Easily sol. in a hot mixture of 1 pt H_2SO_4 and 20 pts. H_2O. (Regnault, A. ch. **62.** 357.) Easily sol. in warm conc. H_2SO_4. (Gmelin.) Very slowly sol. in hot HNO_3+Aq. (Vauquelin.) Insol. in dil. or conc. HNO_3+Aq. (Deville.) Very slowly (Richter), not at all (Berzelius) sol. in hot aqua regia. Easily sol. in HF+Aq.

(β) Insol. in all acids, even aqua regia (Fremy); probably contains Si.

Pure Cr is sol. in conc. H_2SO_4, HCl and dil. HNO_3; sol. in $HgCl_2$+Aq.

Insol. in fuming HNO_3 and aqua regia. (Moissan, C. R. **1894.** 119, 187.)

Cr prepared by aluminothermic method is sol. in haloid acids to form chromic and chromous salts, even in absence of air. (Doring, J. pr. 1902, (2) **66.** 65; **1906,** (2) **73.** 393.)

Aluminothermic Cr is active in contact

with HCl, HBr, HI, HF, H_2SO_4, $H_2C_2O_4$, *i. e.*, sol. in cold conc. or warm dil. acids. Is inactive in contact with conc. HNO_3, $H_2Cr_2O_4$, $HClO_3$, $HClO_4$, H_3PO_4, KOH, citric, formic, acetic and tartaric acids. Cause attributed to a different electric state. (Hittorff, Z. phys. Ch. 1898, **25.** 729.)

Chromium ammonia compounds.

See—

Bromotetramine chromium compounds, $BrCr(NH_3)_4X_2$.

Bromopurpureochromium compounds, $BrCr(NH_3)_5X_2$.

Chlorotetramine chromium compounds, $ClCr(NH_3)_4X_2$.

Chloropurpureochromium compounds, $ClCr(NH_3)_5X_2$.

Diamine chromium sulphocyanides, $Cr(NH_3)_2(SCN)_4M$.

Erythrochromium compounds, $(HO)Cr_2(NH_3)_{10}X_2$.

Iodopurpureochromium compounds, $ICr(NH_3)_5X_2$.

Iodotetramine chromium compounds, $ICr(NH_3)_4X_2$.

Luteochromium compounds, $Cr(NH_3)_6X_3$.

Rhodochromium compounds, $(HO)Cr_2(NH_3)_{10}X_5$.

Rhodosochromium compounds, $(HO)_3Cr_2(NH_3)_6X_3$.

Roseochromium compounds, $Cr(NH_3)_5(OH_2)X_4$.

Xanthochromium compounds, $(HO_2)Cr(NH_3)_5X_2$.

Chromium arsenide, CrAs.

Insol. in mineral acids. (Dieckmann, Z. anorg. 1914, **86.** 294.)

Cr_2As_3. Insol. in mineral acids. (Dieckmann.)

Chromium azoimide, CrN_3.

Pptd. by addition of alcohol and ether. Insol. in H_2O. (Curtius, J. pr. 1900, (2) **61.** 410.)

Chromium boride, CrB.

Insol. in HCl, dil. H_2SO_4, HF, $HF+HNO_3$. Sl. sol. in HNO_3 and in aqua regia. (Wedekind, B. 1907, **40.** 299.)

Sol. in cold dil. or conc. HCl, HF, and H_2SO_4. (Jassonneix, C. R. 1906, **143.** 1151.)

Cr_3B_2. Sol. in conc. or dil. HF, HCl, H_2SO_4; insol. in HNO_3 or alkalis+Aq. (Jassonneix.)

Chromous bromide, $CrBr_2$

Sol. in H_2O. Not deliquescent in dry air. (Moissan, C. R. **92.** 1051.)

Chromic bromide, $CrBr_3$.

Anhydrous. Insol. in H_2O, but dissolves at once in presence of the least trace of $CrBr_2$. (Bauck, A. **111.** 382.)

$+6H_2O$. Deliquescent. Very sol. in H_2O. H_2O dissolves more than 2 pts. crystals at ord. temp. Very sol. in alcohol. Insol. in ether. (Recoura, C. R. **110.** 1029.)

Blue modification. Insol. in alcohol. (Recoura, C. R. **110.** 1193.)

Very hygroscopic. Easily sol. in alcohol and acetone. Insol. in ether. (Werner, A. 1902, **322.** 343.)

$+8H_2O$. Sol. in H_2O. (Varenne, C. R. **93.** 727.)

Chromium molybdenyl bromide, $CrMo_3O_4Br_4$.

Apparently wholly insol. in dil. acids. Sol. in hot conc. HCl+Aq with decomp. Insol. in M_2CrO_4+Aq. (Atterberg.)

$+2H_2O$. Apparently wholly insol. in dil. acids.

Sol. in hot conc. HCl+Aq with decomp. Insol. in M_2CrO_4+Aq. (Atterberg.)

Chromic rubidium bromide, $CrBr_3$, $2RbBr+H_2O$.

Sol. in H_2O with decomp. (Werner, A. 1902, **322.** 345.)

Chromic bromide ammonia.

See **Bromotetramine chromium bromide.**

Chromous bromide hydrazine, $CrBr_2$, $2N_2H_4$.

Insol. in H_2O. Sol. in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, **46.** 1507.)

Chromium carbide, Cr_4C.

(Moissan, C. R. 1894, **119.** 187.)

Cr_3C_2. Does not decomp. H_2O at ordinary temp. or at 100°; insol. in conc. HCl, HNO_3 and aqua regia; sol. in dil. HCl (slowly); insol. in fused KOH; sol. in fused KNO_3. (Moissan, Bull. Soc. 1894, (3) **117.** 1016.)

Chromium iron carbide, $3Fe_3C$, $2Cr_3C_2$.

Decomp. by H_2O; sol. in gaseous hydracids; insol. in HNO_3 and aqua regia. (Williams, C. R. 1898, **127.** 484.)

Chromium tungsten carbide, CW_2, $3Cr_3C_2$.

Not attacked by acids.

Slowly attacked by fused KOH or alkali carbonates. Rapidly decomp. by fused alkali nitrates or $KClO_3$. (Moissan, C. R. 1903, **137.** 294.)

Chromous chloride, $CrCl_2$.

Deliquescent. Very sol. in H_2O with evolution of much heat. (Moberg, J. pr. **29.** 175.)

Practically insol. in ether. Moderately sol. in absolute alcohol, methyl alcohol, and acetaldehyde. (Rohland, Z. anorg. 1899, **21.** 39.)

$+1\frac{1}{2}H_2O$. (Moissan, A. ch. (5) **25.** 40.)

$+2H_2O$. (Knight and Rich, Chem. Soc. 1911, **99.** 89.)

$+3H_2O$. (Knight and Rich.)

Chromous hydrogen chloride, $3CrCl_2, 2HCl+13H_2O$.

Decomp. by H_2O. (Recoura, C. R. **100.** 1227.)

Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Chromic chloride, $CrCl_3$.

Anhydrous.—Peach-blossom-colored modification. Insol. in pure H_2O (Peligot), but by long continued boiling of the finely divided salt with H_2O, traces are dissolved with decomp. Not decomp. by boiling conc. H_2SO_4, or other acids, even aqua regia.

Easily sol. with evolution of heat in H_2O containing only $^1/_{40,000}$ pt. $CrCl_2$. (Peligot, J. pr. **36.** 150). Also sol. in presence of traces of $SnCl_2$ (5 mg. $SnCl_2$ cause 1 g. $CrCl_3$ to dissolve), $FeCl_2$, Cu_2Cl_2, $Na_2S_2O_3$, and other reducing substances; chlorides without reducing properties have no effect. (Pelouze, A. ch. (3) **14.** 251). $TiCl_3$ and SO_2 have similar solvent action. (Ebelmen, A. ch. (3) **20.** 390); also Zn+dil. acids. (Moberg.)

Insol. in dil. alkalies+Aq; very slowly decomp. by boiling conc. alkalies or alkali carbonates+Aq. (Fellenberg, Pogg. **50.** 76.)

Difficulty sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in acetone. (Eidmann, C. C. **1899.** II, 1014.)

Practically insol. in absolute ethyl alcohol, methyl alcohol, acetaldehyde and ether. (Rohland, Z. anorg. 1899, **21.** 39.)

Yellow. Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Violet modification. Very sol. in H_2O to form a green solution. (Moberg, J. pr. **44.** 325.)

The violet mod. is almost insol. in H_2O but if $^1/_{20,000}$ pt. chromous chloride is present, it is readily sol. (Rohland, Z. anorg. 1899, **21.** 39.)

$+4H_2O$. Sl. deliquescent. Very sol. in H_2O, alcohol, and ethyl acetate. (Godeffroy, Bull. Soc. (2) **43.** 229.)

$+6H_2O$. Deliquescent. Sol. in H_2O, but probably decomp. to $CrOCl_2$.

Practically insol. in ether. Moderately sol. in absolute ethyl alcohol, methyl alcohol and acetaldehyde. (Rohland, Z. anorg. 1899, **21.** 39.)

"Monochlorochromic chloride" is sol. in ether and fuming HCl(1:1). (Bjerrum, B. 1906, **39.** 1599.)

Green modification.

Solubility in H_2O at 25°.

25 g. green $CrCl_3+6H_2O$ and 10 g. H_2O.

Time	Total Solubility in %	Composition of the sat. solution	
		% violet salt	% green salt
¼ hr.	58.36	8.30	91.70
½ hr.	...	12.57	87.43
4 hrs.	63.27	24.80	75.20
1 day	68.50	37.64	62.36
2 days	...	40.90	59.10
3 "	68.95	42.78	57.22
11 "	...	42.84	57.16
13 "	...	42.39	57.61
19 "	68.58	42.62	57.38

(Olie, Z. anorg. 1906, **51.** 55.)

Solubility of green $CrCl_3+6H_2O$ in H_2O at 32°.

10 g. $CrCl_3+6H_2O$ and 4 g. H_2O.

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7′	63.69	12.87	87.13	Almost all dissolved
45′	66.24	21.43	78.57	
2h 5′	69.53	34.53	65.47	
48h	69.33	45.27	54.73	
* 11 dys.	70.81	45.27	54.73	

* First 8 days at 35°.

(Olie, Z. anorg. 1907, **53.** 276.)

Solubility of green $CrCl_3+6H_2O$ in H_2O at 35°.

10 g. $CrCl_3+6H_2O$ and 3.3 g. H_2O.

Time	Total solubility in %	Composition of the dissolved substance	
		% violet salt	% green salt
8′	65.85	16.47	83.53
38′	66.74	25.02	74.98
1h	66.21	25.45	74.55
2h 10′	68.90	31.47	68.53
4h	70.79	36.28	63.72
23h	71.34	42.95	57.05
72h	70.79	42.88	57.12

(Olie, *l. c.*)

If a solution saturated with the green hexahydrate below 32° is cooled, the decahydrate separates out; if the solution is saturated above 32°, both the decahydrate and hexahydrate separate out on cooling. (Olie, *l. c.*)

Violet modification.

Solubility in H_2O at 25°.

25 g. violet $CrCl_3+6H_2O$ and 10 ccm. of a 35% solution of green $CrCl_3+6H_2O$.

Time	Total Solubility in %	Composition of the sat. solution	
		% violet salt	% green salt
1 1/6 hr.	65.49	84.05	15.95
5 "	...	84.47	15.53
29 "	...	78.16	21.84
2 dys.	70.47	73.19	26.81
4 "	...	68.71	31.29
5 "	76.38	60.66	39.34
5 dys, 6 hrs.	...	60.36	39.64
6 dys.	...	65.10	34.90
8 "	73.26	65.80	34.20
10 "	...	58.08	41.92
12 "	71.14	41.40	58.60

(Olie, Z. anorg. 1906, **51.** 57.)

Solubility in H_2O at 25°.

25 g. violet $CrCl_3+6H_2O$ and 10 g. H_2O.

Time	Total Solubility in %	Composition of the sat. solution	
		% violet salt	% green salt
1/6 hr.	61.99	98.47	1.53
4 1/2 hrs.	...	96.70	3.30
1 dy.	63.88	91.54	8.46
2 "	...	83.37	16.63
4 "	70.68	69.11	30.89
5 "	...	62.20	37.80
7 "	72.11	62.72	37.28
8 "	...	54.63	45.37
12 "	...	46.39	53.61
13 "	...	47.66	52.34
26 "	70.62	48.55	51.45

(Olie, *l. c.*)

$+6\frac{1}{2}H_2O$. *Green modification.* 100 pts. H_2O dissolve 130 pts. salt at 15°. Sol. in alcohol. (Recoura, C. R. **102.** 518.)

Grayish-blue modification. Very sol. in H_2O. (Recoura, C. R. **102.** 548.)

$+10H_2O$. Very deliquescent; melts in crystal H_2O at 6–7°. Very sol. in H_2O, alcohol, and ethyl acetate. (Godeffroy.)

Easily sol. in H_2O; can be recryst. from H_2O. Sol. in alcohol and ether. (Werner, B. 1906, **39.** 1827.)

Green modification.

Solubility of green $CrCl_3+10H_2O$ in H_2O at 29°.

14.2 g. $CrCl_3+10H_2O$ and 2.5 g. H_2O.

Time	Total solubil'y in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7′	61.35	8.71	91.29	$CrCl_3+10H_2O$
20′	62.46	9.90	90.10	"
1ʰ 55′	65.04	25.05	74.95	"
4ʰ 30′	67.41	32.90	67.10	$CrCl_3+6H_2O$
24ʰ	69.44	42.93	57.07	all dissolved
28ʰ	...	31.78	68.22	$CrCl_3+10H_2O$
29ʰ	67.59	33.65	66.36	$CrCl_3+6H_2O$
48ʰ	69.42	42.17	57.83	"
72ʰ	68.69	43.80	56.20	"

(Olie, Z. anorg. 1907, **53.** 275.)

The composition of the hydrates formed by $CrCl_3$ at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by $CrCl_3$ and of the conductivity and sp. gr. of $CrCl_3$+Aq. (Jones, Am. Ch. J. 1905, **34.** 310.)

Chromic glucinum chloride, $CrCl_3$, $GlCl_2$ $+H_2O$.

Sol. in H_2O with decomp. (Neumann, A. **244.** 329.)

Chromic lithium chloride, $CrCl_3$, $2LiCl+4H_2O$.

Very hygroscopic.

Sol. in ice water but solution soon decomp.

Easily sol. in alcohol. (Werner, B. 1901, **34.** 1603.)

$[Cr(OH_2)Cl_5]Li_2+4H_2O$.

Very hygroscopic. Sol. in ice cold H_2O and in alcohol. (Werner, B. 1901, **34.** 1604.)

Chromic magnesium chloride, $CrCl_3$, $MgCl_2$ $+H_2O$.

Decomp. by H_2O. (Neumann.)

Chromic phosphoric chloride, $CrCl_3$, PCl_5.

Decomp. by H_2O. (Cronander.)

Chromium platinum chloride.

See **chloroplatinate, chromium.**

Chromic potassium chloride, $CrCl_3$, KCl.

Decomp. by H_2O.

$CrCl_3$, $2KCl+H_2O$. (Neumann, A. **244.** 329.)

$CrCl_3$, 3KCl. Easily sol. in H_2O with decomp. (Fremy, A. ch. (3) **12.** 361.)

Chromic rubidium chloride, $CrCl_3$, $2RbCl+H_2O$.

Decomp. by H_2O. (Neumann, A. **244.** 329.)

Slowly sol. in cold, rapidly sol. in hot H_2O with decomp. (Werner, B. 1901, **34.** 1603.)

$CrCl_3$, $3RbCl+8H_2O$. Unstable. Decomp. by alcohol. (Werner, B. 1906, **39.** 1830.)

Chromic sodium chloride, $CrCl_3$, NaCl.

Sol. in H_2O. (Berzelius.)

$CrCl_3$, 3NaCl. Sol. in H_2O. (Berzelius.)

Chromic thallium chloride, $CrCl_3$, 3TlCl.

Sol. with decomp. in H_2O. (Neumann, A. **244.** 329.)

Chromic chloride ammonia.

See **Chlorotetramine chromium chloride.**

Chromous chloride hydrazine, $CrCl_2$, $2N_2H_4$.

Insol. in H_2O. Sol. in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, **46.** 1506.)

Chromic chloride ferric oxide.

Fe_2O_3 is easily sol. in dil., difficultly sol. in conc. $CrCl_3$+Aq. (Béchamp. A, ch. (3) **57.** 311.)

Chromous fluoride, CrF_2.

Sl. sol. in H_2O, hot H_2SO_4 or dil. HNO_3. Sol. in boiling HCl. Insol. in alcohol. (Poulenc, C. R. 1893, **116.** 254.)

Chromic fluoride, CrF_3.

Perfectly sol. in H_2O. (Berzelius.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+3H_2O$. Insol. in H_2O. (Werner and Costachescu, B. 1908, **41.** 4243.)

$+3\frac{1}{2}H_2O$. Sol. in H_2O. (Poulenc, C. R. 1893, **116.** 255.)

$+6H_2O$. Sl. sol. in H_2O. (Werner and Costachescu, B. 1908, **41.** 4242.)

$+9H_2O$. *Violet modification.* Very sl. sol. in H_2O. Insol. in alcohol. Sol. in HCl, and KOH+Aq. (Fabris, Gazz. ch. it. **20.** 582.)

Chromium ***hexa*****fluoride,** CrF_6.

Decomp. by H_2O with evolution of heat. (Berzelius.)

Correct composition is CrO_2F_2. (Oliveri, Gazz. ch. it. **16.** 218.)

Chromic cobaltous fluoride, CrF_3, CoF_2+7H_2O.

Easily sol. in H_2O. (Petersen, J. pr. (2) **40.** 60.)

Chromic cupric fluoride, $CrCuF_5+5H_2O$.

Can be cryst. from HF+Aq. (Higley, J. Am. Chem. Soc. 1904, **26.** 630.)

Chromic nickel fluoride, CrF_3, NiF_2+7H_2O.

Somewhat more sol. in H_2O than CrF_3, CoF_2+7H_2O. (Petersen, J. pr. (2) **40.** 61.)

Chromic potassium fluoride, CrF_3, 3KF.

Nearly insol. in H_2O. (Christensen, J. pr. (2) **35.** 161.)

CrF_3, $2KF+H_2O$. Nearly insol. in H_2O. Sol. in conc. HCl+Aq. (Christensen.)

Chromic sodium fluoride, CrF_3, $2NaF+H_2O$.

(Wagner, B. **19.** 896.)

Chromic thallous fluoride, $2CrF_3$, 3TlF.

Sol. in hot H_2O, less sol. in cold. Sl. sol. in HF. (Ephraim, Z. anorg. 1909, **61.** 242.)

Chromic zinc fluoride, CrF_3, ZnF_2+7H_2O.

Can be cryst. from HF+Aq. (Higley, J. Am. Chem. Soc. 1904, **26.** 630.)

Colloidal solution is perfectly clear. (Biltz, B. 1902, **35.** 4433.)

Chromous hydroxide, CrO_2H_2.

Decomp. by H_2O, especially if hot. (Peligot, A. ch. (3) **12.** 539.)

Slowly sol. in cold conc. acids, even aqua regia; almost insol. in dil. acids. (Moberg, J. pr. **43.** 119.)

Chromic hydroxide, Cr_2O_3, xH_2O, probably $Cr_2O_6H_6$.

Insol. in H_2O. Easily sol. in acids. Easily sol. in cold KOH, or NaOH+Aq; much less sol. in cold NH_4OH+Aq; the presence of NH_4Cl has no influence upon solubility in NH_4OH+Aq. (Fresenius.) Insol. in NH_4OH+Aq if it has been thoroughly washed.

Insol. in KCN+Aq, but sl. sol. in KCN+HCN+Aq. (Rodgers, **1834.**)

Gradually sol. in dil. $FeCl_3$+Aq; after three months, 2 mols. $Cr_2O_6H_6$ are dissolved by 1 mol. $FeCl_3$ without pptn. of $Fe_2O_6H_6$. (Béchamp, A. ch. (3) **57.** 296.)

Alsl sol. in $CrCl_3$+Aq; in four months, $1\frac{1}{2}$ mols. $Cr_2O_6H_6$ are dissolved by 1 mol. $CrCl_3$. (Béchamp.)

Sol. in $Cr(NO_3)_3$+Aq, and clear solution formed as long as 3 mols. HNO_3 are present for 8 mols. Cr_2O_3. (Ordway, Sill. Am. J. (2) **27.** 197.)

Chromic hydroxide, pptd. by alkalies is easily sol. in excess of the reagent; after being dried in a vacuum, however, it is insol. in alkalies. (Herz, Z. anorg. 1901, **28.** 344.)

Freshly pptd. it is sol. in aq. alkali, but it is readily changed into a modification which is insol. (Herz, Z. anorg. 1902, **31.** 352.)

The solubility of chromic hydroxide in an

aqueous solution of red chromic chloride is not directly proportional to the concentration of the latter—a basic chloride is probably formed. (Fischer, Z. anorg. 1904, **40.** 43.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in amylamine+Aq; not pptd. in presence of alkali tartrates, sugar, etc.

$Cr_2O_6H_6+4H_2O$. Difficultly sol. in acids.

$Cr_2O_6H_6+H_2O$. Extremely hygroscopic. Exists in a soluble modification, obtained by dialysis; solution can be diluted with pure H_2O, but gelatinizes with traces of salts. (Graham, Roy. Soc. Trans. **1861.** 183.)

$Cr_2O_2(OH)_2$. Insol. in boiling dil. HCl+Aq.

$Cr_2O(OH)_4$ (*Guignet's green*). Scarcely sol. in boiling HCl+Aq. (Salvétat, C. R. **48.** 295.)

Guignet gave formula as $2Cr_2O_3+3H_2O$.

Chromochromic hydroxide, Cr_3O_4, H_2O(?).

Slightly attacked by acids. (Peligot, A. ch. (3) **12.** 539.)

Chromous iodide, CrI_2.

Easily sol. in H_2O. (Moissan, A. ch. (5) **25.** 401.)

Chromic iodide, CrI_3(?).

Insol. in cold, sol. in hot H_2O, but no separation occurs on cooling. (Berlin.)

$+9H_2O$. Hygroscopic. Sol. in alcohol and acetone. Insol. in $CHCl_3$. (Higley, J. Am. Chem. Soc. 1904, **26.** 628.)

Chromous iodide hydrazine, CrI_2, $2N_2H_4$.

(Traube, B. 1913, **46.** 1507.)

Chromium nitride, CrN.

Insol. in dil. acids and alkalies, conc. HNO_3, HCl, or HF+Aq, even on heating. Slowly sol. in hot aqua regia or cold H_2SO_4. Sol. in cold solutions of alkali hypochlorites. (Ufer, A. **112.** 281.)

Insol. in HCl, HNO_3 and aqua regia. (Férée, Bull. Soc. 1901, (3) **25.** 618.)

Unacted upon by acids at ordinary temperatures. (Smits, Chem. Soc. 1897, **72.** (2) 33.)

Cr_3N_2. Slowly attacked by conc. HNO_3 and by HNO_3+HCl. All other reagents are without action. (Henderson and Galletly, J. Soc. Chem. Ind. 1908, **27.** 387.)

CrN_3. See **Chromium azoimide.**

Chromous oxide, CrO.

Insol. in HNO_3 and dil. H_2SO_4+Aq.

Sol. in HCl. (Férée, Bull. Soc. 1901, (3) **25.** 619.)

Chromic oxide, Cr_2O_3.

When ignited is nearly insol. in acids, but dissolves in H_2SO_4 by long boiling. Insol. in liquid HCl. (Gore.)

Insol. in acetone. (Fidmann, C. C. **1899.** II, 1014.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 1.07 g. Cr_2O_3; 1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.56 g. Cr_2O_3; 1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.20 g. Cr_2O_3. (Bodenbender, J. B. **1865.** 600.)

See also **Chromic hydroxide.**

$+H_2O$. The compound to which Bunsen gave the formula Cr_5O_6. Insol. in acids, but easily attacked by HNO_3. (Férée, Bull. Soc. 1901, (3) **25.** 620.)

Chromochromic oxide, $Cr_3O_4=CrO$, Cr_2O_3.

Known only in form of hydroxide, which see.

$+3H_2O$. Stable in dry air. Decomp. in moist air. (Baugé, C. R. 1898, **127.** 552.)

Cr_4O_5, or Cr_5O_6 (?). Insol. in acids or in aqua regia. (Bunsen, Pogg. **91.** 622.)

Not obtainable. (Geuther, A. **118.** 66.)

Formula is $Cr_2O_3+H_2O$. (Férée.)

Chromium ***tri*****oxide,** CrO_3.

Deliquescent, and very sol. in H_2O, to form solution of H_2CrO_4 or $H_2Cr_2O_7$.

Solubility in H_2O at t°.

t°	0°	15°	50°	99°
% CrO_3	62.08	62.38	64.55	67.39

(Mylius and Funk, Gm. K. **3.** 1, 1332.)

Sat. CrO_3+Aq contains at:

0°	20°	60°
61.54	62.52	65.12% CrO_3.

(Koppel and Blumenthal, Z. anorg. 1907, **53.** 228.)

The system CrO_3-H_2O has been studied at temp. from 0°to−74°. In the limits of concentration investigated, from 0−71.2% CrO_3, no hydrate of CrO_3 cryst. from the aq. solution. (Kremann, M. 1911, **32.** 622.)

Sat. CrO_3+Aq contains at:

82°	100°	115°
66	67.4	68.4% CrO_3.

(Kremann, M. 1911, **32.** 620.)

Solubility in H_2O at°.

t°	% by wt. CrO_3	Solid phase.
−0.9°	3.6	Ice
−1.9	7.8	"
−3.7	11.5	"
−4.8	14.1	"
−10.95	24.9	"
−11.7	25.2	"
−18.75	33.5	"
−25.25	39.2	"
−43.5	49.1	"
−60	53.3	"
−20	61.7	CrO_3
0	62.24	"
+24.8	62.88	"
40	63.50	"
65	64.83	"
90	68.5	"
122	70.7	"
193-196	100	"

(Büchner and Prins, Z. phys. Ch. 1912, **81.** 114.)

Sp. gr. of CrO_3+Aq at t°.

t°	Sp. gr.	% CrO_3
16.0	1.0606	8.25
18.0	1.0679	8.79
14.5	1.0694	8.79
19.5	1.0957	12.34
19.0	1.1569	19.33
20.9	1.20269	31.83
20.1	1.20264	31.83
12.0	1.20714	31.83
35.0	1.20940	32.59
18.6	1.21914	32.59
15.2	1.22106	32.59
9.7	1.22384	32.59
22.0	1.3441	37.77
19.2	1.3448	37.82
22.0	1.34416	37.82
....	1.7028	62.23

(Zettnow, Pogg. **143.** 474.)

Sp. gr. of CrO_3+Aq (H_2CrO_4+Aq). M = according to Mendelejeff at 15°; Z = according to Zettnow, calculated by Gerlach (Z. anal. **27.** 300).

% CrO_3	M	Z	% CrO_3	M	Z
5	1.036	1.037	35	1.324	1.312
10	1.076	1.076	40	1.383	1.373
15	1.119	1.118	45	1.445	1.440
20	1.166	1.162	50	1.510	1.512
25	1.215	1.208	55	1.579	1.587
30	1.268	1.258	60	...	1.656

B.-pt. of CrO_3+Aq at ord. pressure.

B.-pt.	G. CrO_3 in 100 g. of the solution.
102°	10.81
104	24.08
107	36.47
110.5	45.15
116	54.56
120	61.54
127	71.24 sat. solution

(Koppel and Blumenthal, Z. anorg. 1907, **53.** 254.)

Sol. in H_2SO_4; the solubility is least when the acid contains 66% H_2SO_4 (Schrötter); 84.5% H_2SO_4 (Bolley).

Very sol. in H_2SO_4 of 1.85 sp. gr. Sl. sol. in cold $KHSO_4$+Aq. (Fritzsche.)

The statement that CrO_3 is insol. in acids is incorrect. 2.85 g. (ignited) are sol. in HNO_3 to the extent of 2.58 g. 0.81 g. (ignited) are sol. in HNO_3 to the extent of 0.77 g. (Jovitschitsch, M. 1909, **30.** 48.)

Practically insol. in $POCl_3$. (Walden, Z. anorg. 1910, **68.** 312.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in alcohol with decomp.

Sol. in anhydrous ether.

Sol. in acetic anhydride. (Fry, J. Am. Chem. Soc. 1911, **33.** 702.)

Sol. in acetone. (Naumann, B. 1904, 4328.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Chromium oxide, $Cr_5O_9 = 2Cr_2O_3$, CrO_3.

$Cr_8O_{15} = 3Cr_2O_3$, $2CrO_3$.

$CrO_2 = Cr_2O_3$, CrO_3.

$Cr_5O_{12} = Cr_2O_3$, $3CrO_3$.

$Cr_6O_{15} = Cr_2O_3$, $4CrO_3$.

See **Chromate, chromium.**

Chromium ***per*****oxide,** Cr_2O_7(?)

More sol. in ether than in H_2O. Ether solution is somewhat more stable than aqueous solution. (Aschoff, J. pr. **81.** 401.)

Formula is CrO_3, H_2O_2. (Moissan, C. R. **97.** 96.)

Chromium ***per*****oxide ammonia,** CrO_4, $3NH_3$.

Sol. in H_2O with partial decomp.

Sl. sol. in NH_4OH+Aq.

Sol. with decomp. in 20% acetic acid. (Hofmann, B. 1905, **38.** 3060.)

Chromium ***tetr*****oxide potassium cyanide,** CrO_4, 3KCN.

Sol. in H_2O. Insol. in other ordinary solvents. (Wiede, B. 1899, **32,** 381.)

Chromic oxychloride.

From Cr_2O_3. Sol. in H_2O as long as 1 mol. $CrCl_3$ is present for 2½ mols. $Cr_2O_6H_6$. (Ordway, Sill. Am. J. (2) **27.** 197.)

Cr_2O_3, $2CrCl_3$. Sol. in H_2O. (Kletzinsky, Zeit. Ch. **1866.** 277.)

Cr_2O_3, $CrCl_3 = CrOCl$. *Anhydrous.* Only partly sol. in H_2O.

$+3H_2O$. Very deliquescent, and sol. in H_2O. (Peligot.)

Cr_2O_3, $4CrCl_3+6H_2O = Cr_2OCl_4+2H_2O$. (Peligot, J. pr. **37.** 38.)

$+9H_2O = Cr_2OCl_4+3H_2O$. Sol. in H_2O (Moberg); $= Cr_2(OH)_2Cl_4+2H_2O$. (Schiff, A. **124.** 157.)

Cr_2O_3, $7CrCl_3 = Cr_3OCl_7$. Very sol. in H_2O with decomp. (Besson and Fournier, C. R. 1909, **148.** 1194.)

Cr_2O_3, $8CrCl_3+24H_2O$. Sol. in H_2O (Moberg); $= Cr_2(OH)Cl_5+4H_2O$. (Schiff, *l. c.*)

$(CrO_2)_3Cl_2$. (Pascal, C. R. 1909, **148.** 1464.)

$Cr_6O_9Cl_4$. Insol. in H_2O. (Pascal, C. R. 1909, **148.** 1464.)

From CrO_3.

See **Chromyl chloride.**

Chromic oxychloride potassium chloride, $CrOCl_3$, $2KCl$.

Decomp. in the air.

Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4043.)

Chromic oxychloride rubidium chloride, $CrOCl_3$, $2RbCl$.

Decomp. in the air.

Sol. in conc. HCl without decomp. (Weinland, B. 1906, **39.** 4045.)

Chromium oxyfluoride, CrO_2F_2.

See **Chromyl fluoride.**

Chromium phosphide, CrP.

Insol. in acids, but a trace dissolves in aqua regia. Insol. in HF+Aq. (Berzelius.)

Not attacked by acids or by aqua regia. (Granger, C. N. 1898, **77.** 228.)

Insol. in all acids except a mixture of HNO_3 and HF. (Maronneau, C. R. 1900, **130.** 658.)

Insol. in mineral acids. (Dieckmann, Z. anorg. 1914, **86.** 295.)

Insol. in aqua regia. (Granger, C. R. 1897, **124,** 191.)

Cr_2P_3. Insol. in mineral acids. (Dieckmann, Z. anorg. 1914, **86.** 295.)

Chromous selenide, CrSe.

(Moissan, C. R. **90.** 817.)

Chromic selenide, Cr_2Se_3.

Insol. in H_2O. (Moissan, C. R. **90.** 817.)

Chromic potassium selenide, $K_2Cr_2Se_4$.

Insol. in HCl. Easily sol. in conc. HNO_3. (Milbauer, Z. anorg. 1904, **42.** 451.)

Chromium silicide, Cr_2Si.

Sol. in fused KNO_3; insol. in cold HCl and aqua regia.

Insol. in HF+Aq. (Moissan, C. R. 1895, **121.** 625.)

$CrSi_2$. Sol. in HF. Insol. in HCl and aqua regia. (Chalmot, Am. Ch. J. 1897, **19.** 69.)

Cr_3Si_2. Insol. in dil. HCl; sol. in warm conc. HCl and in HF; insol. in HNO_3 and H_2SO_4. (Lebeau, C. R. 1903, **136.** 1330.)

Cr_3Si. Sol. in HF; insol. in other acids; sol. in fused KOH and fused alkali nitrates and carbonates. (Zettel, C. R. 1898, **126.** 834.)

Chromous sulphide, CrS.

Insol. in H_2O or K_2S+Aq. (Peligot.)

Easily sol. in acids. (Moissan, C. R. **90.** 817.)

Sol. in cold conc. acids.

Sol. in molten alkalies. (Mourlot, C. R. 1895, **121.** 944.)

Min. *Daubrelite.*

Chromic sulphide, Cr_2S_3.

Insol. in H_2O or alkali sulphides + Aq. Sl. attacked by HCl+Aq. (W. Müller, Pogg. **127.** 404.)

HNO_3+Aq decomposes or not according to method of preparation. Easily decomp. by aqua regia.

Insol. in caustic alkalies+Aq.

Insol. in K_2S+Aq. (Berzelius.)

Chromochromic sulphide, Cr_3S_4, $= CrS$, Cr_2S_3.

Insol. in H_2O, HCl, or dil. H_2SO_4+Aq. Easily sol. in HNO_3+Aq. (Gröger, W. A. B. **81.** (2) 531.)

Chromic zinc sulphide, Cr_2ZnS_4.

(Gröger, W. A. B. 1880, **81.** 534.)

Chromicyanhydric acid.

Cadmium chromicyanide, $Cd_3[Cr(CN)_6]_2$.

Readily sol. in an excess of KCN and in NH_4OH+Aq. Decomp. by conc. HCl, HNO_3 or H_2SO_4. Slowly decomp. by cold, rapidly by hot dil. HCl, HNO_3, or H_2SO_4. Quickly dissolved by aqua regia. Decomp. by boiling with Na_2O_2, by NaOH+Aq and by Na_2CO_3+Aq. Slowly decomp. by boiling acetic acid. (Cruser and Miller, J. Am. Chem. Soc. 1906, **28.** 1136.)

Cobaltous chromicyanide, $Co_3[Cr(CN)_6]_2$.

Sol. in cold, readily sol. in hot conc. HCl or H_2SO_4. Sl. sol. even in boiling conc.

HNO_3. Slowly sol. in cold dil. H_2SO_4, HCl or HNO_3. Readily sol. in boiling dil. HCl or H_2SO_4. Decomp. but not entirely dissolved by aqua regia. Readily sol. in an excess of KCN. Decomp. by NH_4OH, NaOH or Na_2CO_3+Aq. Decomp. by boiling with Na_2O_2. Insol. in cold or boiling acetic acid. (Cruser and Miller.)

Cuprous chromicyanide, $Cu_3Cr(CN)_6$.

Sol. in KCN, cold conc. or boiling dil HNO_3+Aq. Slowly sol. in cold conc. H_2SO_4, still more slowly sol. in dil. H_2SO_4 but rapidly sol. in hot dil. and conc. H_2SO_4. Readily decomp. by aqua regia. Decomp. by dil. or conc. HCl, slowly going into solution in the cold, but quickly on boiling. (Cruser and Miller.)

Cupric chromicyanide, $Cu_3[Cr(CN)_6]_2$.

Slowly sol. in cold dil. HCl, HNO_3 or H_2SO_4: on boiling the first two readily dissolve it, but the H_2SO_4 dissolves it only slowly. Sol. in aqua regia or cold conc. H_2SO_4. Readily sol. in cold or hot conc. HCl. Decomp. by cold, dissolved by boiling HNO_3. Decomp. by boiling Na_2O_2+Aq. Decomp. by NH_4OH, NaOH or Na_2CO_3+Aq. Readily sol. in an excess of KCN+Aq. Insol. in cold acetic acid. (Cruser and Miller.)

Nickel chromicyanide, $Ni_3[Cr(CN)_6]_2$.

Slowly sol. in cold, readily sol. in hot dil. HCl, HNO_3 or H_2SO_4. Slowly sol. in cold, readily sol. in hot conc. H_2SO_4, HCl or HNO_3. Slowly decomp. by cold, rapidly by boiling aqua regia. Readily sol. in excess of KCN. Sol. in NH_4OH+Aq. Decomp. by NaOH, Na_2CO_3+Aq or Na_2O_2+Aq. Insol. in cold, sl. sol. in boiling acetic acid. (Cruser and Miller.)

Potassium thallous chromicyanide, $K_2TlCr(CN)_6$.

(Fischer and Benzian, Ch. Z. 1902, **26.** 50.)

Thallous chromicyanide, $Tl_3Cr(CN)_6$.

Easily sol. in H_2O. (Fischer and Benzian, Ch. Z. 1902, **26.** 50.)

Zinc chromicyanide, $Zn_3[Cr(CN)_6]_2$.

Insol. in H_2O. Sol. in excess of NH_4OH, NaOH and KCN+Aq. Decomp. by Na_2CO_3 +Aq. Sol. in cold dil. HCl. Slowly sol. in dil. H_2SO_4 and in dil. HNO_3. By boiling with dil. acids a clear solution is quickly obtained. (Cruser, Dissert. **1906.**)

Chromisulphocyanhydric acid.

Cæsium chromisulphocyanide, $Cs_3Cr(SCN)_6+2H_2O$.

Less sol. in H_2O than K salt. (Osann, Dissert. **1907.**)

Lithium chromisulphocyanide, $Li_3Cr(SCN)_6+H_2O$.

Extremely deliquescent. (Osann.)

Rubidium chromisulphocyanide, $Rb_3Cr(SCN)_6+4H_2O$.

Appreciably less sol. in H_2O and alcohol than the K salt. (Osann.)

Chromocyandric acid, $H_4Cr(CN)_6$.

Decomp. rapidly on air. Sol. in H_2O (Moissan, A. ch. (6) **4.** 144.)

Potassium chromocyanide, $K_4Cr(CN)_6$.

Very sol. in H_2O; 100 pts. H_2O dissolve 32.33 pts. at 20°. Much more sol. in hot H_2O. Insol. in alcohol, ether, benzene, or chloroform. (Moissan, A. ch. (6) **4. 136.**)

Above salt was $K_3Cr(CN)_6$. (Christensen.)

$+3H_2O$. (Christensen, J. pr. (2) **31.** 166.)

Chromoiodic acid, CrO_3, HIO_3+2H_2O.

Deliquescent. (Berg, C. R. **104.** 1514.)

Ammonium chromoiodate, CrO_3, $NH_4IO_3+H_2O$.

Moderately sol. in H_2O. (Berg.)

Lithium chromoiodate, CrO_3, $LiIO_3+H_2O$.

Very sol. in H_2O. (Berg.)

Magnesium chromoiodate.

Sol. in H_2O. (Berg.)

Potassium chromoiodate, CrO_3, KIO_3.

Sol. in H_2O. (Berg.)

$+H_2O=KCrIH_2O_7$. Sl. decomp. by H_2O. (Blomstrand, J. pr. (2) **40.** 331.)

Silver chromoiodate, CrO_3, $AgIO_3$.

Sl. attacked by cold, rapidly decomp. by hot H_2O. (Berg, C. R. **111.** 42.)

Sodium chromoiodate, CrO_3, $NaIO_3+H_2O$.

Very sol. in H_2O. (Berg.)

Chromosulphocyanhydric acid.

Sodium chromosulphocyanide, $Na_3Cr(SCN)_5+10$, or $11H_2O$.

Unstable.

Decomp. by H_2O. (Koppel, Z. anorg. 1905, **45.** 360.)

Chromosulphuric acid, $H_2Cr_2(SO_4)_4$.

Sol. in H_2O in all proportions, but solution is easily decomp. on standing or boiling. (Recoura, Bull. Soc. (3) **9.** 586.)

$H_4Cr_2(SO_4)_5$. As above.

$H_6Cr_2(SO_4)_6$. As above.

Ammonium chromosulphate, $(NH_4)_2Cr_2(SO_4)_4+5H_2O$.

Sol. in H_2O after a few minutes. (Recoura.)

Chromium potassium chromosulphate, $[Cr_2(SO_4)_3CrO_4]K_2, [Cr_2(SO_4)_3(CrO_4)_2]K_4$, and $[Cr_2(SO_4)_3(CrO_4)_3]K_6$.

Sol. in H_2O. (Recoura, Bull. Soc. 1897, (3) **17.** 934.)

Potassium chromosulphate, $K_2Cr_2(SO_4)_4+4H_2O$.

Sol. in H_2O in a few minutes. (Recoura, Bull. Soc. (3) **9.** 590.)

Sodium chromosulphate, $Na_2Cr_2(SO_4)_4+10H_2O$.

As K salt. (Recoura.)

Chromotelluric acid.

Ammonium chromotellurate, $2(NH_4)_2O, 4CrO_3, TeO_3$.

Sol. in H_2O. (Berg, C. R. 1911, **152.** 1588.)

Potassium chromotellurate, $2K_2O, 4CrO_3, TeO_3$.

Sl. sol. in cold H_2O without decomp.
Sol. in boiling H_2O. (Berg, Bull. Soc. 1911, (4) **9.** 583.)

Chromous acid, $H_2Cr_2O_4=Cr_2O_3, H_2O$.

Chromic hydroxide shows slightly acid properties, and salts corresponding to the above acid are known.

Aluminum ferrous magnesium chromite (chrome iron ore), $(Fe, Mg)O, (Cr_2, Al_2)O_3$.

Insol. in H_2O or acids, even a mixture of H_2SO_4 and HF. (Ebelmen.)

Barium chromite, $BaCr_2O_4$.

Insol. in H_2O. (Gerber, Bull. Soc. (2) **27.** 436.)

Barium *tetra*chromite, $BaO, 4Cr_2O_3$.

Undecomp. by steam at red heat; insol. in HCl, H_2SO_4, HNO_3; sol. in fused $KOH+KNO_3$; decomp. in the air. (Dufau, C. R. 1896, **122.** 1126.)

Cadmium chromite, $CdCr_2O_4$.

Not attacked by acids. (Viard, C. R. **109.** 142.)

Calcium chromite, $CaCr_2O_4$.

Insol. in H_2O. (Gerber, Bull. Soc. (2) **27.** 436.)
Insol. in HCl, HF, HNO_3, H_2SO_4; sol. in gaseous HCl and HF at red heat; sol. in fused KOH, KNO_3, $KClO_3$, K_2CO_3. (Dufau, C. R. 1895, **121.** 690.)
$2CaO, Cr_2O_3$. Insol. in H_2O, KOH, or NH_4OH+Aq; slowly decomp. by H_2CO_3, or M_2CO_3+Aq; insol. in sugar solution. (Pelouze, A. ch. (3) **33.** 9.)
$4CaO, Cr_2O_3$. Attacked by H_2O. (Moissan, C. R. 1894, **119.** 188.)

Cobaltous chromite, $CoCr_2O_4$.

(Elliot, Dissert, Göttingen, **1862.**)

Cuprous chromite, Cu_2O, Cr_2O_3.

Insol. in HNO_3+Aq(sp. gr. 1.4). (Wöhler, Z. phys. Ch. 1908, **62.** 445.)

Cupric chromite basic, $5CuO, 4Cr_2O_3$.

(Wöhler, Z. phys. Ch. 1908, **62.** 445.)

Cupric chromite, $CuCr_2O_4$.

Not attacked by HNO_3+Aq. (Persoz, A. ch. (3) **25.** 283.)
Not attacked by conc. HCl.
Insol. in dil. acids. (Wöhler, Z. phys. Ch. 1908, **62.** 446.)
$CuO, 3Cr_2O_3$. (Rosenfeld, B. 1879, **12.** 958.)

Glucinum chromite, $GlCr_2O_4$.

Insol. in H_2O. (Mallard, C. R. **105.** 1260.)

Iron (ferrous) chromite (chrome iron ore).

See **Chromite, aluminum ferrous magnesium.**

Iron (ferroferric) chromite, FeO, Fe_2O_3, Cr_2O_3.

Not attacked by $HCl+Aq$. (Ebelmen.)

Iron (ferrous) magnesium chromite.

Insol. in $HCl+Aq$. Scarcely attacked by H_2SO_4.

Lead chromite, $PbCr_2O_4$.

Ppt. Insol. in $KOH+Aq$. (Chancel, C. R. **43.** 927.)

Lithium chromite, $Li_2Cr_2O_4$.

Very sl. sol. in acids. (Weyberg, C. C. **1906**, II. 1659.)

Magnesium chromite, $MgO, 2Cr_2O_3$.

Insol. in H_2O. (Nichols, Sill. Am. J. (2) **47.** 16.)
$MgCr_2O_4$. Insol. in acids or alkalies, except boiling H_2SO_4. (Schweitzer, J. pr. **39.** 259.)
Could not be obtained. (Viard, Bull. Soc. (3) **5.** 934.)
Easily attacked by boiling H_2SO_4+Aq. Less easily by HCl or $HF+Aq$ not attacked by boiling HNO_3. (Dufau, C. R. 1896, **123.** 886.)
$2MgO, Cr_2O_3$. Insol. in H_2O or acids. (Nichols.)
$5MgO, 4Cr_2O_3$. Insol. in acids. (Viard, C. R. **112.** 1003.)
$3MgO, 2Cr_2O_3$. As above. (V.)

Manganese chromite, $MnCr_2O_4$.

Entirely insol. in acids. (Ebelmen, A. ch. (3) **33.** 44.)

Zinc chromite, $ZnCr_2O_4$.

Insol. in acids and alkalies. (Viard, C. R. **109.** 142.)

$+xH_2O$. (Chancel, C. R. **43.** 927.)

$3ZnO, 2Cr_2O_3$. As above. (Viard. C. R. **112.** 1003.)

$6ZnO, 5Cr_2O_3$. As above. (V.)

$8ZnO, 3Cr_2O_3$. (Gröger, M. 1904, **25,** 520.)

Chromovanadic acid.

Ammonium chromovanadate, $2(NH_4)_2O, 2CrO_3, V_2O_5+7H_2O$.

Sol. in H_2O. (Ditte, C. R. **102.** 1105.)

Chromyl amide, $CrO_2(NH_2)_2$.

Sol. in H_2O. (Ohly, C. N. 1899, **80.** 134.)

Chromyl ***sub*****chloride,** $(CrO_2)_5Cl_6$.

Deliquescent, sol. in H_2O with decomp., insol. in dry ether. (Pascal, C. R. 1909, **148,** 1463.)

Chromyl chloride (chlorochromic acid), CrO_2Cl_2.

Decomp. by H_2O with evolution of much heat. Sol. in glacial acetic acid without decomposition.

Sol. in CCl_4, C_6H_6, (mol. wt. det.). (Oddo, Gazz. ch. it. 1899, **29.** (2) 318; Chem. Soc. 1900, **78.** (2) 75.)

Tri**chromyl chloride,** $Cr_3O_6Cl_2$.

Deliquescent. Sol. in H_2O with gradual decomposition. Sol. in conc. HCl+Aq. (Thorpe, Chem. Soc. (2) **8.** 31.)

Scarcely sol. in CS_2.

Sol. in alcohol and ether. (Rawson, C. N. 1889. **59.** 185.)

Chromyl chlorides.

From Cr_2O_3.

See **Chromium oxychlorides.**

Chromyl chloride nitrogen ***tet*****roxide,** $Cr_5Cl_6O_7, 2NO_2$.

Sol. in H_2O with decomp. (Thomas, C. R. 1899, **129.** 828.)

Chromyl fluoride, CrO_2F_2.

Decomp. by H_2O with evolution of heat. (Oliveri, Gazz. ch. it. **16.** 218.)

Clay.

See **Silicate, aluminum,** Al_2O_3, SiO_2+2H_2O.

Cobalt, Co.

Not attacked by H_2O.

Sol. in dil. HCl, or H_2SO_4, or HNO_3+Aq. Conc. hot H_2SO_4, and HNO_3 decomp. with evolution of SO_2 or NO gas.

Exists also in passive state. *See* **Iron.** (Nickles, J. pr. **61.** 186.)

Sol. in conc. KOH+Aq when in finely divided state. (Winkler, J. pr. **91.** 211.)

Sol. in NH_4OH+Aq in presence of air. (Hodgkinson and Bellairs, C. N. 1895, **71.** 73.)

Cobalt ammonia compounds.

See—

Anhydrooxycobaltamine compounds, $[Co(NH_3)_5]_2\begin{bmatrix}Cl\\O(OH)\end{bmatrix}X_4$.

Bromotetramine cobaltic compounds, $BrCo(NH_3)_4X_2$.

Bromopurpureocobaltic compounds, $BrCo(NH_3)_5X_2$.

Carbonatotetramine cobaltic compounds, $(CO_3)Co(NH_3)_4X$.

Chlorotetramine cobaltic compounds, $ClCo(NH_3)_4X_2$

Chloropurpureocobaltic compounds, $ClCo(NH_3)_5X_2$

Croceocobaltic compounds, $Co(NH_3)_4(NO_2)_2X$.

Decamine cobaltic sulphite, $Co_2(NH_3)_{10}(SO_3)_3$.

Diamine cobaltic nitrites, $Co(NH_3)_2(NO_2)_4M$.

Dichrocobaltic compounds, $Co(NH_3)_3X_3$.

Flavocobaltic compounds, $(NO_2)_2Co(NH_3)_4X$.

Fuscocobaltic compounds, $(OH)Co(NH_3)_4X_2$.

Iodotetramine cobaltic compounds, $ICO(NH_3)_4X_2$.

Luteocobaltic compounds, $Co(NH_3)_6X_3$.

Melanocobaltic compounds, $[Co(NH_3)_3Cl_2]_2, NH_2Cl$.

Nitratotetramine cobaltic compounds, $(NO_3)Co(NH_3)_4X_2$.

Nitratopurpureocobaltic compounds, $(NO)_3Co(NH_3)_5X_2$.

Nitritocobaltic compounds, $(NO_2)Co(NH_3)_5X_2$.

Octamine cobaltic compounds, $Co_2(NH_3)_8X_6$.

(=**Tetramine cobaltic compounds,** $Co(NH_3)_4X_3$.

Oxycobaltamine compounds, $Co_2(NH_3)_{10}(OOH)X_4$.

Praseocobaltic compounds, $Co(NH_3)_4X_3$.

Purpureocobaltic compounds, $Co(NH_3)_5X_3$.

Roseocobaltic compounds, $Co(NH_3)_5(OH_2)X_3$.

Sulphatotetramine cobaltic compounds, $(SO_4)Co(NH_3)_4X$.

Sulphatopurpureocobaltic compounds, $(SO_4)Co(NH_3)_5X$.

"Tetramine cobaltic" compounds, $Co(NH_3)_2X_3$.

Xanthocobaltic compounds, $(NO_2)Co(NH_3)_5X_2$.

Cobalt arsenide, CoAs.

As Co_3As_2. (Ducelliez, C. R. 1908, **147.** 425.)

$CoAs_2$. As Co_3As_2. (Ducelliez, C. R. 1908, **147.** 425.)

Co_2As_3. As Co_3As_2. (Ducelliez, C. R. 1908, **147.** 425.)

Co_3As_2. Very sl. attacked by hot conc. HCl, less by H_2SO_4. Easily sol. in HNO_3 and aqua regia. Sl. attacked by fused alkalies and alkali carbonates. (Ducelliez, C. R. 1908, **147.** 425.)

$CoAs_3$. Min. *Skutterudite*. Sol. in HNO_3+Aq, with separation of As_2O_3.

Cobalt arsenide sulphide, $CoAs_2$, CoS_2.

Min. *Cobaltite*. Sol. in HNO_3+Aq, with separation of S and As_2O_3.

Glaucodote. Completely sol. in HNO_3+Aq.

Cobalt azoimide, basic, $Co(OH)N_3$.

Insol. in H_2O.

Sol. in HN_3+Aq. (Curtius, J. pr. 1898, (2) **58.** 300.)

Cobalt potassium azoimide, KN_3, $Co(N_3)_2$.

Sol. in H_2O; Aq. solution decomp. on boiling. (Curtius, J. pr. 1898, (2) **58.** 301.)

Cobalt boride, Co_2B.

Attacked by HNO_3. (Jassonneix, C. R. 1907, **145.** 240.)

CoB. Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat and by acids. (Moissan, C. R. 1896, **122.** 425.)

Not attacked by HCl; rapidly attacked by HNO_3. Not attacked by dil. but decomp. by conc. H_2SO_4. Rapidly attacked by aqua regia. (Moissan, A. ch. 1896, (7) **9.** 272.)

CoB_2. (Jassonneix, C. R. 1907, **145.** 241.)

Cobaltous bromide, $CoBr_2$.

Deliquescent. Sol. in H_2O, alcohol, and ether.

Sat. $CoBr_2$+Aq contains at:

59°	75°	97°
66.7	66.8	68.1% $CoBr_2$.

(Étard, A. ch. 1894, (7) **2.** 542.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $SO_2Cl(OH)$. (Walden.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

1g. $CoBr_2$ is sol. in 9.74g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.013. (Naumann, B. 1909, **42.** 3792.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 24.)

+2, and $6H_2O$. (Hartley, Chem. Soc. (2) **12.** 214.)

Cobaltous hydrazine bromide hydrazine, $2CoBr_2$, $4N_2H_4HBr$, N_2H_4(?).

Sol. in H_2O with decomp. (Ferratini, C. A. **1912.** 1613.)

Cobaltous mercuric bromide, basic, $CoBr_2$, $HgBr_2$, $6CoO+20H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 369.)

Cobalt stannic bromide.

See **Bromostannate, cobalt.**

Cobaltous bromide ammonia, $CoBr_2$, $6NH_3$.

Sol. in H_2O with residue of cobalt hydroxide. (Rammelsberg, Pogg. **55.** 245.)

Cobaltous bromide hydrazine, $CoBr_2$, $2N_2H_4$.

Decomp. by boiling with H_2O. (Franzen, Z. anorg. 1908, **60.** 270.)

Cobalt carbonyl, $Co(CO)_4$.

Insol. in H_2O. More or less sol. in CS_2, ether, alcohol and $Ni(CO)_4$. Relatively stable with non-oxidizing acids. Quickly decomp. by oxiding acids. (Mond, Hirtz and Cowap, C. N. 1908, **98.** 165.)

Cobaltous chloride, $CoCl_2$.

Deliquescent. Sol. in H_2O with evolution of heat. 100 pts. H_2O dissolve 43.3 pts. $CoCl_2$ at 0°. (Engel, A. ch. (6) **17.** 355.)

100 pts. sat. $CoCl_2$+Aq at t° contain pts. $CoCl_2$.

t°	Pts. $CoCl_2$	t°	Pts. $CoCl_2$	t°	Pts. $CoCl_2$
−22	24.7	25	34.4	56	48.4
−4	28.0	34	37.5	78	48.8
+7	31.2	41	39.8	94	50.5
11	31.3	45	41.7	96	51.2
12	32.5	49	46.7	112	52.3

(Étard, C. R. **113.** 699.)

Sp. gr. of $CoCl_2$+Aq containing—

5	10	12	20	25% $CoCl_2$.
1.0496	1.0997	1.1579	1.2245	1.3002

Sat. solution, 1.3613.

(Franz, J. pr. (2) **5.** 284.)

Sp. gr. of $CoCl_2$+Aq containing in 1000 g. H_2O, g. $CoCl_2+6H_2O$—

119 g. (=½ mol.)	238	357	476	594
1.055	1.101	1.141	1.177	1.209

833	952	1071	1190
1.238	1.264	1.287	1.309

Containing g. $CoCl_2$ (anhydrous)—

65 g.(=½ mol.)	130	195	260	325	390
1.058	1.112	1.164	1.213	1.260	1.304

(Gerlach, Z. anal. **28.** 466.)

Sp. gr. of $CoCl_2$+Aq at room temp. containing:

7.97	14.858	22.27% $CoCl_2$.
1.0807	1.1613	1.2645

(Wagner, W. Ann. 1883, **18.** 267.)

Sp. gr. of $CoCl_2$+Aq at 20° containing M g mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001159	1.003052	1.006065	1.009190

M	0.10	0.25	0.50	0.75
Sp. gr.	1.012386	1.03049	1.05492	1.09118

M	1.0	1.5	2.0
Sp. gr.	1.11847	1.17502	1.23637

(Jones and Pearce, Am. Ch. J. 1907, **38.** 711.)

Sp. gr. of $CoCl_2$+Aq. at 25°.

Concentration of $CoCl_2$+Aq.	Sp. gr.
1—normal	1.0571
½— "	1.0286
¼— "	1.0144
⅛— "	1.0058

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

Solubility in HCl+Aq at 0°. $\frac{CoCl_2}{2}$ = ½ mols.

$CoCl_2$ in mgs. in 10 ccm. of solution. HCl = mols. HCl in mgs. in ditto. H_2O = g. H_2O.

$\frac{CoCl_2}{2}$	HCl	$CoCl_2$ +HCl	Sp. gr.	H_2O
62.4	0	62.4	1.343	9.36
58.525	3.7	62.2	1.328	9.34
50.8	11.45	62.25	1.299	9.27
37.25	25.2	62.45	1.248	9.13
12.85	55.0	67.85	1.167	...
4.75	74.75	79.50	1.150	8.46
12.0	104.5	116.5	1.229	7.5
25.0	139.0	164.0	1.323	...

(Engel, A. ch. (6) **17.** 355.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in alcohol.

Sat. solution in alcohol (0.792 sp. gr.) contains 23.66 % $CoCl_2$ and has sp. gr. = 1.0107. (Winkler, J. pr. **91.** 209.)

Very sol. in ether.

100 pts. absolute ether dissolve only 0.021 g. $CoCl_2$. (Bödtker, Z. phys. Ch. 1897, **22.** 511.)

100 g. formic acid (95%) dissolve 6.2 g. $CoCl_2$ at 20.2°. (Aschan, Ch. Z. 1913, **37.** 1117.)

1 g. $CoCl_2$ is sol. in 271 g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 0.938. (Naumann, B. 1909, **42.** 3791.)

Difficultly sol. in ethyl acetate. (Naumann B. 1910, **43.** 314.)

100 pts. acetone dissolve 8.62 pts. anhydrous $CoCl_2$. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

0.08 pts. sol. in 100 pts. ethyl acetate at 14°.
0.26 " " " 100 " " " 79°.
9.11 " " " 100 " acetone " 0°.
9.28 " " " 100 " " " 22.5°.

(Laszczynski, B. 1894, **27,** 2286.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

1 g $CoCl_2$ is sol. in 36.4 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.825. (Naumann, B. 1904, **37.** 4334.)

100 g. acetonitrile dissolve 4.08 g. $CoCl_2$ at 18° (Naumann and Schier, B. 1914, **97.** 249.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Solubility in pyridine at t°.

t°	G. $CoCl_2$ sol. in 100 g. pyridine	Solid phase
−50.3	0.4200	$CoCl_2$, $6C_5H_5N$
−45.0	0.4204	
−30.0	0.4224	
−19.6	0.4227	
−10.0	0.4329	
0	0.4326	
+23.0	0.572	$CoCl_2$, $4C_5H_5N$
25.0	0.578	
34.6	0.755	
37.6	0.760	
44.6	0.959	
47.2	1.029	
51.0	1.122	
55.0	1.206	
60.0	1.342	
64.2	1.483	
68.0	1.597	
74.8	2.079	$CoCl_2$, $2C_5H_5N$
78.2	2.330	
79.8	2.488	
88.0	3.397	
96.5	7.817	$CoCl_2$
98.8	8.862	
106.0	14.340	
110.0	16.500	

(Pearce and Moore, Am. Ch. J. 1913, **50.** 226.)

Mol. weight determined in piperidine, and pyridine. (Werner Z. anorg. 1897, **15.** 18 and 23.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

+H_2O.

$+2H_2O$. Very deliquescent. (Bersch, J. B. **1867**. 291.)

17.16 pts. sol. in 100 pts. acetone at 0°.
17.06 " " 100 " " " 25°.
(Laszczynski, B. 1894, **27**. 2287.)

$+4H_2O$. Deliquescent. (Bersch.)

$+6H_2O$. Not deliquescent. Easily sol. in H_2O.

Solubility of $CoCl_2+6H_2O$ in ethyl alcohol +Aq at 11.5° under addition of increasing amounts of $CoCl_2$.

P = Percent of alcohol by volume.
G = Grams of $CoCl_2$ added.
C_c = Grams of $CoCl_2$ in 5 cc. of the solution.
C_w = Grams of water in 5 cc. of the solution, calculated from
(1) the water content of the alcohol.
(2) the water of crystallization which had gone into solution.
(3) the water held mechanically in $CoCl_2+6H_2O$.

P	G	Cw	Cc
91.3	0.0	1.325	1.168
98.3	0 0	1.134	1.214
98.3	0 0	1.068	1.181
99.3	0.0	1.045	1.199
"	0.194	0 899	1 204
"	0.400	0.829	1.325
"	0.612	0.764	1.459
"	0.813	0.688	1.568
"	1.022	0.634	1.713
"	1.240	0.553	1.831
"	1.446	0.483	1.943
"	0.650	0.500	2.186

(Bödtker, Z. phys. Ch. 1897, **22**. 508.)

Easily soluble in absolute ethyl alcohol. 100 pts. absolute alcohol dissolve at room temperature 56.20 pts. $CoCl_2$. Water precipitates $CoCl_2+6H_2O$ from a solution of $CoCl_2$ in absolute alcohol. (Bödtker.)

100 pts. absolute ether dissolve 0.291g. $CoCl_2+6H_2O$. (Bödtker, Z. phys. Ch. 1897, **22**. 511.)

Anhydrous ethylene glycol dissolves 10.6% $CoCl_2+6H_2O$ at 16.4°. (de Coninck, Chem. Soc. 1904, **86**, (2) 741.)

Cobaltous hydrazine chloride, $CoCl_2, 2N_2H_4HCl+2\frac{1}{2}H_2O$.

Sol. in H_2O. (Ferratini, C. A. **1912**. 1613.)

Cobaltous iodine chloride, $CoCl_2, 2ICl_3+8H_2O$.

Hygroscopic. Decomp. by H_2O. CCl_4 separates ICl_3. (Weinland and Schlegelmilch, Z. anorg. 1902, **30**. 137.)

Cobalt lithium chloride, $CoCl_2, LiCl+3H_2O$.

Very deliquescent. Sol. in H_2O with decomp. Sol. in LiCl+Aq without decomp. Sol. in alcohol without decomp. (Chassevant, A. ch. (6) **30**. 27.)

Cobaltous mercuric chloride basic, $CoCl_2, HgCl_2, 6CoO+20H_2O$.

(Mailhe, A. ch. 1902, (7) **27**. 369.)

Cobaltous mercuric chloride, $CoCl_2, HgCl_2$.

Very deliquescent. (v. Bonsdorff.)

Cobaltous thallic chloride, $2TlCl_3, CoCl_2+8H_2O$.

Hydroscopic; can be cryst. from H_2O. (Gewecke, A. 1909, **366**. 222.)

Cobaltous tin (stannic) chloride, $CoCl_2, SnCl_4+6H_2O$.

See **Chlorostannate, cobaltous.**

Cobaltous chloride ammonia, $CoCl_2, 2NH_3$.

Decomp. by H_2O. (F. Rose.)

$CoCl_2, 4NH_3$. Decomp. by H_2O. (H. Rose.)

$CoCl_2, 6NH_3$. Decomp. by H_2O. Sol. in dil. NH_4OH+Aq with ease, but difficultly in conc. NH_4OH+Aq. Insol. in absolute alcohol. (Fremy.)

Cobaltous chloride hydrazine, $CoCl_2, 2N_2H_4$.

Insol. in cold H_2O.

Slowly decomp. by cold, rapidly by hot H_2O.

Easily sol. in dil. acids and NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60**. 270.)

Cobaltous chloride hydroxylamine, $CoCl_2, 2NH_2OH$.

Decomp. in the air; sol. in H_2O. (Feldt, B. 1894. **27**. 403.)

Cobaltic chloride hydroxylamine, $CoCl_3, 6NH_2OH$.

Insol. in alcohol.

Sol. in acidified H_2O without decomp.; sol. in conc. H_2SO_4 without decomp. (Feldt, B. 1894, **27**. 404.)

Cobaltous fluoride, CoF_2.

Sl. sol. in H_2O; insol. in alcohol and ether; slowly attacked by cold HCl, H_2SO_4, or HNO_3+Aq. (Poulenc, C. R. **114**. 1429.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **29**. 827.)

$+2H_2O$. Sol. in a little H_2O without decomp. Decomp. into oxyfluoride by boiling with much H_2O. Sol. in HF+Aq. (Berzelius.)

$+4H_2O$. Two modifications.

Solubility of α mod. at ?° = 2.2328 %
" " β " " " = 2.3203 %.

(Costachescu, Ann. Sci. Univ. Jassy, 1912, **7**, 1, 10.)

Cobaltic fluoride, CoF_3.

Sol. in conc. H_2SO_4. (Barbieri, Chem. Soc. 1905, **88**, (2) 393.)

Cobaltous hydrogen fluoride, CoF_2, $5HF+6H_2O$.

Easily sol. in H_2O and dil. acids.

Sol. in NH_4OH+Aq with decomp. (Böhm, Z. anorg. 1905, **43.** 330.)

Cobalt columbium fluoride.

See **Fluocolumbate, cobalt.**

Cobaltous iron (ferric) fluoride, CoF_2, FeF_3+7H_2O.

Sol. in dil. $HF+Aq$. (Weinland, Z. anorg. 1899, **22.** 269.)

Cobaltous manganic fluoride, $2CoF_2$, $Mn_2F_6+8H_2O$.

(Christensen, J. pr. (2) **34.** 41.)

Cobalt molybdenyl fluoride.

See **Fluoxymolybdate, cobalt.**

Cobaltous potassium fluoride, CoF_2, KF.

Sl. sol. in H_2O; less in ethyl or methyl alcohol; insol. in amyl alcohol or benzene. Decomp. by hot H_2SO_4. (Poulenc, C. R. **114.** 747.)

$+H_2O$. Sl. sol. in H_2O. (Wagner, B. **19.** 896.)

CoF_2, $2KF$.

Cobaltous sodium fluoride, CoF_2, $NaF+H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Cobaltous stannic fluoride.

See **Fluostannate, cobaltous.**

Cobalt vanadium fluoride.

See **Fluovanadate, cobalt.**

Cobaltous hydroxide, CoO_2H_2.

Insol. in H_2O. Sol. in acids. Insol. in $KOH+Aq$. Sol. in ammonium sulphate, chloride, nitrate, or succinate$+Aq$. (Brett.)

Sol. in warm acetic acid; insol. in NH_4OH+Aq and cold NH_4Cl+Aq, but sol. in warm NH_4Cl+Aq. (de Schulten, C. R. **109.** 266.)

Insol. in H_2O and dil. $KOH+Aq$; somewhat sol. in conc. $KOH+Aq$; easily sol. in NH_4 salts$+Aq$. (Fresenius.)

Easily sol. in $KCN+Aq$. (Rodgers, **1834.**)

Sol. in conc. K_2CO_3+Aq. (Gmelin.)

Not pptd. by $KOH+Aq$ in presence of $H_2C_4H_4O_6$ or NH_4 citrate. (Spiller.)

Sol. in large amt. in boiling $NH_4SCN+Aq$. (Grossmann, Z. anorg. 1908, **58.** 269.)

Insol. in methyl, or amyl amine $+Aq$. (Wurtz.)

Many non-volatile organic substances prevent its pptn.

Cobaltic hydroxide, $3Co_2O_3$, $2H_2O$.

(Mills, Phil. Mag. (4) **35.** 257.)

Co_2O_3, $2H_2O$. Decomp. by $HCl+Aq$; gives brown solutions with cold HNO_3 or H_2SO_4+Aq, which soon decomp. (Wernicke, Pogg. **141.** 120.)

$Co_2O_6H_6=Co_2O_3$, $3H_2O$. Sol. in warm HCl, HNO_3, and H_2SO_4, with decomp. (Proust.)

Sol. in cold H_3PO_4, H_2SO_4, HNO_3, or $HCl+Aq$, but decomp. on standing or warming. (Winkelblech.)

Sol. in racemic, tartaric, oxalic, or citric acid as cobaltous salt.

Sol. in conc. acetic acid without immediate decomp. (Remele). Solution is not decomp. by boiling. Sol. in warm sat. $(NH_4)_2C_2O_4+Aq$ with decomp.

Not attacked by cold or hot NH_4OH+Aq.

Insol. in boiling NH_4Cl+Aq.

Sol. when freshly pptd. in $(NH_4)_2SO_3+Aq$. (Geuther, A. **128.** 157.)

Cobaltocobaltic hydroxide, Co_3O_4, $3H_2O$.

Insol. in H_2O. Sol. in oxalic acid; solution decomp. by heat. Sol. in $HCl+Aq$ with evolution of Cl. (Gibbs and Genth, Sill. Am. J. (2) **23.** 257.)

Co_3O_4, $7H_2O$. Sol. in weak acids, especially $HC_2H_3O_2$ without decomp. (Fremy.)

Co_6O_7, $6H_2O$. Min. *Heterogenite.* Sol. in dil. $HCl+Aq$ with evolution of Cl.

Cobaltous iodide, CoI_2.

Deliquescent, and very sol. in H_2O.

100 pts. sat. CoI_2+Aq at t° contain pts. CoI_2.

t°	Pts. CoI_2	t°	Pts. CoI_2	t°	Pts. CoI_2
—22	52.4	14	61.6	60	79.2
— 8	56.7	25	66.4	82	80.7
— 2	58.7	34	73.0	111	80.9
+ 9	61.4	46	79.0	156	83.1

(Étard, C. R. **113.** 699.)

Sol. in $SO_2(OCH_3)_2$. (Walden, Z. anorg. 1902, **29.** 388.)

Sol. in $SOCl_2$. (Walden, Z. anorg. 1900, **25.** 216.)

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25.** 214.)

Easily sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.) (Naumann, B. 1904, **37.** 4328.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Sol. in methyl acetate. (Naumann, B. 1909, **42,** 3790.)

$+2H_2O$.

$+4H_2O$. Very deliquescent. (Étard.)

$+6H_2O$. (Hartley, Chem. Soc. (2) **12.** 214.)
$+9H_2O$. Very hydroscopic. (Bolschakoff, C. C. **1898,** II. 660.)

Cobaltous lead iodide, 2 CoI_2, PbI_2+3H_2O.
Decomp. by H_2O. (Mosnier, A. ch. 1897, (7) **12.** 412.)

Cobaltous mercuric iodide, CoI_2, HgI_2+6H_2O.
Partially decomp. by H_2O.
Sol. in alcohol and acetone. (Dobroserdoff, C. C. **1901,** II. 332.)
CoI_2, $2HgI_2+6H_2O$. Decomp. by H_2O; sol. in alcohol and acetone. (Dobroserdoff, C. C. **1901,** II. 332.)

Cobaltous iodide ammonia, CoI_2, $4NH_3$.
Decomp. by H_2O. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **48.** 155.)
CoI_2, $6NH_3$. Insol. in NH_4OH+Aq. (Rammelsberg.)

Cobaltous iodide hydrazine, CoI_2, $2N_2H_4$.
Sl. sol. in H_2O. Easily sol. in acids. (Franzen, Z. anorg. 1911, **70.** 147.)

Cobaltic octamine compounds.
See **Octamine cobaltic compounds.**

Cobaltous oxide, CoO.
Insol. in H_2O. Easily sol. in dil. or conc. HCl or HNO_3+Aq. Slowly sol. in cold, but easily in hot dil. H_2SO_4+Aq, acetic, or tartaric acid +Aq. Insol. in NH_4OH+Aq. Sol. in hot NH_4Cl +Aq, KOH, or NaOH+Aq. (Rose.)
Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett, **1834.**)
Insol. in K_2CO_3+Aq. Sol. in boiling Co and Ni nitrates +Aq, with pptn. of the oxides. (Persoz.)
Easily sol. in dil. acids, even tartaric, acetic, and oxalic acids. Not attacked by NH_4OH+Aq. Sol. in 13% NH_4Cl+Aq with evolution of NH_3; also in $NH_4SCN+Aq$. Sol. in warm conc. NaOH, and KOH+Aq. (Zimmerman, A. **232.** 324.)
Solubility in (calcium sucrate+sugar)+Aq.
1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 1.56 g. CoO; 1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.29 g. CoO. (Bodenbender, J. B. **1865.** 600.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
See also **Cobaltous hydroxide.**

Cobaltic oxide, Co_2O_3.
Decomp. by most acids, even in the cold, with formation of cobaltous salts. Sol. in acetic acid without immediate decomp.
See also **Cobaltic hydroxide.**

Cobaltocobaltic oxide, $Co_3O_4=CoO, Co_2O_3$.
Insol. in boiling conc. HCl, HNO_3, or aqua regia. Sol. by long standing with H_2SO_4. (Gibbs and Genth, Sill. Am. J. (2) **23.** 257.)
See also **Cobaltocobaltic hydroxide.**
$Co_4O_5=2CoO, Co_2O_3$.
$Co_6O_7=4CoO, Co_2O_3$. Not attacked by boiling dil. HNO_3 or H_2SO_4+Aq. (Beetz.)
$Co_8O_9=6CoO, Co_2O_3+20H_2O$. Sol. in dil. acids, with residue of Co_2O_3, which dissolves on warming. (Gentele, J. pr. **69.** 131.)
$+8H_2O$. As above. (Gentele.)

Cobaltous oxychloride, $CoCl_2$, $3CoO+3\frac{1}{2}H_2O$.
Ppt. Very sl. sol. in H_2O. (Habermann, M. **5.** 432.)

Cobaltous oxychloride hydroxylamine, CoOCl, $2NH_2OH$.
Insol. in H_2O; unstable; insol. in alcohol. (Feldt, B. 1894, **27.** 404.)

Cobaltous oxyfluoride, CoO, CoF_2+H_2O.
Ppt. (Berzelius, Pogg. **1.** 26.)

Cobaltous oxyiodide, CoO, CoI_2.
Insol. in H_2O. (Rammelsberg.)

Cobaltous oxysulphide, CoO, CoS.
Cold HCl+Aq dissolves out CoO; hot HCl+Aq decomp. with evolution of H_2S. (Arfvedson, Pogg. **1.** 64.)

Cobalt phosphide, Co_2P.
Sol. in conc. HNO_3. Slowly attacked by HCl and H_2SO_4. (Maronneau, C. R. 1900, **130.** 658.)
Sol. in HNO_3, aqua regia, and in fused alkalies. (Granger, Bull. Soc. 1896, (3) **15.** 1089.)
Co_2P_3. Insol. in HNO_3 and aqua regia; stable in the air even when heated. (Granger, Bull. Soc. 1896, (3) **15.** 1087.
Co_3P_2. Insol. in conc. HCl+Aq. Sol. in HNO_3+Aq. (Rose, Pogg. **24.** 332.)

Cobalt ***sub*****selenide,** Co_2Se.
Sol. in bromine water.
Only sl. attacked by boiling fuming HCl. (Fonzes-Diacon, C. R. 1900, **131.** 704.)

Cobalt ***mono*****selenide,** CoSe.
(Little, A. **112.** 211.)

Cobalt ***di*****selenide** $CoSe_2$.
Sol. in Br_2+Aq.
Only sl. attacked by boiling fuming HCl. (Fonzes-Diacon, C. R. 1900, **131.** 705.)

Cobalt *sesqui*selenide, Co_2Se_3.

Sol. in Br_2+Aq.

Only sl. attacked by boiling fuming HCl. (Fonzes-Diacon, C. R. 1900, **131.** 704.)

Cobalt selenide, Co_3Se_4.

Sol. in Br_2+Aq.

Only sl. attacked by boiling fuming HCl. (Fonzes-Diacon, C. R. 190, **131.** 704.)

Cobalt silicide, Co_2Si.

Sol. in HF and aqua regia. Insol. in cold H_2O. Decomp. by steam at red heat. Sol. in fused alkali carbonates. (Vigouroux, C. R. 1895, **121.** 687.)

CoSi. Insol. in HNO_3 and H_2SO_4. Sol. in aqua regia and HCl, and in fused KOH. (Lebeau, C. R. 1901, **132.** 557.)

Not attacked by dil. or conc. HNO_3, or conc. H_2SO_4. Sol. in aqua regia and in conc. HCl.

Not attacked by dil. alkali hydroxides + Aq.; attacked by fused alkali. (Lebau, Bull. Soc. 1901, (3), **25.** 540.)

$CoSi_2$. Sl. sol. in hot conc. HCl and hot conc. alkali + Aq. Sol. in HF; insol. in HNO_3 and H_2SO_4. (Lebeau, C. R. 1902, **135.** 476.)

Cobaltous sulphide, CoS.

Anhydrous. Easily sol. in acids, even $HC_2H_3O_2$, but only slowly in the latter case. (Hjortdahl, C. R. **65.** 75.)

Not attacked by cold dil. HCl+Aq. (Ebelmen, A. ch. (3) **25.** 94.)

Min. *Seypoorite.*

$+xH_2O$. 1 l. H_2O dissolve $41.62+10^{-6}$ moles CoS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Sol. in conc. mineral acids; very sl. sol. in cold dil. acids; scarcely sol. in acetic acid. (Wackenroder.)

Sol. when still moist in SO_2+Aq. (Berthier.)

Easily sol. in HNO_3, but only very sl. sol. in HCl+Aq. Not pptd. from very dil. acid solutions by H_2S.

Insol. in H_2O, alkalies, and alkali carbonates, or sulphides + Aq. (Fresenius.)

Insol. in NH_4Cl, and NH_4NO_3+Aq. (Brett.)

When pptd. by $(NH_4)_2S$+Aq, shows a brown colour in presence of 200,000 pts. H_2O. (Pfaff.)

Tartaric acid, etc. does not hinder the pptn. by $(NH_4)_2S$+Aq. (Rose.)

Sol. in potassium thiocarbonate + Aq. (Rosenbladt, Z. anal. **26.** 15.)

Sol. in Na_2S_x or K_2S_x+Aq. (de Koninck, Zeit. angew. Ch. **1891.** 202.)

Cobaltic sulphide, Co_2S_3.

Partially decomp. by HCl+Aq; sol. in HNO_3+Aq with decomposition.

Sl. attacked by HCl+Aq; and slowly even by aqua regia. (Schneider, J. pr. (2) **9.** 209.)

Min. *Cobalt pyrite.*

$+xH_2O$. Insol. in KCN+Aq. (Fleck, J. pr. **97.** 303.) More sol. in HCl+Aq than CoS_2. (Dingler, Berz, J. B. **10.** 139.)

Cobaltoccbaltic sulphide, Co_3S_4.

Min. *Linnæite.* Sol. in warm HNO_3+Aq, with residue of S.

Cobalt *di*sulphide, CoS_2.

Not attacked by alkalies or acids except HNO_3 and aqua regia. (Setterberg, Pogg. **7.** 40.)

Cobalt sulphide, Co_4S_3.

Easily sol. in hot HCl with evolution of H_2S (and H_2?). (Proust.)

Cobalt potassium sulphide, $K_2Co_{11}S_{10}$.

Slowly sol. in cold HCl and aqua regia. Quickly sol. in warm aqua regia.

Sol. in HF and H_2SO_4 only on warming.

Insol. in $(NH_4)_2S$, organic acids, alkalies, 12% HCl+Aq and KCN+Aq. (Milbauer, Z. anorg. 1904, **42.** 447.)

Cobalt telluride, CoTe.

(Fabre, C. R. **105.** 673.)

Cobalt decamine sulphurous acid.

See **Decamine cobaltisulphurous acid.**

Cobaltic acid.

Potassium cobaltate, $K_2Co_9O_{16}+2H_2O$, or $3H_2O$.

Insol. in H_2O (Pebal, A. **100.** 262), but decomp. by long boiling. Sol. in conc. acids.

K_2O, $xCoO_3$. Sol. in H_2O. (Winkler, J. pr. **91.** 351.)

Does not exist. (Donath, W. A. B. **102, 2b.** 71.)

Cobalticyanhydric acid, $H_3Co(CN)_6+\frac{1}{2}H_2O$.

Deliquescent. Very sol. in H_2O and only sl. decomp. on boiling.

Sol. in HCl+Aq without decomp. even on boiling. Sl. sol. in conc., more sol. in dil. HNO_3+Aq. Not decomp. by boiling conc. HNO_3+Aq or aqua regia. Insol. in conc., sl. sol. in dil. H_2SO_4+Aq. Sol. in alcohol. Insol. in ether. (Zwenger, A. **162.** 157.)

Ammonium cobalticyanide, $(NH_4)_3Co(CN)_6+\frac{1}{2}H_2O$.

Very sol. in H_2O; sl. sol. in alcohol.

Ammonium barium cobalticyanide, $NH_4BaCo(CN)_6+H_2O$.

Sol. in H_2O. (Weselsky.)

Ammonium calcium cobalticyanide, $NH_4CaCo(CN)_6+10H_2O$.

Sol. in H_2O.

Ammonium lead cobalticyanide, $NH_4PbCo(CN)_6+3H_2O$.

Sol. in 8.31 pts. H_2O at 18°, and sl. sol. in 93% alcohol. (Schuler.)

Ammonium mercuric cobalticyanide, $(NH_4)_6Co_2Hg(CN)_{14}+H_2O$.

Sol. in H_2O with decomp.

Insol. in alcohol. (Soenderop, Dissert. **1899.**)

Ammonium sodium cobalticyanide, $NH_4Na_2Co(CN)_6$.

Only sl. sol. in H_2O. (Weselsky, B. **2.** 598.)

Ammonium strontium cobalticyanide, $NH_4SrCo(CN)_6+9H_2O$.

Sol. in H_2O. (W.)

Barium cobalticyanide, basic, $Ba_3[Co(CN)_6]_2$, BaO_2H_2.

Not very stable. Cannot be recryst. without partial decomp. (W.)

Barium cobalticyanide, $Ba_3[Co(CN)_6]_2+10H_2O$.

Sl. efflorescent. Very sol. in H_2O. Insol. in alcohol.

Barium cobalticyanide chloride, $Ba_3[Co(CN)_6]_2$, $BaCl_2+16H_2O$.

Sol. in H_2O without decomp. (W.)

Barium lithium cobalticyanide, $BaLiCo(CN)_6+15H_2O$.

The most sol. of the double cobalticyanides. (Weselsky.)

Barium potassium cobalticyanide, $BaKCo(CN)_6+11H_2O$.

Sol. in H_2O. (W.)

Bismuth cobalticyanide $BiCo(CN)_6$.

Ppt. (Mathews, J. Am. Chem. Soc. 1900, **22.** 275.)

$+5H_2O$. Moderately stable with dil. min. acids; more stable with conc. acids than Cd or Zn comp.

Decomp. by NH_3 and alkalies. (Fischer and Cuntze, Ch. Z. 1902, **26.** 872.)

Cadmium cobalticyanide, $Cd_3[Co(CN)_6]_2+7\frac{1}{2}H_2O$.

Attacked by strong min. acids only when hot. Behaves as Zn salt, toward conc. H_2SO_4 and dil. and conc. HCl.

Insol. in $K_3Co(CN)_6$+Aq. Sol. in NH_4OH and NH_4Cl+Aq. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Cadmium potassium cobalticyanide, $KCdCo(CN)_6$.

Not attacked by H_2O. (Fischer and Cuntze, Ch. Z. **1902.** 26, 873.)

Cadmium sodium cobalticyanide, $NaCdCo(CN)_6$.

(Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Cadmium cobalticyanide ammonia, $Cd_3[Co(CN)_6]_2$, $4NH_3+2H_2O$.

(Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

$Cd_3[Co(CN)_6]_2$, $5NH_3+3H_2O$. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

$Cd_3[Co(CN)_6]_2$, $7NH_3$. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

$Cd_3[Co(CN)_6]_2$, $9NH_3+2H_2O$. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Calcium potassium cobalticyanide, $CaKCo(CN)_6+9H_2O$.

Sol. in H_2O. (W.)

Cobaltous cobalticyanide, $Co_3[Co(CN)_6]_2+14H_2O$.

Insol. in H_2O and acids. Sl. sol. in NH_4OH+Aq. Decomp. by KOH+Aq.

Cupric cobalticyanide, $Cu_3[Co(CN)_6]_2+7H_2O$.

Insol. in H_2O and acids. Sol. in NH_4OH++Aq.

Cupric cobalticyanide ammonia, $Cu_3[Co(CN)_6]_2$, $4NH_3+7H_2O$.

Sol. in H_2O. (Zwenger.)

Lead cobalticyanide, basic, $Pb_3[Co(CN)_6]_2$, $3PbO_2H_2+11H_2O$.

Insol. in H_2O or alcohol; somewhat sol. in hot $Pb(C_2H_3O_2)_2$+Aq. (Schuler.)

Lead cobalticyanide, $Pb_3[Co(CN)_6]_2+4H_2O$.

Very sol. in H_2O. Insol. in alcohol. (Zwenger.)

$+7H_2O$. Sol. in 1.77 pts. H_2O at 18°, and 1.63 pts. at 19.° Insol. in absolute alcohol. Sl. sol. in 93% alcohol. (Schuler, W. A. B. **79.** 302.)

Lead potassium cobalticyanide, $PbKCo(CN)_6+3H_2O$.

Sol. in 6.74 pts. H_2O at 18° and much more easily in hot H_2O. Insol. in absolute, sl. sol. in 93% alcohol. (Schuler.)

Lead cobalticyanide nitrate, $Pb_3[Co(CN)_6]_2$, $Pb(NO_3)_2+12H_2O$.

Sol. in 16.91 pts. H_2O at 18°, 16.79 pts. at 19°, and much less hot H_2O.

Nearly insol. in 93% alcohol. (Schuler.)

Mercurous cobalticyanide, $Hg_3Co(CN)_6$.

Ppt. Decomp. by HCl. Not attacked by cold, but by hot conc. H_2SO_4. Not attacked by HNO_3, acetic or oxalic acid. Decomp. by alkalies+Aq. (Miller and Mathews, J. Am. Chem. Soc. 1900, **22.** 64.)

Mercuric cobalticyanide, $Hg_3[Co(CN)_6]_2$.
Sl. sol. in H_2O, decomp. by boiling.
Insol. in alcohol and ether. Not attacked by HCl. (Soenderop, Dissert, **1899.**)

Mercuric potassium cobalticyanide, $K_6HgCo_2(CN)_{14}$.
Sol. in H_2O with decomp. Insol. in alcohol. Sl. sol. in ether. (Soenderop, Dissert, **1899.**)
$K_6Hg_3Co_4(CN)_{24}$. (Soenderop, Dissert. **1899.**)

Mercuric sodium cobalticyanide, $Na_6Hg_3Co_4(CN)_{24}+4H_2O$.
Extremely deliquescent. (Soenderop, Dissert, **1899.**

Nickel cobalticyanide, $Ni_3[Co(CN)_6]_2+12H_2O$.
Insol. in H_2O and acids. Not attacked by boiling HCl+Aq. Sol. in NH_4OH+Aq. Decomp. by KOH+Aq.

Nickel cobalticyanide ammonia, $Ni_3[Co(CN)_6]_2$, $4NH_3+7H_2O$.
Insol. in H_2O.

Potassium cobalticyanide, $K_3Co(CN)_6$.
Easily sol. in H_2O. Insol. in alcohol.

Potassium strontium cobalticyanide, $KSrCo(CN)_6+9H_2O$.
Sol. in H_2O. (Weselsky.)

Potassium thallium cobalticyanide, $K_3Tl_3[Co(CN)_6]_2$.
More sol. in H_2O than corresponding K salt. (Fischer and Benzian, Ch. Z. 1902, **26.** 49.)

Potassium zinc cobalticyanide, $KZnCo(CN)_6+3H_2O$.
(Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Potassium cobalticyanide mercuric chloride, $2K_3Co(CN)_6$, $3HgCl_2$.
(Soenderop, Dissert. **1899.**)

Potassium cobalticyanide mercuric iodide, $4K_3Co(CN)_6$, HgI_2.
Sol. in H_2O with subsequent decomp. Sol. in alcohol and ether with decomp. (Soenderop, Dissert, **1899.**)

Silver cobalticyanide, $Ag_3Co(CN)_6$.
Insol. in H_2O and acids. Sol. in NH_4OH+Aq.

Silver cobalticyanide ammonia, $Ag_3Co(CN)_6$, $NH_3+\frac{1}{2}H_2O$.
Insol. in H_2O. (Zwenger.)

Sodium cobalticyanide, $Na_3Co(CN)_6+2H_2O$.
Easily sol. in H_2O; insol. in alcohol.

Sodium zinc cobalticyanide, $NaZnCo(CN)_6+H_2O$.
(Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Strontium cobalticyanide, $Sr_3[Co(CN)_6]_2+10H_2O$.
Very sol. in H_2O. (Weselsky.)

Thallium cobalticyanide, $Tl_3Co(CN)_6$.
100 pts. H_2O dissolve 3.6 pts. at 0°, 5.86 pts. at 9.5°, 10.04 pts. at 19.5°. (Fronmüller, B. **11.** 91.)

Yttrium cobalticyanide, $YCo(CN)_6+2H_2O$
Nearly insol. in H_2O. (Cleve.)

Zinc cobalticyanide, $Zn_3[Co(CN)_6]_2+12H_2O$.
Sol. in HCl+Aq and salt is pptd. by dilution with H_2O. Decomp. by H_2SO_4. Insol. in $K_4Co(CN)_6$+Aq. Sol. in NH_4OH and NH_4Cl+Aq. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)

Zinc cobalticyanide ammonia, $Zn_3[Co(CN)_6]_2$, $5NH_3$.
Decomp. by H_2O and acids. (Fischer and Cuntze, Ch. Z. 1902, **26.** 873.)
$Zn_3[Co(CN)_6]_2$, $6NH_3$. (Fischer and Cuntze.)
$+3H_2O$. (Fischer and Cuntze.)
$Zn_3[Co(CN)_6]_2$, $10NH_3+9H_2O$. Decomp. by H_2O. (Fischer and Cuntze.)

Cobaltimolybdic acid.

Ammonium barium cobaltous cobaltimolybdate, $\frac{1}{2}(NH_4)_2O$, $1\frac{1}{2}BaO$, CoO, CoO_2, $10MoO_3+18\frac{1}{2}H_2O$.
Difficultly sol. in H_2O. (Friedheim and Keller, B. 1906, **39.** 4306.)

Ammonium cobaltous cobaltimolybdate, $2(NH_4)_2O$, CoO, CoO_2, $10MoO_3+12H_2O$.
Much more sol. in H_2O than $3(NH_4)_2O$, CoO, CoO_2, $12MoO_3+20H_2O$. Sp. gr. of cold sat. solution = 1.096. (Friedheim and Keller.)
$3(NH_4)_2O$, CoO, CoO_2, $12MoO_3+20H_2O$.
100 cc. cold sat. aqueous solution contain 3 g. of the salt. Sp.gr. of the solution = 1.0234. Sol. in conc. HCl.
Decomp. by conc. H_2SO_4, by KOH+Aq and by NaOH+Aq. (Friedheim and Keller.)

Barium cobaltous cobaltimolybdate, $3BaO$, CoO, CoO_2, $9MoO_3+25H_2O$.
Sl. sol. in H_2O. (Friedheim and Keller.)

Cobaltous potassium cobaltimolybdate, CoO, $3K_2O$, CoO_2, $10MoO_3+10H_2O$. (Kurnakoff, Ch. Z. 1890, **14.** 113.)

$+11H_2O$. Sol. in conc. HCl. Decomp. by KOH+Aq and by NaOH+Aq. (Friedheim and Keller.)

$3K_2O$, CoO, CoO_2, $12MoO_3+15H_2O$. Sl. sol. in H_2O. Sol. in conc. HCl. Decomp. by KOH+Aq and by NaOH+Aq. (Friedheim and Keller.)

$+20H_2O$. (Kurnakoff, Ch. Z. 1890, **14.** 113.)

Potassium cobaltimolybdate, $3K_2O$, CoO_2, $9MoO_3+6\frac{1}{2}H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 703.)

Cobaltinitrocyanhydric acid.

Potassium cobaltinitrocyanide, $K_4Co_2(CN)_9NO_2+3H_2O$.

Very sol. in H_2O but quickly decomp. Insol. in alcohol. (Rosenheim and Koppel, Z. anorg. 1898, **17.** 68.)

Silver cobaltinitrocyanide, $Co_2Ag_5NO_2(CN)_{10}+6H_2O$, and $+21H_2O$.

(Rosenheim and Koppel.)

Sodium cobaltinitrocyanide, $Na_6Co_4(NO_2)(CN)_{10}+11H_2O$.

Very deliquescent. Sol. in H_2O. (Rosenheim and Koppel.)

Cobaltisulphurous acid, $H_6Co_2(SO_3)_6$.

Not obtained in a solid state. (Berglund, Acta Lund. **1872.**)

Cobaltisulphites.

The cobaltisulphites are insol. or at least very sl. sol. in H_2O. (Berglund, Acta Lund. **1872.** 23.)

Ammonium cobaltous cobaltisulphite, $(NH_4)_2SO_3$, $2CoSO_3$, $Co_2(SO_3)_3+14H_2O=(NH_4)_2Co_2Co_2(SO_3)_6+14H_2O$.

Scarcely sol. in H_2O, but decomp. thereby. Easily sol. in acids, when finely divided; also in H_2SO_3+Aq. (Berglund.)

$2(NH_4)_2SO_3$, $CoSO_3$, $Co_2(SO_3)_3+8H_2O=(NH_4)_4CoCo_2(SO_3)_6+8H_2O$. As above. (Berglund.)

Barium cobaltisulphite. $3BaSO_3$, $Co_2(SO_3)_3+12H_2O=Ba_3Co_2(SO_3)_6+12H_2O$.

Ppt. Insol. in H_2O. Not attacked by cold acids even H_2SO_4, but is decomp. by boiling therewirth. (Berglund, Acta Lund. **1872.**)

Bismuth cobaltisulphite, $Bi_2Co_2(SO_3)_6$.

Insol. in H_2O, dil. HNO_3, or HCl+Aq. (Berglund, Acta Lund. **1872.** 31.)

Calcium cobaltisulphite, $Ca_3Co_2(SO)_3)_6$.

Ppt. Insol. in H_2O or HCl+Aq. (Berglund, Acta Lund. **1872.** 30.)

Cobaltous cobaltisulphite, $Co_3Co_2(SO_3)_6=3CoSO_3$, $Co_2(SO_3)_3$.

Ppt. (Berglund, B. **7.** 470.)

Cobaltous potassium cobaltisulphite, $CoK_4Co_2(SO_3)_6$.

Insol. in H_2O. (Berglund.)

Silver cobaltisulphite, $Co_2(SO_3)_3$, $3Ag_2SO_3$.

Properties as the following comp. (Berglund.)

Silver cobaltous cobaltisulphite, $CoSO_3$, $Co_2(SO_3)_3$, $2Ag_2SO_3+9H_2O$.

Insol. in H_2O. Insol. in HNO_3+Aq. Decomp. by HCl or H_2S+Aq. (Berglund.)

Sodium cobaltous cobaltisulphite.

Decomp. by H_2O, so that it has not been obtained pure. (Berglund, Acta Lund. **1872,** 29.)

Cobaltoctamine sulphurous acid.

See **Octamine cobaltisulphurous acid.**

Cobaltocobalticyanhydric acid, $H_3Co_3(CN)_{11}$.

Unstable. (Jackson and Comey, Am. Ch. J. **1897.** 19, 277.)

Barium cobaltocobalticyanide, $BaHCo_3(CN)_{11}+1\frac{1}{2}H_2O$.

Somewhat sol. in H_2O when pure.

The crude salt is insol. even in hot H_2O. (Jackson and Comey.)

Cupric cobaltocobalticyanide, $Cu_3Co_6(CN)_{22}+4H_2O$.

Ppt. (Jackson and Comey.)

Potassium hydrogen cobaltocobalticyanide, $K_2HCo_3(CN)_{11}+2H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O.

Insol. in alcohol. (Jackson and Comey.)

$KH_2Co_3(CN)_{11}+H_2O$. Insol. in cold or hot H_2O when impure.

The pure salt is slowly sol. in cold H_2O. More sol. in warm H_2O. (Jackson and Comey.)

Silver cobaltocobalticyanide, $Ag_3Co_3(CN)_{11}+H_2O$.

Ppt. (Jackson and Comey, B. 1896, **29.** 1021.)

Zinc cobaltocobalticyanide, $ZnHCo_3(CN)_{11}+3H_2O$.

Ppt. (Jackson and Comey.)

Cobaltocyanhydric acid, $H_4Co(CN)_6$.

Very unstable. Sol. in H_2O. Insol. in alcohol.

Cuprous potassium cobaltocyanide, $K_2CuCo(CN)_6$.

(Straus, Z. anorg. 1895, **9.** 17.)

Potassium cobaltocyanide, $K_4Co(CN)_6$.

Decomp. on air. Very deliquescent, and sol. in H_2O. Insol. in alcohol and ether. (Descamps, Zeit. Ch. **1868.** 952.)

Cobaltous acid.

Barium cobaltite, $BaCoO_3$.

Insol. in H_2O or dil. $HC_2H_3O_2$+Aq. Sol. in HCl+Aq. (Rousseau, C. R. **109.** 64.)

$BaCo_2O_5$. As above. (Rousseau.)

Cobaltous potassium cobaltite, $3CoO_2$, CoO, K_2O.

Rapidly hydrolysed by H_2O.

Sol. in conc. HCl. (Bellucci, Chem. Soc. 1907, **92,** (2) 354.)

Magnesium cobaltite, $MgCoO_3$.

Insol. in H_2O, NH_4OH, or $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4Cl+Aq, from which it is pptd. by KOH+Aq. (Berzelius, Pogg. **33.** 126.)

Sol. in HF, HCl, $HNO_3+H_2SO_4$; decomp. and partially dissolved by NH_4OH+Aq; quite stable when heated. (Dufau, C. R. 1896, **123.** 240.)

Potassium cobaltite.

According to Bellucci and Dominici the compounds formerly described are more or less decomp. by hydrolysis. (C. C. **1907.** I, 1530.)

Sodium cobaltite.

Sol. in NaOH+Aq, but pptd. by diluting the solution.

Columbic acid (Niobic acid), $3Cb_2O_5$, $4H_2O$, or $3Cb_2O_5$, $7H_2O$.

Easily sol. in HF; very sl. sol. in HCl+Aq, but is sol. in H_2O after being treated with HCl+Aq. Sol. in conc. H_2SO_4. Sol. in KOH+Aq. Insol. in NaOH+Aq, but becomes sol. in H_2O by being treated with NaOH+Aq. Sol. in boiling Na_2CO_3+Aq. (Rose, Pogg. **113.** 109.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Cb_2O_5, $4H_2O$.

Cb_2O_5, $7H_2O$. (Santesson, Bull. Soc. (2) **24.** 52.)

Aluminum columbate, Al_2O_3, $3Cb_2O_5+12H_2O$.

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1652.)

Barium columbate, 7BaO, $6Cb_2O_5+18H_2O$.

Ppt. (Bedford, J. Am. Chem. Soc. 1905, **27.** 1218.)

Cadmium columbate, CdO, Cb_2O_5.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson, Z. anorg. 1896, **12.** 199.)

$+3\frac{1}{2}H_2O$. Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1652.)

Cæsium columbate, $4Cs_2O$, $3Cb_2O_5+14H_2O$.

Very sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1654.)

$7Cs_2O$, $6Cb_2O_5+30H_2O$. Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1655.)

Calcium columbate, 2CaO, Cb_2O_5.

Insol. in H_2O. (Joly, C. R. **81.** 266.)

CaO, Cb_2O_5. Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson, Z. anorg. 1896, **12.** 198.)

Cobalt columbate, CoO, Cb_2O_5.

Sol. in conc. boiling H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson.)

Copper columbate, CuO, Cb_2O_5.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson.)

$+3\frac{1}{2}H_2O$. Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1652.)

Iron (ferrous) columbate, $Fe(CbO_3)_2$.

Min. *Columbite.* Insol. in acids.

Iron (ferrous) columbate tantalate, $xFe(TaO_3)_2$, $yFe(CbO_3)_2$.

Min. *Tantalite.* Not attacked by acids.

$Fe(CbO_3)_2$, $4Fe(TaO_3)_2$. Min. *Tapiolite.*

Lithium columbate, $7Li_2O$, $6Cb_2O_5+26H_2O$.

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1655.)

Magnesium columbate, MgO, Cb_2O_5.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $KHSO_4$ at red heat. (Larsson, Z. anorg. 1896, **12.** 196.)

$+4H_2O$. Precipitate. (Rammelsberg.)

$+7H_2O$. Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1651.)

4MgO, Cb_2O_5. Insol. in H_2O. (Joly, C. R. **81.** 266.)

3MgO, Cb_2O_5. As above.

Manganous columbate.

Insol. in H_2O. (Joly, C. R. **81.** 266.)

3MnO, $5Cb_2O_5$. Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson, Z. anorg. 1896, **12.** 201.)

Potassium columbate, $KCbO_3$.

Sol. in H_2O. (Joly, in Fremy's Encyc. Ch.)

$K_2Cb_4O_7+5\frac{1}{2}H_2O$. Insol. in H_2O. (Santesson.)

$K_2Cb_6O_{16}+5H_2O$. Nearly insol. in H_2O.

$K_4Cb_2O_7+11H_2O$. Insol. in H_2O. (Santesson, Bull. Soc. (2) **24.** 53.)

$K_4Cb_8O_{22}+11H_2O$. (Santesson.)

$K_6Cb_4O_{13}+13H_2O$. Sol. in H_2O.

$K_8Cb_6O_{19}+16H_2O$. Efflorescent. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 20.)

Very sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1652.)

$K_{14}Cb_{12}O_{37}+27H_2O$. Sol. in H_2O. Insol. in alcohol. (E. F. Smith.)

$K_{16}Cb_{14}O_{43}+32H_2O$. Sol. in H_2O.

Potassium sodium columbate, $3K_2O$, Na_2O, $3Cb_2O_5+9H_2O$.

Very slightly sol. in H_2O. Insol. in alkalies. (Marignac.)

Rubidium columbate, $3Rb_2O$, $4Cb_2O_5+9\frac{1}{2}H_2O$.

(E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1655.)

$4Rb_2O.3Cb_2O_5+14H_2O$. Very sol. in H_2O. (E. F. Smith.)

Silver columbate, Ag_2O, $Cb_2O_5+2H_2O$.

Ppt. (E. F. Smith.)

$7Ag_2O$, $6Cb_2O_5+5H_2O$. Insol. in H_2O. (Bedford, J. Am. Chem. Soc. 1905, **27.** 1218.)

Sodium columbate, $NaCbO_3+3\frac{1}{2}H_2O$.

Completely sol. in H_2O. (Rose).

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1651.)

$+2\frac{1}{2}H_2O$. Sl. sol. in cold H_2O. Insol. in $NaOH+Aq$. (Santesson.)

$2Na_2O$, $3Cb_2O_5+9H_2O$. Insol. in H_2O or $NaOH+Aq$. (Santesson.)

$8Na_2O$, $7Cb_2O_5$. 1 pt. is sol. in 195–200 pts. H_2O at 14–20°; in ether 75–80 pts. or in 103 pts. boiling water. (Rose.)

$7Na_2O$, $6Cb_2O_5+32H_2O$. Very stable. Sol. in H_2O. (Bedford, J. Am. Chem. Soc. 1905, **27.** 1217.)

Thorium columbate, $5Th_2O$, $16Cb_2O_5$.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson, Z. anorg. 1896, **12.** 202.)

Yttrium columbate, Y_2O_3, Cb_2O_5.

Insol. in H_2O. (Joly, C. R. **81.** 1261.)

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson.)

Zinc columbate, ZnO, Cb_2O_5.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson.)

$7ZnO$, $6Cb_2O_5+25H_2O$. Insol. in H_2O. (Bedford, J. Am. Chem. Soc. 1905, **27.** 1218.)

Zirconium columbate, ZrO_2, $5Cb_2O_5$.

Sol. in boiling conc. H_2SO_4; insol. in most acids; decomp. by $HKSO_4$ at red heat. (Larsson.)

*Per*columbic acid.

See **Percolumbic acid.**

Columbium (Niobium), Cb.

Scarcely attacked by HCl, HNO_3, or aqua regia. Conc. H_2SO_4 dissolves easily on warming.

Sol. in fused oxidizing agents; sol. in hot conc. H_2SO_4 and in HF; also in $HF+HNO_3$; insol. in other acids. (Moissan, C. R. 1901, **133.** 24.)

Columbium ***penta*****bromide,** $CbCr_5$.

(Rose, Pogg. **104.** 422.)

Columbium carbide nitride, 3CbC, 2CbN.

(Joly, Bull. Soc. (2) **25.** 506.)

Columbium ***tri*****chloride,** $CbCl_3$.

Not deliquescent; not attacked by H_2O, but easily oxidised by HNO_3+Aq. Insol. in NH_4OH+Aq. (Roscoe, C. N. **37.** 25.)

Columbium ***penta*****chloride,** $CbCl_5$.

Decomp. by H_2O with separation of a hydrate of Cb_2O_5. Sol. in cold $HCl+Aq$, forming a solution which soon gelatinises, and separates out Cb_2O_5 by heat or dilution; with hot $HCl+Aq$, forms a cloudy solution which does not gelatinise. Sol. in H_2SO_4 to form a clear liquid which gelatinises on heating. Sol. in $KOH+Aq$. Sol. in alcohol with slight residue. (Rose, Pogg. **104.** 432.)

Columbium ***penta*****fluoride,** CbF_5.

Very hydroscopic; sol. in H_2O without separation of columbic acid. (Ruff, B. 1909, **42.** 492.)

Columbium fluoride with MF.

See **Fluocolumbate, M.**

Columbium hydride, CbH(?).

Insol. in HCl, HNO_3, and dil. H_2SO_4+Aq, even on boiling. Sol. in boiling conc. H_2SO_4 and in fused $KHSO_4$. Sol. in cold $HF+Aq$ if not too dilute. Also attacked by $KOH+Aq$. (Marignac, N. Arch. Phys. Nat. **31.** 89.)

Not attacked by boiling H_2O, or boiling HCl.

Oxidized by hot H_2SO_4. Insol. in boiling HNO_3. (Muthmann, A. 1907, **355.** 90.)

Columbium hydroxide Cb_2O_5, xH_2O.

See **Columbic acid.**

Columbium nitride.

Not attacked by boiling nitric acid or aqua regia, but sol. in a cold mixture of HNO_3 and HF. (Rose, Pogg. **111.** 426.)

Cb_3N_5. Not attacked by boiling H_2O or HCl. Insol. in conc. HNO_3, and H_2SO_4.

Decomp. by fused KOH. Not attacked by boiling with KOH+Aq. (Muthmann, A. 1907, **355.** 94.)

Columbium *di*oxide, Cb_2O_2.

Sol. when still moist in boiling dil. HCl+Aq. Insol. in hot HNO_3; less sol. in aqua regia than in HCl+Aq. Sol. in conc. H_2SO_4 after long heating. (Rose.)

Insol. in H_2O, KOH, or conc. acids, even when boiling. (Delafontaine.)

Columbium *tri*oxide, Cb_2O_3.

Insol. in acids except HF. (Smith, Z. anorg. 1894, **7.** 28.)

Columbium *tetr*oxide, Cb_2O_4.

Not attacked by cold or hot H_2O, HCl, HNO_3, H_2SO_4, or aqua regia. Slightly attacked by boiling KOH+Aq. (Delafontaine.)

Columbium *pent*oxide, Cb_2O_5.

When ignited insol. in hot conc. H_2SO_4. When it has not been ignited it forms a clear solution with H_2SO_4, which can be diluted without forming any precipitate. (Rose, Pogg. **112.** 549.)

Sol. in fused $KHSO_4$, which can be diluted with H_2O without causing pptn. Insol. in HF.

Columbium oxybromide, $CbOBr_3$.

Decomp. by H_2O into Cb_2O_5 and HBr. Sol. in hot H_2SO_4 and conc. HCl+Aq. (Rose, Pogg. **104.** 442.)

$3H_2O$, Cb_2O_4, HBr(?). Easily sublimed. (Smith, Z. anorg. 1894, **7.** 97.)

Columbium oxybromide rubidium bromide, $CbOBr_3$, 2RbBr.

Unstable in moist air. Decomp. by H_2O. (Weinland, B. 1906, **39.** 3059.)

Columbium oxychloride, $CbOCl_3$.

Attracts H_2O from air without deliquescing and decomposed. Decomp. with H_2O with evolution of heat. Insol. in hot or cold HCl+Aq. Sol. by long contact with H_2SO_4 to a cloudy liquid, which clears up on warming, but soon separates out Cb_2O_5. Sol. in cold KOH+Aq and hot K_2CO_3+Aq. (Rose.)

Sol. in alcohol, from which it is precipitated by ether. (Blomstrand.)

$3H_2O$, Cb_2O_4, HCl. Sublimate. (Smith, Z. anorg. 1894, **7.** 97.)

Columbium oxychloride rubidium chloride, $CbOCl_3$, 2RbCl.

Decomp. by H_2O. (Weinland, B. 1906, **39.** 3057.)

Columbium oxyfluoride, $CbOF_3$.

(Joly, C. R. **81.** 1266.)

Columbium oxyfluoride *with* MF.

See **Fluoxycolumbate,** *and* **Fluoxyhypocolumbate, M.**

Columbium oxysulphide, Cb_2OS_3.

Insol. in boiling HCl+Aq. Slowly decomp. into Cb_2O_5 by boiling with HNO_3 or aqua regia. Insol. in boiling dil. H_2SO_4+Aq. Converted into columbic sulphate, sol. in H_2O, by boiling conc. H_2SO_4. Sl. sol. in hot HF. Insol. in boiling K_2S+Aq. (Rose, Pogg. **111.** 193.)

Copper, Cu.

Copper is not attacked by distilled H_2O, or by NH_4NO_3, KNO_3 or $(NH_4)_2SO_4$+Aq, or by a mixture of those salts in solution. (Muir, cited by Carnelly, Chem. Soc. **30.** 1.)

Distilled H_2O has slight action on Cu. 100 ccm. H_2O dissolved from 2 sq. dcm. Cu from 0.035 mg. Cu in one hour up to 0.280 mg. in 72 hours. 100 ccm. H_2O dissolved 0.44 mg. from 6 sq. dcm. in 48 hours. Presence of solder diminishes solubility about one-half. At 90–100° the amount dissolved is about one-half that at ord. temp. (Carnelley, Chem. Soc. **30.** 1.)

100 ccm. distilled H_2O dissolved only 1 mg. Cu from 11.8 sq. cm. during a week, while air free from CO_2 was conducted through the solution. When the air contained CO_2, 3 mg. were dissolved. (Wagner, Dingl. **221.** 259.)

100 l. sea water dissolved 12.96 g. Cu from 1 sq. m. (Calvert and Johnson, C. N. **11.** 171.)

Solubility in H_2SO_4.

Not attacked by dil. H_2SO_4+Aq. (Vogel, Schw. J. **32.** 301.)

Action of H_2SO_4 at ordinary temp. is very slight even after a long time. (Barruel, J. Pharm. **20.** 13 [**1834**].)

H_2SO_4 has no action below 130°. (Calvert and Johnson, Chem. Soc. **19.** 438.)

H_2SO_4 acts slightly even at 20.°

16.3 g. H_2SO_4 (1.843 sp. gr.) dissolved the following amts. from 3 g. Cu, having a surface of 65 sq. cm. at the given temp.

Temp.	Time	% Cu dissolved
19°	14 days	About 6
60	120 min.	2.5
80	30 "	1.5
100	30 "	3.1
124	30 "	22.7
130	30 "	32.6
137	30 "	35 0
150	30 "	69.2
170	10 "	51.92
195	2 "	53.5
220	½ "	70.57
270	few seconds	nearly 100

With dilute acid the action was much less violent, as is seen in the following table—

Tem.	Time	Acid	Sp. gr.	% Cu dissolved
100°	30 min.	H_2SO_4	1.843	2.380
100	30 "	$2H_2SO_4, H_2O$	1.8295	0.585
100	30 "	H_2SO_4, H_2O	1.780	0
100	30 "	$H_2SO_4, 2H_2O$	1.620	0
130	30 "	H_2SO_4	1.843	32.6
130	30 "	H_2SO_4, H_2O	1.780	1.18
130	30 "	$H_2SO_4, 2H_2O$	1.620	0
165	15 "	H_2SO_4	1.843	70
165	30 "	H_2SO_4, H_2O	1.780	16.5
165	30 "	$H_2SO_4, 2H_2O$	1.620	2.7

(Pickering, Chem. Soc. **33.** 112.)

Cu is very sl. attacked by cold HCl+Aq of 1.12 sp. gr., but somewhat more on warming. Even less sol. in dil. HCl+Aq. (Löwe, Z. anal. **4.** 361.)

Sol. in warm conc. HI+Aq. (Rose.)

Slowly attacked by H_2SO_3+Aq. (Causse, Bull. Soc. (2) **45.** 3.)

More or less sol. in all dil. mineral acids and also in organic acids, as acetic, tartaric, etc., when supply of air is afforded; but absolutely insol. in the latter acids when air is wholly excluded. The importance of this fact in the use of Cu cooking utensils is manifest.

Easily attacked by ord. HNO_3+Aq.

With very conc. HNO_3+Aq (sp. gr. 1.52) it becomes passive, as in the case of Fe.

Pure dil. HNO_3+Aq of 1.07 sp. gr. or less does not attack Cu at 20°, but if NO_2 or KNO_2, is added the action begins at once. If HNO_3+Aq is more conc. the Cu is attacked. HNO_3+Aq of 1.108 sp. gr. begins to act at −2°, and of 1.217 sp. gr. at −10°.

HNO_3+Aq of 1.512 sp. gr. attacks Cu violently at 20°, but action soon ceases on account of formation of a crust of $Cu(NO_3)_2$, insol. in pure HNO_3. (Millon, A. ch. (3) **6.** 95.)

Easily sol. in 2N-$HClO_3$+Aq at 50°. (Hendrixson, J. Am. Chem. Soc. 1904, **26.** 756.)

Not appreciably sol. in anhydrous HF. (Poulenc, A. ch. 1894, (7) **2.** 12.)

When in contact with the air, Cu is soon oxidised by acids, alkalies (especially NH_4OH +Aq), and many fatty bodies.

Sol. in $(NH_4)_2CO_3$+Aq. (Traube, B. **18.** 1887.)

Slowly sol. in NH_4OH+Aq. (Schönbein, B. A. B. **1856.** 580.)

Sol. in KI+Aq when warm and conc. (Rose.)

When finely divided, Cu is easily sol. in hot $FeCl_3$+Aq.

Action of dilute solutions of salts on solubility of Cu in H_2O.

100 ccm. solution of the following salts dissolve the amts. of Cu given below, from a surface of 1 sq. dcm. in 48 hours.

Salts	G. salt dissolved in 100 ccm. H_2O	Mg. Cu dissolved
H_2O	....	0.11
KNO_3	0.01	0.07
	0.05	0.13
	5.00	0.16
$NaNO_3$	0.05	0.18
	5.00	0.19
$CaSO_4$	0.05	0.11
K_2SO_4	0.05	0.12
	5.00	0.28
$MgSO_4$	0.05	0.16
	5.00	0.34
Na_2CO_3	0.01	0.05
	0.05	0.11
	5.00	2.80
K_2CO_3	0.05	0.14
	5.00	2.35
NaCl	0.01	0.05
	0.05	0.18
	5.00	7.50
KCl	5.00	8.17
$(NH_4)_2SO_4$	0.05	0.66
	5.00	28.50
NH_4NO_3	0.01	0.17
	0.05	0.66
	5.00	60.00
NH_4Cl	0.05	0.92
	5.00	158.75

At 100° the action of KNO_3, K_2SO_4, and NH_4NO_3 is diminished, while that of $(NH_4)_2SO_4$, Na_2CO_3, and NaCl is increased.

Tables are also given for mixtures of the above salts. (Carnelley, Chem. Soc. **30.** 1.)

Solubility of Cu in dilute salt solutions.

11.8 sq. cm. Cu were used, and the action continued one week, while air with or without CO_2 was passed through the solution continually.

100 ccm. solution of the following salts dissolved the given amts. Cu.

Salt	G. salt dissolved in 100 ccm. H_2O	Mg. Cu dissolved without CO_2	Mg. Cu dissolved with CO_2
$NaCl$	0.50	4	115
KCl	0.50	4	115
$MgCl_2$	0.83	5	112
NH_4Cl	1.00	904	138
K_2SO_4	1.00	0	4
KNO_3	1.00	0	3
Na_2CO_3	1.00	0	...
$NaOH$	0.923	0	...
CaO_2H_2	sat.	0	...

(Wagner, Dingl. **221.** 260.)

Distilled H_2O dissolved no Cu from 420 sq. mm. in 150 hours at ord. temp.

NH_4NO_3+Aq with less than 0.4 g. per litre showed the same result.

KNO_3+Aq or $(NH_4)_2SO_4$+Aq containing 0.1 to 0.2 g. per litre dissolved no Cu.

H_2O containing carbonates+nitrates, carbonates+sulphates, or chlorides+nitrates also dissolved no Cu.

NH_4NO_3+Aq containing 0.4 g. per litre dissolved 3 mg. per litre after 150 hours contact.

From a surface of 2100 sq. m. of Cu, H_2O charged with CO_2 at ord. pressure, and containing the following salts in solution, dissolved the given amts. Cu. in 120 hours.

Salt	G. salt dissolved in 1 l. H_2O	Mg. Cu dissolved
H_2O	....	1.0
K_2CO_3	0.2	0.2
$CaCl_2$	0.2	1.80
NH_4NO_3	0.02	1.40
NH_4NO_3	0.04	1.40
K_2CO_3+	0.1	
NH_4NO_3	0.02	1.00
K_2CO_3+	0.2	
NH_4NO_3	0.04	0.1
NH_4NO_3+	0.2	
$CaCl_2$	0.2	3.6

From a surface of 2100 sq. m., H_2O charged with CO_2 at pressure of 6 atmos. dissolved 0.6 mg. in 48 hours.

H_2O when charged with CO_2 at 6 atmos. and containing:

16 mg. NH_4NO_3 per litre, dissolved 0.8 mg. in 48 hours.

80 mg. NH_4NO_3 per litre, dissolved 1.4 mg. in 48 hours.

40 mg. K_2CO_3, per litre, dissolved 1.2 mg in 48 hours. (Muir, Proc. Soc. Manchester, **15.** 31.)

Sol. in KCN+Aq. (Goyder, C. N. 1894, **69.** 262.)

A solution of $(NH_4)_2S_2O_8$ containing 0.829 g. in 110 cc. dissolves 0.2050–0.2279 g. Cu. (Turrentine, J. phys. Chem. 1907, **11.** 625.)

Sl. attacked by liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Amts. Cu dissolved by action of various oils on 8 sq. in. Cu by 10 days' exposure and subsequent 67 days—

	Amt. Cu dissolved in 10 days	Amt. Cu dissolved in subsequent 67 days
Linseed oil .	0.3000 grain	0.2445 grain
Olive oil . .	0.2200 "	0.0200 "
Colza oil . .	0.0170 "	0.1230 "
Almond oil .	0.1030 "	0.1170 "
Seal oil . .	0.0485 "	0.0315 "
Sperm oil .	0.0030 "	0.0575 "
Castor oil .	0.0065 "	0.0035 "
Neatsfoot oil	0.1100 "	....
Sesame oil .	0.1700 "	0.0015 "
Paraffine oil .	0.0015 "	....

(Watson, C. N. **36.** 200.)

Qualitative results of the action of various oils on Cu are also given by Thompson. (C. N. **34.** 176, 200, 219.)

½ ccm. oleic acid dissolves 0.0157 g. Cu in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Sol. in an alkaline solution of gelatine (3.54 %) copper gauze dissolved in 48 hours. (Lidoff, C. C. **1899,** II. 471.)

Cuprous acetylide, Cu_2C_2.

Decomp. by heating with H_2O or KCN+Aq. Decomp. by HNO_3. (Keiser, Am. Ch. J. 1892, **14.** 289.)

Not decomp. by H_2SO_4, NH_4OH, KOH+Aq or acetic acid, even on warming. The dry salt is sol. in very dil. HCl+Aq without evolution of gas. Sol. in conc. KCN+Aq. (Böttger, A. 1859, **109.** 356.)

Cupric acetylide, CuC_2.

Easily sol. in HCl. Turns brown in the air, and becomes insol. in acids. (Phillips, Z. anorg. 1894, **6.** 241.)

$3Cu_4C_8O+2H_2O$. Solubility as that of $Cu_8C_{17}H_4O_3$. (Söderbaum, B. 1897, **30.** 764.)

$Cu_8C_{17}H_4O_3$. Insol. in H_2O.

When dry is violently decomp. by conc. H_2SO_4 or not too dil. HNO_3. Rapidly decomp. by warming with dil. acids, especially HCl.

Insol. in NH_4OH+Aq in absence of air, partially sol. in presence of air.

Insol. in organic solvents. (Söderbaum, B. 1897, **30.** 762.)

Cuprous acetylide iodide, Cu_2C_2I, CuI.

Ppt. (Berthelot and Delépine, A. ch. 1900, (7) **19.** 54.)

Cupric arsenide, Cu_5As_2.

(Reinsch, J. pr. **24.** 244.)

Cu_4As_2. (Gehlen.)

Cu_3As_2. Ppt. Decomp. by acids. (Kane, Pogg. **44.** 471.)

Cu_3As. Min. *Domeykite.* Insol. in HCl +Aq; sol. in HNO_3.

Cu_6As. Min. *Algodonite.*

Cu_9As. Min. *Darwinite.*

Cuprous azoimide, CuN_3.

Insol. in H_2O. (Curtius.)

Sensitive to sunlight. (Wöhler, B. 1913, **46.** 2053.)

Cupric azoimide, basic, CuO, CuN_6.

Insol. in H_2O. (Wöhler, B. 1913, **46.** 2055.)

Cupric azoimide, CuN_6.

Very explosive.

Very sl. sol. in H_2O. Decomp. by boiling with H_2O. (Curtius, J. pr. 1898, (2) **58.** 296.)

Copper azoimide ammonia, CuN_6, $2NH_3$.

Ppt. Insol. in H_2O. Easily sol. in dil. acids. (Dennis, J. Am. Chem. Soc. **1907.** 29, 19.)

Copper boride, Cu_3B_2.

(Marsden, J. B., **1880.** 330.)

Cuprous bromide, Cu_2Br_2.

1 l.H_2O dissolves at 18°-20°:

0.4320 millimols bromine.
0.3157 " cupric copper.
0.1061 " cuprous copper.

(Bodländer, Z. anorg. 1902, **31.** 460.)

Sol. in HBr, HCl without decomp., or HNO_3+Aq with decomp., also in NH_4OH +Aq. Insol. in boiling conc. H_2SO_4 or $HC_2H_3O_2$+Aq. (Berthemot, A. ch. **44.** 385.)

Sol. in H_2SO_3+Aq. (Lean and Whatmough, Chem. Soc. 1898, **73.** 151.)

Sol. in NaCl, and $Na_2S_2O_3$+Aq. (Renault, C. R. **59.** 319.)

Solubility of Cu_2Br_2 in KBr+Aq.
All values recorded in millimols per litre.

KBr	Total copper	Cupric copper	Cuprous copper
25	0.119	0.012	0.107
40	0.200	0.013	0.187
60	0.310	0.025	0.285
80	0.423	0.012	0.411
100	0.5836	...	0.5836
120	0.6934	...	0.6934
500	8.719	...	8.719

(Bodländer and Storbeck, Z. anorg. 1902, **31.** 462.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1897,** II. 1014.)

100 g. acetonitrile dissolve 3.86 g. Cu_2Br_2 at 18°. (Naumann and Schier, B. 1914, **47.** 249.)

Sol. in pyridine. (Naumann, B. 1904, **37.** 4609.)

Mol. weight determined in pyridine, methyl and ethyl sulphides. (Werner, Z. anorg. 1897, **15.** 19, 26, and 28.)

Cupric bromide, $CuBr_2$.

Deliquescent. Very sol. in H_2O. Insol. in benzene. (Franchimont, B. **16.** 387.)

Very sl. attacked by cold or even hot H_2SO_4. (Viard, C. R. 1902, **135.** 169.)

Moderately sol. in liquid NH_3. (Horn, Am. Ch. J. 1908, **39.** 219.)

100 g. 95% formic acid dissolve 0.16 g. at 21°. (Aschan, Ch. Z. 1913, **37.** 1117.)

100 g. acetonitrile dissolve 24.43 g. $CuBr_2$ at 18°. (Naumann and Schier, B. 1914, **47.** 249.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. in acetone with a brown color. (Eidmann, C. C. **1899,** II. 1014.)

+$2H_2O$(?). (Berthemot, A. ch. 1830, **44.** 385.)

+$4H_2O$. Very sol. in H_2O. (Sabatier, Bull. Soc. 1894, (3) **11.** 677.)

Cupric hydrogen bromide, $CuBr_2$, HBr+ $2H_2O$.

Decomp. by H_2O. (Sabatier, Bull. Soc. 1894, (3) **11.** 681.)

+$10H_2O$. (Weinland and Knöll, Z. anorg. 1905, **44.** 116.)

Cupric lithium bromide, $CuBr_2$, 2LiBr+$6H_2O$.

Very hydroscopic. (Sementschenko, Z. anorg. 1899, **19.** 336.)

Very hydroscopic; decomp. by H_2O. (Kurnakoff, C. C. **1899,** I. 16.)

Cupric potassium bromide, $CuBr_2$, KBr.

Decomp. by H_2O. (Sabatier, Bull. Soc. 1894, (3) **11.** 683.)

Cuprous bromide ammonia, Cu_2Br_2, $2NH_3$.

Stable when dry.

Easily sol. in HNO_3 and NH_4OH+Aq. Other mineral acids and acetic acid separate Cu_2Br_2. (Richards, Z. anorg. 1898, **17.** 245.)

Cu_2Br_2, $6NH_3$. (Lloyd.)

Cu_2Br_2, $3NH_3$. (Lloyd, J. phys. Chem. 1908, **12.** 399.)

Cupric bromide ammonia, $CuBr_2, 2NH_3$.

Sol. in NH_4Br+Aq without decomp. (Richards, B. **23.** 3790.)

$3CuBr_2, 10NH_3$. Decomp. by H_2O. (Richards, Am. Ch. J. **15. 651.**)

$CuBr_2, 3NH_3$. Completely sol. in a little H_2O, but is decomp. by dilution. Insol. in alcohol. (Rammelsberg, Pogg. **55.** 246.)

$CuBr_2, 4NH_3+H_2O$. 100 pts. H_2O dissolve 69.03 pts. $CuBr_2, 4NH_3$ at 25°. (Pudschies, Dissert.)

$CuBr_2, 5NH_3$. As above. (Rammelsberg.)

$CuBr_2, 6NH_3$. Sol. in small amts. of H_2O, but decomp. on dilution. (Richards.)

Cupric bromide nitric oxide, $CuBr_2$, NO.

Decomp. by H_2O. (Manchot, B. 1914, **47.** 1607.)

Cuprous chloride, Cu_2Cl_2.

1.53 g. Cu_2Cl_2 dissolve in 100 g. H_2O at 21.5°; 1.55 g. at 26.5°. (Kremann and Noss, M. 1912, **33.** 1206.)

Solubility of Cu_2Cl_2 in H_2O in an atmosphere of hydrogen.
Solubility is recorded in mg-atoms per l.

t°	Total Cu	$CuCl_2$ by analysis	Cl	Cu_2Cl_2 calc.	Cu_2Cl_2 by analysis
....	2.752	2.124	5.672	0.628	...
20.2	2.919	2.254	5.525	0.665	0.420
19.6	2.971	2.294	5.464	0.677	0.474
19.3	2.861	2.245	5.464	0.616	0.499

(Bodländer, Z. anorg. 1902, **31.** 12.)

Solubility of Cu_2Cl_2 in H_2O in an atmosphere of CO_2.
Solubility is recorded in mg-atoms per l.

t°	Total Cu	$CuCl_2$ by analysis	Cl	Cu_2Cl_2 by analysis	Cu_2Cl_2 calc.
20.6	2.818	...	5.235	0.525	...
21.7	2.805	2.243	5.430	0.516	0.562
..	2.880	2.258	5.312	0.391	0 662
19.7	2.805	2.138	5.390	0.336	0.667

(Bodländer, l. c.)

Sol. in conc. HCl+Aq; insol. in dil. HNO_3, or H_2SO_4+Aq. Not attacked by cold conc. H_2SO_4, and only sl. on warming. (Rosenfeld, B. **12.** 954.) Sol. in NH_4OH+Aq; sol. in hot NaCl, KCl, $FeCl_3$, $ZnCl_2$, $MnCl_2$, etc. +Aq. 1 mol. $Na_2S_2O_3$ in aqueous solution dissolves 1 mol. Cu_2Cl_2. (Winkler, J. pr. **88.** 428.) Sol. in KI, I_2, KCN, or $(NH_4)_2SO_4$+Aq. (Renault, C. R. **59.** 558.)

Solubility in HCl+Aq at 17°. $\frac{Cu_2Cl_2}{2}$ = ½ mols. $CuCl_2$ in mgs. in 10 ccm. solution. HCl = mols. HCl in ditto.

$\frac{Cu_2Cl_2}{2}$	HCl	Sp. gr.
0.475	8.975	1.050
1.4	15.7	...
1.575	18.2	...
4.5	34.5	1.080
8.25	47.8	1.135
11.5	57.0	...

(Chatelier, calc. by Engel, A. ch. (6) **17.** 377.)

Solubility of Cu_2Cl_2 in HCl+Aq at 0°.

$\frac{Cu_2Cl_2}{2}$	HCl	Sp. gr.
1.5	17.5	1.049
2.9	26.0	1.065
8.25	44.75	1.132
15.5	68.5	1.261
33.0	104.0	1.345

(Engel, *l. c.*)

Freshly pptd. Cu_2Cl_2 is sol. in H_2SO_3+Aq. (Lean and Whatmough, Chem. Soc. 1898, **73.** 150.)

Sl. sol. in normal NH_4OH+Aq only by shaking several hours, a 0.02 normal solution of cuprous copper being obtained. (Gaus, Z. anorg. 1900, **25.** 258.)

Insol. in $Na_2S_2O_6$+Aq. (Siewert, Gm. K. **5.** 1, 893.)

Sol. in alkyl triphosphites. (Arbusoff, C. C. **1906,** II. 750.)

Solubility in $FeCl_2, 4H_2O$+Aq at 21.5°.

In 100 g. H_2O		Solid phase
g. $FeCl_2$	g. Cu_2Cl_2	
...	1.535	Cu_2Cl_2
6.015	1.33	"
11.62	1.81	"
16.30	3.11	"
26.305	7.125	"
29.35	8.06	"
33.125	9.565	"
43.75	12.44	"
54 00	17.04	"
66.40	21.60	"
73.20	23.20	$Cu_2Cl_2+FeCl_2, 4H_2O$
71.895	21.655	$FeCl_2, 4H_2O$
69.34	11.895	"
65.10	....	"

(Kremann and Noss, M. 1912, **33.** 1208.)

Solubility of Cu_2Cl_2 in KCl+Aq at t°. Determined in an atmosphere of CO_2.

t°	g. mol. KCl per l.	g. atoms Cu per l.
18.3	0.05	0.002411
16	0.1	0.004702
16	0.2	0.009458
19.2	1.0	0.0970
16.4	2.0	0.3840

(Bodländer and Storbeck, Z. anorg. 1902, **31.** 17.)

Solubility of Cu_2Cl_2 in KCl+Aq at t°. Determined in an atmosphere of CO_2. All values recorded in millimols per litre.

t°	KCl	Cupric copper	Total copper	Cuprous copper calc.	Cl
20°	0	2.222	2.851	0.629	5.436
19	1	1.901	2.385	0.484	5.287
19	2	1.571	2.150	0.589	5.614
19	2.5	1.421	1.955	0.534	6.015
19	3	1.523	1.983	0.460	6.247
16	5	1.008	1.522	0.514	7.525
18	10	0.475	1.236	0.761	11.735
20	15	0.322	1.344	1.022	16.437
19	20	0.324	1.446	1.122	21.356
19	30	0.1308	1.761	1.630	31.911
18	50	0.1088	2.411	2.302	...
16	100	0	4.702	4.702	...
16	200	0	9.485	9.485	...
19	1000	0	97.0	97.0	...
16	2000	0	384.0	384.0	...

(Bodländer and Storbeck, Z. anorg. 1902, **31.** 24.)

Solutions of 0.05=0.4 normal KCl dissolve Cu_2Cl_2 with the formation of $KCuCl_2$; those of higher concentration with the formation of K_2CuCl_3. (Bodländer and Storbeck, Z. anorg. 1902, **31.** 41.)

Solubility of Cu_2Cl_2+KCl in H_2O at 22°.

G. in 1 g. of solution Cu_2Cl_2	G. in 1 g. of solution KCl	Solid Phase
0.00115	0.0387	Cu_2Cl_2
0.00405	0.0656	"
0.00861	0.0824	"
0.0137	0.0984	"
0.0219	0.1133	"
0.0390	0.1406	"
0.0484	0.1530	"
0.0675	0.1639	"
0.0719	0.1747	"
0.0863	0.1839	"
0.1043	0.2027	"
0.1084	0.2018	"
0.1021	0.2031	"
0.1204	0.2095	"
0.1332	0.2164	"

Solubility of Cu_2Cl_2+KCl in H_2O at 22°.—*Continued*

G. in 1 g. of solution Cu_2Cl_2	G. in 1 g. of solution KCl	Solid Phase
0.1621	0.2330	Cu_2Cl_2
0.1723	0.2384	"
0.1907	0.2374	"
0.2148	0.2516	"
0.2145	0.2506	Cu_2Cl_2+Cu_2Cl_2, 4KCl
0.2149	0.2549	Cu_2Cl_2, 4KCl
0.1548	0.2387	"
0.1473	0.2363	"
0.1399	0.2357	"
0.1439	0.2389	"
0.1451	0.2363	"
0.1155	0.2320	"
0.1139	0.2350	"
0.0953	0.2359	"
0.0735	0.2349	"
0.0555	0.2389	"
0.0453	0.2404	"
0.0366	0.2433	"
0.0314	0.2503	"
0.0285	0.2499	"
0.0265	0.2523	"
0.0220	0.2628	"
0.0193	0.2687	"
0.0176	0.2698	"
0.0193	0.2703	Cu_2Cl_2, 4KCl+KCl
0.0160	0.2706	KCl
0.0124	0.2668	"
0.0058	0.2632	"
0.0000	0.2568	"

(Brönsted, Z. phys. Ch. 1912, **80.** 208.)

Solubility in NaCl+Aq.

Sat. NaCl+Aq dissolves 16.9 % Cu_2Cl_2 at 90°; 11.9 % at 40°; and 8.9 % at 11°.

15 % NaCl+Aq dissolves 10.3 % Cu_2Cl_2 at 90°; 6.0 % at 40°; and 3.6 % at 14°.

5% NaCl+Aq dissolves 2.6 % Cu_2Cl_2 at 90°, and 1.1 % at 40.° (Hunt, Sill. Am. J. (2) **49.** 154.)

Solubility in NaCl+Aq at 26.5°.

In 100 g. H_2O Cu_2Cl_2	In 100 g. H_2O NaCl	Solid phase
1.55	..	Cu_2Cl_2
3.15	10.80	"
7.30	20.70	"
40.60	27.00	"
49.10	36.48	"
57.21	44.14	Cu_2Cl_2+NaCl
41.40	55.95	NaCl
18.70	50.90	"

(Kremann and Noss, M. 1912, **33.** 1210.)

Solubility of Cu_2Cl_2 in $CuSO_4$+Aq at t°.
Values recorded in millimols per l.

t°	Conc. of $CuSO_4$	Cupric copper	Total copper	Cuprous copper calc.	Cl
19.7	...	2.258	2.880	0 622	5.312
16.3	0.49375	2.746	3.125	0.379	4.805
18.6	0.9875	3.145	3 602	0.457	4.908
17.5	1.4812	3.315	3.915	0.600	4.530
19.4	1 975	4.131	4.553	0.422	4.687
20.4	2.4687	4.349	4.786	0.437	4.287
20.5	2.9625	4.625	5.193	0.509	4.256
20.1	4.9375	6.546	7.276	0.730	4.329

(Bodländer and Storbeck, Z. anorg. 1902, **31.** 22.)

Insol. in $SbCl_3$. (Klemensiewicz, Bull. Acad. Crac. 1908, **6,** 485.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20,** 827.)

Insol. in alcohol.

Sl. sol. in ether. (Gehlen.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Sol. in pyridine. (Schroeder, Dissert. **1901.**)

Insol. in phosgene. (Eidmann, Dissert. **1899.**)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Alexander, Dissert. **1899.**) (Naumann, B. 1904, **37.** 3601.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

100 g. acetonitrile dissolve 13.33 g. Cu_2Cl_2 at 18°. (Naumann and Schier, B. 1914, **47.** 249.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, **15.** 7.)

Mol. weight determined in pyridine methyl and ethyl sulphides. (Werner, Z. anorg. 1897, **15.** 19, 25 and 28.)

Min. *Nantokite.* Sol. in HCl, HNO_3, or NH_4OH+Aq.

Cupric chloride, $CuCl_2$.

Deliquescent. 100 pts. H_2O dissolve 70.6 pts. $CuCl_2$ at 0°; 100 pts. $CuCl_2$+Aq contain 41.4 pts. $CuCl_2$. (Engel, A. ch. (6) **17.** 350.)

100 pts. H_2O dissolve 76.2 pts. $CuCl_2$ at 16.1°, or 100 pts. $CuCl_2$+Aq sat. at 16.1° contain 43.25 pts. $CuCl_2$. (Rudorff, B. **6.** 484.)

100 pts. $CuCl_2$+Aq sat. at 17° contain 43.06 pts. $CuCl_2$; at 31.5°, contain 44.7 pts. $CuCl_2$. Coefficient of solubility = 41.4 + 0.105t. (Reicher and Deventer, Z. phys. Ch. **5.** 560.)

Sat. $CuCl_2$+Aq. contains at:

-20°	-5°	+12°	17°	32°	
37	38.8	39.3	41.7	43.2%	$CuCl_2$,
39°	55°	68°	73°	91°	
44.0	46.5	47.9	48.6	51.0%	$CuCl_2$.

(Étard, A. ch. 1894, (7) **2.** 536.)

Sp. gr. of $CuCl_2$+Aq at 17.5°.

% $CuCl_2$	Sp. gr.	% $CuCl_2$	Sp. gr.
5	1.0455	25	1.2918
10	1.0920	30	1.3618
15	1.1565	35	1.4447
20	1.2223	40	1.5284

(Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $CuCl_2$+Aq at 22.9°, containing in 1000 g. H_2O, g. $CuCl_2+2H_2O$.

85.5 (=½ mol.)	171	255.5	g. $CuCl_2+2H_2O$,
1.057	1.108	1.154	
342	427.5	513	g. $CuCl_2+2H_2O$,
1.197	1.238	1.275	
598.5		684	g. $CuCl_2+2H_2O$,
1.309		1.341	
769.5		855	g. $CuCl_2+2H_2O$,
1.371		1.399	
940.5		1.026	g. $CuCl_2+2H_2O$.
1.425		1.449	

Containing $CuCl_2$ (anhydrous).

67.5 (=½ mol.)	135	202.5	270	g. $CuCl_2$,
1.059	1.114	1.165	1.213	
337.5	405	472.5		g. $CuCl_2$.
1.257	1.299	1.30		
540	607.5	675		g. $CuCl_2$.
1.379	1.416	1.453		

(Gerlach, Z. anal. **28.** 468.)

Sp. gr. of $CuCl_2$+Aq at 0°. S = pts. $CuCl_2$ in 100 pts. solution; S_1 = mols. $CuCl_2$ in 100 mols. of solution.

S	S_1	Sp. gr.
39.4170	8.00	1.4797
35.3839	6.82	1.4173
30.9255	5.65	1.3529
26.1129	4.51	1.2881
20.6697	3.36	1.2204
14.5820	2.23	1.1494
8.0732	1.16	1.0796

(Charpy, A. ch. (6) **29.** 25.)

Tables for 7°, 30.5°, 49.2°, and 65° are also given by Charpy.

Sp. gr. of $CuCl_2$+Aq at room temp., containing:

12.006	21.349	33.027%	$CuCl_2$.
1.1037	1.2154	1.3312	

(Wagner, W. Ann. 1883, **18.** 273.)

Sp. gr. at 20° of $CuCl_2$+Aq containing M. mols. $CuCl_2$ per liter.

M.	0.01	0.05	0.075
Sp. gr.	1.001208	1.00637	1.009264
M.	0.10	0.20	0.50
Sp. gr.	1.012614	1.030991	1.051479
M.	0.75		1.0
Sp. gr.	1.090912		1.120249
M.	1.5		2.0
Sp. gr.	1.177618		1.234551

(Jones and Pearce, Am. Ch. J. 1907, **38.** 717.)

Sp. gr. of $CuCl_2$+Aq at 25°.

Concentration of $CuCl_2$+Aq.	Sp. gr.
1—normal	1.0624
½— "	1.0313
¼— "	1.0158
⅛— "	1.0077

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Much less sol. in HCl+Aq than in H_2O. 1 l. HCl+Aq containing 45 pts. HCl to 100 pts. H_2O dissolves only 290 g. $CuCl_2$ at 12°, whereas 1 l. H_2O at 12° dissolves 630 g. $CuCl_2$. (Ditte, C. R. 1881, **92.** 353.)

Solubility in HCl+Aq at 0°. $\frac{CuCl_2}{2}$ = ½ mols. in milligrammes in 10 ccm. solution. HCl = mols. HCl in ditto; H_2O = g. H_2O.

$\frac{CuCl_2}{2}$	HCl	Sum of equiv.	Sp. gr.	H_2O
91.75	0	91.75	1.490	8.73
86.8	4.5	91.3	1.475	8.74
83.2	7.8	91	1.458	....
79.35	10.5	89.85	1.435	8.64
68.4	20.25	88.65	1.389	8.56
50.0	37.5	87.5	1.319	8.47
22.8	70.25	93.05	1.231	8.21
23.5	102.5	126	1.288	7.56
26.7	128	154.7	1.323	6.77

(Engel, A. ch. (6) **17** 351.)

Not decomp. by cold H_2SO_4.

Sol. in NH_4Cl+Aq. Very sol. in conc. NaCl+Aq. (Boussingault.)

Solubility of $CuCl_2$ in NH_4Cl+Aq at 30°.

% NH_4Cl	% $CuCl_2$	Solid phase
29.5	0	NH_4Cl
28.6	1.9	$NH_4Cl+CuCl_2, 2NH_4Cl, H_2O$
12.1	15.6	$CuCl_2, 2NH_4Cl, H_2O$
2.03	43.2	$CuCl_2, 2NH_4Cl, H_2O+CuCl_2, 2H_2O$
0	43.95	$CuCl_2, 2H_2O$

(Schreinemakers, Z. phys. Ch. 1909, **66.** 688.)

See also $NH_4Cl+CuCl_2$ under ammonium chloride.

Solubility of $CuCl_2+HgCl_2$ in H_2O at 35°.

% $HgCl_2$	% $CuCl_2$	Solid Phase
0	44.47	$CuCl_2, 2H_2O$
21.03	33.50	"
37.30	26.07	"
44.47	23.31	"
50.47	21.50	$CuCl_2+HgCl_2$
52.44	19.40	$HgCl_2$
52.54	18.46	"
52.81	18.06	"
51.03	14.73	"
49.50	5.94	"
23.87	2.64	"
8.51	8.51	"

(Schreinemakers and Thonus, Proc. K. Akad. Wet. 1912, **15.** 472.)

Solubility of $CuCl_2$+KCl in H_2O at t°.

t°	Cl per g. of solution: As $CuCl_2$	Cl per g. of solution: As KCl	Mols. per 100 mols. H_2O: $CuCl_2$	Mols. per 100 mols. H_2O: KCl	
39.4	0 120	0.107	5 56	9 93	$CuCl_2, 2KCl.2H_2O$ + KCl
49.9	0.129	0 115	6.39	11 4	"
60 4	0 142	0 125	7.71	13 6	"
79.1	0 168	0 142	11.1	18 8	"
90.5	0 188	0.154	14.9	24 4	"
93 7	0 194	0 156	16.2	26 0	$CuCl_2$, KCl+KCl
98.8	0.197	0 162	17.5	28 7	"
0	0 214	0.021	9.84	1 94	$CuCl_2, 2KCl.2H_2O+CuCl_2.3H_2O$
39.6	0.232	0.049	12.9	5.44	"
50.1	0.233	0.059	13 7	6 90	"
52.9	0.241	0 062	14 8	7 63	"
60 2	0 246	0.066	15.8	8.49	$CuCl_2$, KCl+$CuCl_2.2H_2O$
72.6	0.255	0 063	16.8	8.35	"
64.2	..	...	14.9	11.6	$CuCl_2, 2KCl.2H_2O+CuCl_2$, KCl
72.5	..		14.8	1.50	$CuCl_2$, KCl

(Meyerhoffer, *Z.* phys. Ch. 1890, **5.** 102.)

100 g. H_2O dissolve 72.6 g. $CuCl_2$+16. 0 g NaCl. (Rudorff, B. **6.** 684.)

Solubility of $CuCl_2$+NaCl in H_2O at 30°.

% NaCl	% $CuCl_2$	Solid Phase
0	43.95	$CuCl_2, 2H_2O$
3.10	41.14	"
4.28	41.06	"
6.41	39.40	"
10.25	36.86	$CuCl_2$+NaCl
12.02	32.38	NaCl
12.25	32.40	"
13.54	28.64	"
15.40	23.72	"
18.44	16.98	"
20.61	11.03	"
26.47	0	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, **65.** 586.)

Solubility of $CuCl_2$ in $CuSO_4$+Aq at 30°.

Composition of the solution: % by wt. $CuCl_2$	% by wt. $CuSO_4$	Solid phase.
0	20.32	$CuSO_4$, $5H_2O$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.77	2.89	$CuSO_4$, $5H_2O$+$CuCl_2$, $2H_2O$
42.47	2.90	"
43.25	1.14	$CuCl_2$, $2H_2O$
43.95	0	"

(Schreinemakers, Z. phys. Ch. 1909, **69.** 561.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Sol. in alcohol and ether.

Sol. in 1 pt. strong alcohol.

100 pts. absolute methyl alcohol dissolve 68 pts. $CuCl_2$ at 15.5°; 100 pts. absolute ethyl alcohol dissolve 53 pts. $CuCl_2$ at 15.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

See also under $CuCl_2$+$2H_2O$.

Solubility of $CuCl_2$+KCl in absolute alcohol at 25°.

% $CuCl_2$	% KCl	Solid Phase
1.27	0.28	KCl+KCl, $CuCl_2$
1.51	0.28	"
2.15	....	KCl, $CuCl_2$
5.25	...	"
30.16	...	"
34.17	0.21	KCl, $CuCl_2$+$CuCl_2$, C_2H_5OH
34.45	0.21	"
34 29	0.21	"
33.97	0.00	$CuCl_2$, C_2H_5OH

(Foote and Walden, J. Am. Chem. Soc. 1911, **33.** 1032.)

Solubility of $CuCl_2$+KCl in acetone at 25°.

% $CuCl_2$	% KCl	Solid Phase
0.34	0.38	KCl+KCl, $CuCl_2$
0.48	....	KCl, $CuCl_2$
1.50	....	"
2.06	....	"
2.49	0.27	KCl, $CuCl_2$+$CuCl_2$, C_3H_6O
2.32	....	"

(Foote and Walden, J. Am. Chem. Soc. 1911, **33.** 1032.)

100 g. of sat. solution of $CuCl_2$ in ethyl alcohol contains 33.97 g. $CrCl_2$. (Foote and Walden, J. Am. Chem. Soc. 1911, **33.** 1032.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in benzene.

Solubility in organic solvents.

Solvent	t°	Sat. solution contains % $CuCl_2$
Methyl alcohol	22	36.8
	40	37.5
	50	37.1
	60	37.5
Abs. ethyl alcohol	0	32.0
	19	35.7
	20	35.9
	38	38.5
	50	41.7
Propyl alcohol	−15	26.8
	19	30.9
	37	30.7
	57	30.3
	62	30.5
Allyl alcohol	−20	23.4
	− 4	23.6
	27	22.9
	32	23.3
N-butyl alcohol	0	15.2
	23	15.8
	37	15.7
	55	16.1
	84	16.2
	92	16.7
Ethyl formate	−20	10.2
	+24	9.4
	37	7.4
	50	7.2
Ethyl acetate	+20	3.0
	40	2.5
	72	1.3
Acetone	−20	18.4
	+ 8	18.8
Isopropyl alcohol	32	11.0
	70	28.3
	84	28.7

(Étard, A. ch. 1894, (7) **2.** 565.)

See also under $CuCl_2$+$2H_2O$.

1 g. $CuCl_2$ is sol. in 181 g. methyl acetate at 18°. Sp. gr. 18°/4° of the sat. solution = 0.939. (Naumann, B. 1909, **42.** 3793.)

1 g. $CuCl_2$ is sol. in 249 g. ethyl acetate at 18°. Sp. gr. of sat. solution 18°/4° = 0.9055. (Naumann, B. 1904, **37.** 3603.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

1 pt. sol. in 249.3 pts. ethyl acetate at 10°. (Alexander, Dissert. **1899.**)

Solubility in acetone.

34.7 g. acetone dissolve 1 g. $CuCl_2$ at 18°. Sp. gr. of sat. solution 18°/4° = 0.8154. (Naumann, B. 1904, **37.** 4329.)

1.40 pts. are sol. in 100 pts. acetone at 56°. (Laszczynski, B. 1894, **27.** 2287.)

Sol. in acetone and methylal. 1 gram. dissolves in 34.08 grams of acetone at 18°. (Eidmann, C. C. **1899**, II, 1014.)

100 pts. absolute ether dissolve 0.043 g. $CuCl_2$. (Bödtker, Z. phys. Ch. 1897, **22.** 511.)

Mol. weight determined in pyridine and methyl sulphide. (Werner, Z. anorg. 1897, **15.** 20 and 25.)

100 g. sat. solution in acetonitrile contains 1.57 g. $CuCl_2$. (Naumann and Schier, B. 1914, **47.** 249.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in boiling dipropylamine. (Werner, Z. anorg. 1897, **15.** 34.)

Sol. in urethane. (Ley, Z. phys. Ch. 1897, **22.** 81); (Castoro Z. anorg. 1899, **20,** 61.)

$+H_2O$. (Ditte, A. ch. (5) **22.** 551.)

Sol. in H_2O with slight decomp. (Sabatier, Bull. Soc. 1895, (3) **13.** 601.)

$+2H_2O$. Deliquescent. 100 g. H_2O dissolve 121.4 g. $CuCl_2+2H_2O$ at 16.1°. (Rüdorff.)

Aq. sol. at 35° contains 9.689 Mol. % $CuCl_2$.
" 15° " 8.934 " % "

(Schreinemakers, C. C. **1911,** II. 349.)

$CuCl_2+2H_2O+Aq$. sat. at 30° contains 43.95% $CuCl_2$. (Meerburg, C. C. **1904,** II. 1362.)

43.95 g. anhydrous $CuCl_2$ are dissolved in 100 g. $CuCl_2+Aq$ at 30°. (Schreinemakers, Arch. neer. Sc. 1910 [2], **15.** 117.)

44.47% by weight anhydrous $CuCl_2$ is dissolved in H_2O at 35°. (Schreinemakers and Thonus, Verh. k. Akad. Wet. Amst. 1912, **21.** 333.)

Solubility of $CuCl_2+2H_2O$ in ethyl alcohol $+Aq$ at 11.5°.

Percent of ethyl alcohol by volume	Grams $CuCl_2$ dissolved in 5 cc.
99.3	1.175
98.3	1.116
96.3	1.097
95.3	1.070
94.3	1.059

Anhydrous salt dissolves readily in absolute ethyl alcohol; $CuCl_2+2H_2O$ is precipitated by H_2O.

Solubility of $CuCl_2+2H_2O$ in ethyl alcohol + Aq at 11.5° C. under addition of increasing amounts of $CuCl_2$.

P = Percent of ethyl alcohol by volume.
G = Grams of $CuCl_2$ added.
C_c = Grams of $CuCl_2$ in 5 cc. of the solution.
C_w = Grams of water in 5 cc. of the solution, calculated from
(1) the water content of the alcohol.
(2) the water of crystallization which had gone into solution.
(3) the water held mechanically in $CuCl_2+2H_2O$.

P	G	Cw	Cc
89.3	0.000	0.794	1.137
90.3	"	0.744	1.122
91.3	"	0.695	1.104
92.3	"	0.648	1.090
94.3	"	0.561	1.096
95.3	"	0.517	1.095
96.3	"	0.478	1.116
97.3	"	0.440	1.140
98.3	"	0.396	1.194
99.3	"	0.369	1.208
"	0.223	0.330	1.295
"	0.444	0.290	1.395
"	0.665	0.270	1.506
"	0.887	0.247	1.639
"	1.106	0.223	1.772
"	1.324	0.205	1.921
"	1.540	0.191	2.086
"	1.739	0.179	2.236
"	1.957	0.164	2.400

(Bödtker, Z. phys. Ch. 1897, **22.** 506–507.)

100 pts. absolute ether dissolve 0.061 g. $CuCl_2+2H_2O$. (Bödtker, Z. phys. Ch. 1897, **22.** 511.)

0.11 pts. are sol. in 100 pts. ether at 16°.
0.11 " " " " 100 " " " 35°.
8.86 " " " " 100 " acetone " 0°.
8.92 " " " " 100 " " " 13.5°.

(Laszczynski, B. 1894, **27.** 2286 and 2287.)

Solubility in organic solvents at t°.

Solvent	t°	Pts. of solvent required to dissolve 1 pt. $CuCl_2+2H_2O$ at t°.
Pure methyl alcohol	20°	7.3
"	18.9	7.6
Ethyl alcohol (95°)	20.3	11.6
"	19.6	11.9
Pure acetone	22.1	43.6
"	20.0	44.2
90 pts. ethyl alcohol (98°) +10 pts. H_2O	21.8	9.0
"	23.0	8.5

Solubility in organic solvents at t°.—*Cont.*

Solvent	t°	Pts. of solvent required to dissolve 1 pt. $CuCl_2+2H_2O$ at t°
80 pts. abs. alcohol+20 pts. H_2O	28.1	6.0
"	20.7	6.2
80 pts. acetone+20 pts. H_2O	23.1	5.3
"	21.8	5.6
80 pts. acetone+20 pts. methyl alcohol	23.1	12.0
"	24.0	11.6
10 pts. methyl alcohol+90 pts. ethyl alcohol (98°)	24.2	5.4
"	25.0	5.1
20 pts. methyl alcohol+80 pts. ord. ether	24.1	15.1
"	22.4	15.7
80 pts. abs. alcohol+20 pts. ord. ether	24.1	8.8
"	25.0	8.5
Comm. methyl alcohol	23.9	5.4
"	23.0	5.6
85 pts. pyridine+15 pts. H_2O	24.4	63.4
"	23.6	63.7
60 pts. pyridine+40 pts. H_2O	27.3	26.7
"	28.0	26.2
75 pts. *α* picoline+25 pts. H_2O	26.1	51.6
"	25.1	52.3
70 pts. *α* picoline+30 pts. H_2O	26.1	47.3

(de Coninck, C. R. 1900, **131.** 59.)

Solubility in organic solvents.

Sol. in propyl alcohol, hot glycol, hot glycerine, hot paraldehyde, hot crys. acetic acid, pure acetone, 30% methylamine+Aq, pure pyridine, pure α-picoline, acetonitrile; sl. sol. in isobutyl and amyl alcohols, crystallizable formic acid, ethyl acetate; insol. in cold glycol, cold glycerine, cold paraldehyde, benzaldehyde, cold crystallizable acetic acid, ord. ether, abs. ether, hot and cold CS_2, cold aniline, cold orthotoluidine, methylene chloride, ethyl iodide, propyl iodide, ethylene bromide, benzene, toluene, xylene, ligroin, nitrobenzene, cold piperidine and essence of terebenthine. (de Coninck, C. R. 1900, **131.** 59.)

$+5H_2O$.

Aq. sol. at 35° contains 2.921 Mol. % $CuCl_2$.
15° " 1.11

(Schreinemakers, C. C. **1911,** II. 349.)

Cuprous hydrogen chloride, CuCl,HCl.

Sol. in H_2O. (Neumann, M. 1894, **15.** 493.)

Cupric hydrogen chloride, $CuCl_2$, $HCl+3H_2O$

Decomp. by H_2O. Sol. in HCl+Aq below 0° .(Engel, C. R. **106.** 273.)

$CuCl_2$, 2HCl. Deliquescent. Very sol. in H_2O. (Alexander, Dissert. **1899.**)

$+5H_2O$. Properties as above. (Sabatier, C. R. **106.** 1724.)

$CuCl_2$,3HCl. Sol. in H_2O. (Neumann M. 1894, **15.** 493.)

Cupric gold (auric) chloride, $CuCl_2$, $2AuCl_3+6H_2O$.

10% is sol. in H_2O at 18°. (Mylius, Z. anorg. 1911, **70.** 210.)

Cupric lithium chloride, $CuCl_2$, $LiCl+2\frac{1}{2}H_2O$.

Decomp. on air. Decomp. by dissolving in H_2O. Sol. in conc. LiCl+Aq without decomp. Decomp. by alcohol. (Chassevant, A. ch. (6) **30.** 33.)

$+2H_2O$. (Meyerhoffer, W. A. B. **100, 2b.** 621.)

Cupric mercuric chloride.

Easily sol. in H_2O. (v. Bonsdorff.)

Cupric mercuric potassium chloride, $CuCl_2$, $3HgCl_2$, $6KCl+2H_2O$.

Deliquescent in moist air. Sol. in boiling H_2O without decomp., and recrystallises if cooled slowly. Insol. in absolute alcohol. (v. Bonsdorff, Pogg. **33.** 81.)

Cuprous nitrosyl chloride, Cu_2Cl_2, 2NOCl.

Very deliquescent and sol. in H_2O with immediate decomp. (Sudborough, Chem. Soc. **59.** 658.)

Cuprous potassium chloride, Cu_2Cl_2, 4KCl.

Sol. in H_2O. (Mitscherlich, A. ch. **73.** 384.)

For solubility data, *see* Cu_2Cl_2+KCl under cuprous chloride.

Cupric potassium chloride.

$CuCl_2$,KCl. (Meyerhoffer, Z. phys. Ch. **3.** 336.)

Sol. in H_2O; only sl. sol. in conc. HCl+Aq. (Gröger, Z. anorg. 1899, **19.** 330.)

$CuCl_2$, $2KCl+2H_2O$. Sol. in H_2O and alcohol. (Berzelius, Pogg. **13.** 458.)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, **34.** 322.)

For solubility data, *see* $CuCl_2$+KCl under cupric chloride.

Cupric rubidium chloride, $CuCl_2$, 2RbCl.

Easily sol. in H_2O and HCl+Aq. (Godeffroy, B. **8.** 9.)

$+2H_2O$. Sol. in H_2O. (Wyrouboff, J. B. **1887.** 538.)

Cuprous sodium chloride.

Very sol. in H_2O.

Cupric sodium chloride.

Easily sol. in conc. $NaCl$+Aq. Sol. in alcohol of 0.837 sp. gr.

No double salt exists. (Schreinemakers and de Baat, Z. phys. Ch. 1909, **65.** 586.)

Cupric thallic chloride, $CuCl_2$, $2TlCl_3$.

Sol. in H_2O. (Willm, A. ch. (4) **5.** 55.)

$+6H_2O$. Can be cryst. from H_2O. (Gewecke, A. 1909, **366.** 225.)

Cuprous chloride ammonia, Cu_2Cl_2, NH_3. (Lloyd, J. phys. Chem. 1908, **12.** 399.)

Cu_2Cl_2, $2NH_3$. Decomp. by H_2O or acids, not by alcohol. (Ritthausen, J. pr. **59.** 369.)

Cu_2Cl_2, $3NH_3$. (Lloyd, J. phys. Chem. 1908, **12.** 399.)

Cu_2Cl_2, $6NH_3$. (Lloyd, J. phys. Chem. 1908, **12.** 399.)

Cupric chloride ammonia, $CuCl_2$, $2NH_3$.

Decomp. by H_2O. (Kane, A. ch. **72.** 273.)

$CuCl_2$, $4NH_3$. Sol. in H_2O. (Bouzat, C. R. 1902, **135.** 294.)

$+H_2O$ (*Cuprammonium chloride*). Sol. in H_2O and hot NH_4OH+Aq.

$+2H_2O$. Sol. in small amt. of H_2O. $Cu(OH)_2$ is pptd. by dilution. (Bouzat, A. ch. 1903, (7) **29.** 350.)

$CuCl_2$, $5NH_3$. (Bouzat, A. ch. 1903, (7) **29.** 350.)

$+1\frac{1}{2}H_2O$. Sol. in H_2O. On dilution $Cu(OH)_2$ is pptd. Sol. in NH_4OH+Aq; solubility decreases as NH_3 concentration increases. (Bouzat, A. ch. 1903, (7) **29.** 350.)

$CuCl_2$, $6NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20.** 55.)

Sol. in H_2O but decomp. by great dilution with pptn. of $Cu(OH)_2$.

Insol. in liquid NH_3. (Bouzat, A. ch. 1903, (7) **29.** 350.)

Cuprocupric chloride ammonia, Cu_2Cl_2, $CuCl_2$, $4NH_3+H_2O$.

Decomp. by H_2O or alcohol. Abundantly sol. in NH_4Cl+Aq, but with partial decomposition. (Ritthausen.)

Cupric chloride ammonia platinous chloride, $CuCl_2$, $4NH_3$, $PtCl_2$.

See **Platodiamine cupric chloride.**

Cuprous chloride carbon monoxide, Cu_2Cl_2, $2CO+4H_2O$.

Very sol. in HCl (sp. gr. 1.19) with evolution of CO. Sol. in NH_4OH+Aq. (Manchot and Friend, A. 1908, **359.** 110.)

$2Cu_2Cl_2$, $CO+2H_2O$. Insol. in H_2O. (Berthelot, A. ch. 1856, (3) **46.** 488.)

$4Cu_2Cl_2$,$3CO+7H_2O$. Insol. in H_2O, but decomp. therewith very quickly. Sol. in Cu_2Cl_2+HCl.

Cupric chloride hydrazine, $CuCl_2$, $2N_2H_4$.

Easily decomp. (Hofmann and Marburg, A. 1899, **305.** 222.)

Cuprous chloride mercuric sulphide, Cu_2Cl_2, $2HgS$.

Insol. in H_2O; sol. in conc. hot HCl+Aq; not decomp. by boiling dil. H_2SO_4+Aq, but decomp. by conc. H_2SO_4. (Heumann, B. **7.** 1390.)

Cuprous fluoride, Cu_2F_2.

Insol. in H_2O or HF. Sol. in conc. HCl+Aq, from which it is precipitated by H_2O. Insol. in alcohol. (Berzelius, Pogg. **1.** 28.)

Decomp. by H_2O into sol. CuF_2. Sol. in boiling HCl+Aq and in HNO_3+Aq. Only sl. attacked by warm H_2SO_4. (Poulenc, C. R. **116.** 1447.)

Cupric fluoride, CuF_2.

Easily takes up H_2O to form CuF_2+2H_2O. Sol. in HCl, HNO_3, or HF+Aq. (Poulenc, C. R. **116.** 1448.)

Solubility at 25° in HF+Aq.

Normality of HF+Aq.	g. atoms Cu in 1000 c. c. of solution
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.08	0.388
2.28	0.463

Solubility is decreased by presence of KF. (Jaeger, Z. anorg. 1901, **27.** 29.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

$+2H_2O$. Sl. sol. in cold, decomp. by hot H_2O. (Berzelius.)

Cupric hydrogen fluoride, CuF_2, $5HF+5H_2O$.

Deliquescent.

Easily sol. in H_2O and dil. acids.

Sol. in NH_4OH+Aq with decomp. (Böhm, Z. anorg. 1905, **43,** 329.)

Cupric potassium fluoride, CuF_2, $2KF$.

Easily sol. in H_2O.

CuF_2, KF. Very sl. sol. in H_2O; sl. sol. in dil. acids. (Helmholt, Z. anorg. **3.** 115.)

Cupric rubidium fluoride, CuF_2, RbF.

As the K salt. (Helmholt.)

Cupric silicon fluoride.

See **Fluosilicate, cupric.**

Copper stannic fluoride.
See **Fluostannate, copper.**

Copper tantalum fluoride.
See **Fluotantalate, copper.**

Copper titanium fluoride.
See **Fluotitanate, copper.**

Copper tungstyl fluoride.
See **Fluoxytungstate, copper.**

Copper zirconium fluoride.
See **Fluozirconate, copper.**

Cupric fluoride ammonia, CuF_2, $4NH_3+5H_2O$.
Decomp. rapidly in the air.
Easily sol. in H_2O.
Decomp. by boiling with H_2O with evolution of NH_3.
Easily sol. in dil. acids. (Böhm, Z. anorg. 1905, **43.** 333.)

Cuprous hydride, CuH.
Insol. in H_2O. Sol. in HCl+Aq. (Wurtz, C. R. **18.** 102.)
Sol. in warm conc. HCl with decomp. (Bartlett, Am. Ch. J. 1895, **17.** 187.)

Cupric hydride, CuH_2.
Sol. in HCl with decomp. (Bartlett, Am. Ch. J. 1895, **17.** 187.)

Copper hydrosulphide, 7CuS, H_2S.
(Linder and Picton, Chem. Soc. 1892, **61.** 120.)
9CuS, H_2S. (Linder and Picton.)
22CuS, H_2S. (Linder and Picton.)

Cuprous hydroxide, Cu_2O, xH_2O.
Sol. in acids as cupric salt. Insol. in NaOH, or KOH+Aq.
Sol. in NH_4OH, and $(NH_4)_2CO_3$+Aq; sol. in $Na_2S_2O_3$+Aq.

Cuprocupric hydroxide, CuOH, $3Cu(OH)_2+3H_2O$.
Sol. in acids. (Francke, Dissert. **1907.**)

Cupric hydroxide, 3CuO, H_2O.
Insol. in H_2O or dil. alkalies. Easily sol. in warm NH_4Cl+Aq. (Rose.)
Much more difficultly sol. than CuO_2H_2 in KOH+Aq. (Chodnew, J. pr. **28.** 220.)
True composition is 6CuO, H_2O.
See also **Cupric oxide.**
CuO_2H_2. Insol. in H_2O, but decomp. into 6CuO, H_2O by being boiled therewith.
Extremely easily sol. in acids.
Sol. in NH_4OH, and NH_4 salts+ Aq.

Solubility in NH_4OH+Aq at 25°.

NH_3 norm.	g. Cu per l.	equiv. CuO_2H_2 per l.
2.63	3.05	0.096
2.00	2.12	0.067
1.32	1.08	0.034
2.540	6.26	0.197
1.965	6.28	0.166
1.280	4.13	0.129
0.973	3.36	0.106
0.870	3.08	0.097
0.540	2.36	0.074
0.391	2.04	0.064
3.176	8.06	0.253
2.070	5.72	0.180
1.272	4.75	0.149
0.451	2.54	0.080
0.320	2.13	0.067

The non-agreement of the results is due to the presence of different modifications of CuO_2H_2.

(Bonsdorff, Z. anorg. 1904, **41.** **182.**)

Solubility in NH_4OH+Aq at 18°.

NH_3 mols per l.	Cu g. atoms per l.
0.20	0.00054
0.50	0.0033
1.0	0.0109
1.5	0.0204
2.0	0.0314
2.5	0.0442
3.0	0.0548
4.0	0.0784
5.0	0.1041
6.0	0.1254
8.0	0.1599
9.96	0.1787

(Dawson, Z. phys. Ch. 1909, **69.** 111.)

Sol. in cold NaOH, or KOH+Aq (Proust); but CuO is pptd. on boiling (Berthollet); is not pptd. (Chodnew, J. pr. **28.** 220.)
Insol. in NaOH or KOH+Aq unless they contain organic matter (Berzelius). This is contradicted by Volcker (A. **59.** 34).
Entirely sol. in conc. KOH+Aq, but solution is decomp. by heating. (Fremy, A. ch. (3) **12.** 510.)
Sol. in NaOH+Aq (70% NaOH). (Löw, Z. anal. **9.** 463.)
The solubility in NaOH of CuO_2H_2, prepared either from $CuSO_4$ or $Cu(NO_3)_2$, decreases with decrease in concentration of the base. The solubility of CuO_2H_2 in NaOH is only very slightly affected by the addition of sodium or potassium carbonate. (Fischer, Z. anorg. 1904, **40.** 41.)

Solubility of crystalline CuO_2H_2 in ammoniacal $Ba(OH)_2$ and NaOH solutions at 18°.

Solvent contains per litre	Cu concentration g. atoms per l.
1 mol. NH_3+0 mol. $Ba(OH)_2$	0.01090
" +0.0025 "	0.00907
" +0.005 "	0.00801
" +0.01 "	0.00633
" +0.02 "	0.00526
2 mols. NH_3+0 mol. $Ba(OH)_2$	0.0314
" +0.01 "	0.0277
4 mols. NH_3+0 mol. $Ba(OH)_2$	0.0784
" +0.01 "	0.0747
1 mol. NH_3+0 mol. NaOH	0.0109
" +0.01 "	0.00766
" +0.02 "	0.00655
" +0.03 "	0.00531
" +0.05 "	0.00456
" +0.10 "	0.00410

(Dawson, Chem. Soc. 1909, **95.** 377.)

Solubility of crystalline CuO_2H_2 in ammoniacal salt solutions at 18°.

Solvent contains per litre	Conc. of dissolved Cu. g. atoms per l.
1 mol. NH_3	0.0109
0.05 mol. NH_3+0 01 mol. $(NH_4)_2SO_4$	0.00129
" +0.025 "	0.00511
0.1 mol. NH_3+0.01 mol. $(NH_4)_2SO_4$	0.00326
" +0.025 "	0.0108
" +0.05 "	0.0233
0.2 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.00054
" +0.01 "	0.00649
" +0.025 "	0.0175
" +0.05 "	0.0384
" +0.10 "	0.0690
0.5 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.0033
" +0.01 "	0.0127
" +0.025 "	0.0284
" +0.05 "	0.0536
" +0.10 "	0.1013
" +0.20 "	0.1844
1.0 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.0109
" +0.01 "	0.0210
" +0.025 "	0.0386
" +0.05 "	0.0660
" +0.10 "	0.1185
" +0.20 "	0.2275
" +0.40 "	0.4135
2 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.0314
" +0.01 "	0.0462
" +0.025 "	0.0605
" +0.05 "	0.0886
" +0.10 "	0.1468
" +0.20 "	0.2591
" +0.40 "	0.4718
3 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.0548
" +0.01 "	0.0672
" +0.025 "	0.0847
" +0.05 "	0.1156

Solubility of crystalline CuO_2H_2 in ammoniacal salt solutions at 18°—*Continued*

Solvent contains per litre	Conc. of dissolved Cu. g. atoms per l.
3 mol. NH_3+0.10 mol. $(NH_4)_2SO_4$	0.1740
" +0.20 "	0.2861
" +0.40 "	0.5044
4 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.0784
" +0.01 "	0.0922
" +0 025 "	0.1101
" +0.05 "	0.1397
" +0.10 "	0.2002
" +0.20 "	0.3188
" +0.40 "	0.5451
5 mol. NH_3+0.00 mol. $(NH_4)_2SO_4$	0.1041
" +0.01 "	0.1154
" +0 025 "	0.1320
" +0.05 "	0.1639
" +0.10 "	0.2239
" +0 20 "	0.3415
" +0.40 "	0.5615
1 mol. NH_3+0 00 mol. Na_2SO_4	0.0109
" +0.025 "	0.0134
" +0.10 "	0.0162
" +0 20 "	0.0192
" +0 40 "	0 0784
4 mol. NH_3+0.10 mol. Na_2SO_4	0.0994
" +0.20 "	0.1161

(Dawson, Chem. Soc. 1909, **95.** 377.)

Sl. sol. in alkali carbonates+Aq, especially $KHCO_3$ and $NaHCO_3$. (Berzelius.)

Sol. in cold $Na_2S_2O_3$+Aq, but pptd. on warming. (Field, Chem. Soc. (2) **1.** 28.)

Partially sol. when freshly pptd. in KCN +Aq. (Rodgers, **1834.**)

Sol. in $(NH_4)_2S_2O_8$+Aq. (Moreau, Apoth. Ztg. 1901, **16.** 383.)

Sol. in MSCN+Aq.; more difficultly sol. in NH_4SCN+Aq than ZnO_2H_2. (Grossmann, Z. anorg. 1908, **58.** 269.)

Very sol. in hydroxylamine. (Jannasch and Cohen, J. pr. 1905, (2), **72.** 14.)

Insol. in acetone. (Eidmann, C. C. [illegible], II. 1014.)

Sol. in large amt. in $NaC_2H_3O_2$+Aq. (Mercer, **1844.**)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in cane sugar+Aq, unless an alkali or alkaline earth is present. (Peschier.)

Recently pptd. CuO_2H_2 is easily sol. in cane sugar with NaOH, KOH, or CaO_2H_2+Aq; less sol. in presence of SrO_2H_2 or BaO_2H_2. (Becquerel.)

Not pptd. by KOH+Aq in solutions containing tartaric acid, cane sugar, and many other non-volatile organic substances.

Sol. in Ca, Ba, Sr, K or Na sucrates+Aq, and ppts. of double sucrates form when solutions of the first three bases are heated, but no

ppt. forms in the last two cases even at 100°. (Hunton.)

Insol. in simple Ca, Ba, or K sucrates+Aq, but immediately sol. when an excess of cane sugar+Aq is present. (Peligot.)

Moderately sol. in amyl amine, easily sol. in methyl, less in ethyl amine. (Wurtz.)

Sol. in sorbine+Aq. (Pelouze.)

Not pptd. in presence of aromatic oyxacids or phenols of the ortho series. Thus in presence of salicylic acid, pyrocatechin, gallic acid, pyrogallic acid, etc., NaOH+Aq does not ppt. CuO_2H_2 from Cu solutions, but pptn. is not prevented by benzoic acid, resorcin, hydroquinone, etc. (Weith, B. **9.** 342.)

Sol. in solutions of alkali salts of "spaltungsprodukte" of albumen. (Kalle and Co, Pat. 1901.)

Sol. in starch emulsion which has become thin liquid in an alternating magnetic field. (Rosenthal, C. C. 1908, I. **593.**)

$CuO, 2H_2O$. (Rubénovitch, C. R. 1899, **129.** 336.)

$CuO, 3H_2O$. (Kosmann, Z. anorg. 1893, **3.** 373.)

$2CuO, 3H_2O$. (Cross, Gm.—K. **5.** 1, 753.)

$4CuO, H_2O$. Insol. in NH_4OH+Aq. (Mailhe, A. ch. 1902, (7) **27.** 393.)

Cupric hydroxide ammonia, $CuO_2H_2, 4NH_3$.

Present in ammoniacal solution of CuO_2H_2. (Dawson, Z. phys. Ch. 1909, **69.** 110.)

Cuprous imide, Cu_2NH.

Decomp. at 160° forming Cu_3N.

Readily hydrolysed by H_2O.

Sol. in liquid NH_3 solutions of NH_4NO_3. (Franklin, J. Am. Chem. Soc. 1912, **34.** 1502.)

Cuprous iodide, Cu_2I_2.

Insol. in H_2O, or dil. acids.

Calculated from electrical conductivity of Cu_2I_2+Aq, 1 l. H_2O dissolves about 8 mg. Cu_2I_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Sol. in conc. H_2SO_4. (Vitali, Gm.—K. **5.** 1, 947.)

Sol. with difficulty in conc. HCl+Aq.

Decomp. by conc. HNO_3, or H_2SO_4. Insol. in NaCl, KNO_3, Na_2SO_3, KBr, or NH_4Cl+Aq. Sol. in NH_4OH, $Na_2S_2O_3$, KCN, or KI+Aq. (Renault, C. R. **59.** 558.)

Appreciably sol. in N/10 HCl. Practically insol. in N/10 H_2SO_4. (Moser, Z. anal. 1904, **43.** 604.)

Results of experiments on solubility of Cu_2I_2 in I_2+Aq in presence of acids and salts are given by Bray and MacKay.

Cu_2I_2 was found to be sl. sol. in H_2O but a considerable amt. dissolves in presence of I_2, owing to formation of CuI_2 and CuI_3. (J. Am. Chem. Soc. 1910, **32.** 1207.)

Solubility of Cu_2I_2 in I_2+Aq at 20°.

g. per l. Cu	I	Solid Phase
0.285	0.585	Cu_2I_2
0.482	1.305	"
0.583	1.922	"
0.678	2.557	"
0.756	3.204	"
0.844	3.954	"
0.898	4.436	"
0.964	5.085	"
1.032	5.685	"
1.090	6.282	"
1.112	6.530	"
1.232	7.653	$Cu_2I_2+I_2$
1.040	6.449	I_2
0.898	5.594	"
0.718	4.711	"
0.606	3.856	"
0.448	2.949	"
0.300	2.069	"
0.159	1.230	"
0.925 *	5.461	$Cu_2I_2+I_2$
1.658**	11.366	"

* at 0°. ** at 40°.

(Fedotieff, Z. anorg. 1911, **69.** 26.)

Solubility in NH_4Br+Aq at 20°.

NH_4Br+Aq.	g. Cu_2I_2 in 1 l. of the solution
2–N	1.9068
3–N	3.6540
4–N	6.0588

(Kohn and Klein, Z. anorg. 1912, **77.** 254.)

Sol. in $FeCl_3$+Aq. (Fleischer, C. N. 1869, **19.** 206.)

Solubility in KBr+Aq at t°.

t°	KBr+Aq.	g. Cu_2I_2 in 1 l. of the solution
19.5	2–N	1.4666
24.0	2–N	1.5576
19.5	3–N	3.4094
23.0	3–N	3.5949
22.0	4–N	7.1263
22.0	4–N	6.9768

The solutions undergo change in the course of a few days, iodine being set free; the solubility of the cuprous iodide is not markedly affected thereby.

(Kohn, Z. anorg. 1909, **63.** 337.)

1 l. of a 0.2N solution of KI dissolves 0.000157 g. mol. Cu_2I_2. (Bodländer, Z. anorg. 1902, **31.** 475.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Practically insol. in methylene iodide. (Retgers, Z. anorg. 1893, **3.** 347.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in acetone (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014.)

100 g. acetonitrile dissolve 3.52 g. Cu_2I_2 at 18°. (Naumann and Schier, B. 1914, **47.** 249.)

Min. *Marshite.* (Gm.—K. **5.** 1, 945.)

Cupric iodide, CuI_2.

Exists only in very dil. aqueous solution. (Traube, B. **17.** 1064.)

Copper *per*iodide, CuI_4.

Sol. in H_2O. (Walker and Dover, Chem. Soc. 1905, **87.** 1588.)

Copper ammonium iodide ammonia.

See **Cupriammonium iodide ammonia.**

Cuprous mercuric iodide, Cu_2I_2, HgI_2.

KI+Aq dissolves out HgI_2.

Cuprous mercuric iodide ammonia, CuI_2, $2HgI_2$, $4NH_3$.

Decomp. by H_2O or acids. Sol. in a mixture of acetic acid and alcohol.

CuI_2, HgI_2, $4NH_3$. As above. (Jörgensen, J. pr. (2) **2.** 347.)

Cupric nitrogen iodide, CuI_2, $N_2H_4I_2$.

Decomp. by H_2O; or NH_4OH+Aq. (Guyard, C. R. **97.** 526.)

Cupric thallic iodide ammonia, CuI_2, $2TlI_3$, $4NH_3$.

Decomp. slowly by H_2O. Sol. in NH_4OH+Aq with decomp. Sol. in alcohol.

Cuprous iodide ammonia, Cu_2I_2, NH_3.

Ppt. (Anderline, Gazz. ch. it. 1912, **42.** I, 321.)

$+4H_2O$. Insol. in H_2O. Very sol. in NH_4OH+Aq. (Silberrad, Chem. Soc. 1905, **87.** 67.)

Cu_2I_2, $3NH_3$. (Lloyd, J. phys. Chem. 1908, **12.** 399.)

Cu_2I_2, $4NH_3$. (Levol, J. Pharm. **4.** 328.)

$+H_2O$. (Saglier, C. R. **104.** 1440.)

Cu_2I_2, $6NH_3$. (Lloyd.)

Cupric iodide ammonia, CuI_2, $4NH_3+H_2O$.

Decomp. by H_2O. Sol. in NH_4OH+Aq without decomp. Not attacked by cold alcohol or ether. (Berthemont, J. Pharm. **15.** 445.) (Pozzi-Escot, C. R. 1900, **130.** 90.)

CuI_2, $6NH_3$. Sol. in liquid NH_3. (Horn, Am. Ch. J. 1908, **39.** 205.)

$3CuI_2$, $10NH_3$. Decomp. by H_2O. (Richards, Am. Ch. J. 1895, **17.** 302.)

Sol. in liq. NH_3. (Horn, Am. Ch. J. 1908, **39.** 204.)

Cupriammonium iodide ammonia, $3Cu(NH_3)_2I_2$, $4NH_3$.

Decomp. by air and by H_2O. (Richards, Am. Ch. J. 1895, **17.** 302.

Copper *per*iodide ammonia, 2CuI, I_4, $5NH_3$ $+H_2O$.

Because of its insolubility it cannot be recryst from any solvent. (Silberrad, Chem. Soc. 1905, **87.** 66.)

Copper *tetra*iodide, ammonia, CuI_4, $4NH_3$.

(Jörgensen, J. pr. (2) **2.** 353.)

Copper *hexa*iodide ammonia, CuI_6, $4NH_3$.

Not decomp. in H_2O in closed vessels. (Jörgensen.)

Copper mercuric iodide ammonia, $CuHg_3I_6$, $5NH_3$.

$CuHgI_3$, $2NH_3$. Ppt. Decomp. by H_2O and by alcohol.

$CuHg_2I_5$, $3NH_3$. Ppt. Decomp. by long washing with H_2O.

$CuHg_2I_5$, $4NH_3$. Ppt. Decomp. by H_2O. Sl. attacked by abs. alcohol.

CuI_2, HgI_2, $4NH_3$. Ppt. (Anderline, Gazz. ch. it. 1912, **42,** (1) 321; C. C. 1912, II. 95.)

Copper nitride, Cu_6N_2.

Decomp. by dil. or conc. acids.

Easily decomp. by H_2O when finely powdered. (Rossel, C. R. 1895, **121.** 942.)

Copper *sub*oxide, Cu_4O.

Not attacked by H_2O. Decomp. by dil. H_2SO_4+Aq into Cu and $CuSO_4$; dil. HCl+Aq has similar action. Not attacked by NH_4OH +Aq or $NH_4OH+(NH_4)_2CO_3$+Aq. (Rose, Pogg. **120.** 1.)

Cu_3O. Not attacked by dil. or conc. min. acids, even aqua regia. Slowly **sol. in HF+Aq.** (Bailey and Hopkins, Chem. Soc. 1890, **57.** 272.)

Is a solution of oxide in Cu. (Jordis, Zeit. angew. Ch. 1908, **21.** 51.)

Cuprous oxide, Cu_2O.

Insol. in H_2O. Decomp. by H_2SO_4+Aq, H_3PO_4+Aq, or cold very dil. HNO_3+Aq into a cupric salt and Cu. Converted by HCl+Aq into cuprous chloride.

Solubility of Cu_2O in NH_4OH+Aq at 25°.

Conc. of total Cu		Conc. of total NH_3	
G. in 1000 g. of solution	G. mol. in 1000 g. of solution	G. in 1000 g. of solution	G. mol. in 1000 g. of solution
Preparation I			
0.3593	0.00566	3.91	0.23
0.5024	0.00791	12.07	0.71
0.6869	0.01080	13.77	0.81
0.6964	0.01095	16.15	0.95
1.0144	0.01597	27.03	1.59
1.0462	0.01645	32.64	1.92
1.0557	0.01660	36.89	2.17
1.2243	0.01924	45.73	2.69
1.3229	0.02081	68.68	4.04
1.4882	0.02340	74.12	4.36
1.5105	0.02375	81.26	4.78
1.6313	0.02565	98.52	5.56
1.6981	0.02670	122.40	7.20
Preparation II			
0.4229	0.00665	7.82	0.46
0.6678	0.01050	8.16	0.48
0.9890	0.01555	22.61	1.33
1.0494	0.01650	28.39	1.67
1.3528	0.02127	54.15	3.19
1.5047	0.02366	72.08	4.24
1.5963	0.02510	78.20	4.60
1.6555	0.02603	102.05	6.00

(Donnan and Thomas, Chem. Soc. 1911, **99.** 1791.)

Sol. in boiling NH_4Cl+Aq. (Rose.)

Sl. sol. in excess of KOH+Aq. (Chodnew.)

Sol. in conc. $MgCl_2$, and $FeCl_2$+Aq. (Hunt, C. R. **69.** 1357.)

Sl. attacked by liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)

Min. *Cuprite.* Sol. in HCl, HNO_3, and NH_4OH+Aq.

Cupric oxide, CuO.

Insol. in H_2O. Easily sol. in acids. Sol. in H_2SO_3+Aq. Insol. in NH_4OH+Aq, but dissolves on addition of a few drops of acid or $(NH_4)_2CO_3$+Aq. Insol. in dil., but sol. in warm conc. NaOH, and KOH+Aq. (Low, Z. anal. **9.** 463.)

CuO prepared at a low temp. is easily sol. in dil. acids, but when ignited is slowly sol. in boiling conc. acids, but moderately rapidly in a cold mixture of NH_4I+HCl. (Joannis, C. R. 1886, **102.** 1161.)

Solubility in N-HNO_3. 1 l. of the solution contains 0.4802 g. atoms Cu at 25°. (Jaeger, Z. anorg. 1901, 27, 33.)

Solubility of CuO in HF+Aq at 25°.

	Time	G. CuO in 10 ccm. of the solution
0.25N-HF	1¼ hrs.	0.0431
	3¾ "	0.0619
	25¼ "	0.0812
	71½ "	0.0823
	170½ "	0.0907
N-HF (a)	5½ "	0.3018
	21½ "	0.2797
	52 "	0.2747
	201½ "	0.2339
	226½ "	0.2353
N-HF (b)	4¼ "	0.3220
	44¼ "	0.2930
	117¾ "	0.2431
	167¾ "	0.2219
2.02N-HF	1½ "	0.3646
	5 "	0.4533
	71½ "	0.3583
	156½ "	0.3311

(Deussen, Z. anorg. 1905, **44.** 421.)

Solubility of CuO in HF at 25°.
Cu = g-atoms Cu in 1 l. of the solution.

HF normality	Cu
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.08	0.388
2.28	0.463

(Jaeger, Z. anorg. 1901, **27.** 29.)

Solubility of CuO in HF+KF at 25°.
Cu = g-atoms Cu in 1 l. of the solution.

HF normality	Cu
0.12	0.0356
0.28	0.06437
0.57	0.1442
1.11(1.08)	0.2451
2.17(2.28)	0.2517

(Jaeger, l. c.)

Sl. sol. in large excess of KOH+Aq. (de Coninck, C. C. **1904,** II, 65.)

Slowly sol. in boiling NH_4Cl+Aq, and less easily in NH_4NO_3+Aq. (Rose.)

Sol. in boiling H_2O solutions of Al_2, Gl, U, Cr_2, Fe_2, or Bi nitrates and chlorides, $Hg(NO_3)_2$, $Hg_2(NO_3)_2$, $SbCl_3$, $SnCl_2$, and $SnCl_4$, with pptn. of oxides of the bases of those salts. Unacted upon by boiling H_2O solutions of Mn, Mg, Ni, Co, Zn, Ce, or

Fe nitrates or chlorides, $AgNO_3$, $Pb(NO_3)_2$, $Cd(NO_3)_2$, and $HgCl_2$. (Persoz.)

Pure CuO is very sl. sol. in NH_4OH+Aq but the solution is greatly increased by the addition of NH_4 salts. (Muthmann, C. C. **1904.** II, 410.)

Sol. in hot $(NH_4)_2SO_4$ or $(NH_4)_2SO_3$+Aq. (Jumau, Electrochem. Ind. 1908, **6.** 258.)

15% dissolves in $(NH_4)_2CO_3$+Aq in 24 hrs. (Schnabel, Z. B. H. Sal. 1880, **28.** 282.)

Sl. attacked by liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Solubility in N-acetic acid. 1 l. of the solution contains 0.1677 g-atoms Cu at 25°. (Jaeger, Z. anorg. 1902, **27.** 33.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Sl. sol. in benzamide. (Dessaignes, A. ch. 1852, (3), **34.** 146.)

Insol. in piperidine. (Cahours, C. R. 1852, **34.** 481.)

Sol. in acid amines as asparagin. (Piria, A. ch. 1848, (3), **22.** 160.)

Sol. in amines alone or mixed with NH_3. (Lance, Dissert. **1905.**)

Slowly sol. in Ca or any other alkali sucrate+Aq, but not in cane sugar+Aq. (Hunton.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 10.26 g. CuO.

1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 5.68 g. CuO.

1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 3.47 g. CuO. (Bodenbender, J. B. **1865.** 600.)

Polypeptides in aqueous solution dissolve CuO by short boiling. (Fischer, B. 1906, **39.** 576.)

$+{}^1/_6H_2O = 6CuO+H_2O$. Insol. in dil., but sol. in conc. KOH or NaOH +Aq.

Sol. in volatile oils.

See also **Cupric hydroxide.**

Min. *Melaconite.* Sol. in HCl, or HNO_3+Aq.

Cuprocupric oxide, $Cu_5O_3 = 2Cu_2O$, CuO.

(Favre and Maumené.)

$Cu_3O_2+H_2O = Cu_2O$, $CuO+H_2O$. When freshly pptd., sol. in HCl+Aq, but insol. after drying. (Siewert, J. B. **1866.** 257.)

$Cu_4O_3 = Cu_2O$, 2CuO. (Siewert.)

All oxides of Cu except Cu_4O, Cu_2O, CuO, and CuO_2 are mixtures. (Osborne, Sill. Am. J. (3) **32.** 33; Debray, C. R. **99.** 583.)

Copper *di*oxide, CuO_2+H_2O.

Insol. in H_2O. Decomp. by acids with formation of cupric salt and H_2O_2. (Weltzien, A. **140.** 207.)

Cuprous oxide ammonia (**cuprosammonium oxide**).

Known only in solution. (Wagner, C. C. **1863.** 239.)

Cupric oxide ammonia (**cuprammonium hydroxide**), 3CuO, $4NH_3+6H_2O$.

Insol. in H_2O. (Kane, A. ch. **72.** 283.)

CuO, $4NH_3+4H_2O$. Very deliquescent. Decomp. in the air and by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9.** 438.)

Cuprous oxybromide, Cu_2Br_2, $CuO+H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxybromide, $CuBr_2$, $3CuO+3H_2O$.

Insol. in H_2O. Easily sol. in dil. acids or NH_4OH+Aq. (Brun, C. R. **109.** 66.)

Insol. in H_2O but decomp. by continued boiling. Sol. in conc. acetic acid, sl. sol. in conc. $CuBr_2$+Aq. Insol. in dil. KBr+Aq. (Richards, Proc. Am. Acad. 1890, **25.** 215.)

Cupric oxybromide ammonia, 2CuO, $CuBr_2$, $2NH_3+3H_2O$.

(Kohlschütter and Pudschies, B. 1904, **37.** 1159.)

Cuprous oxychloride, Cu_2Cl_2, $CuO+3H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxychloride, CuO, $CuCl_2+H_2O$.

Decomp. by H_2O. (Rousseau, C. R. 1890, **110.** 1263.)

2CuO, $CuCl_2$. Insol. in H_2O. Sol. in HCl +Aq, from which it is reprecipitated by dilution with H_2O.

$+H_2O$. (Kane, A. ch. **72.** 277.)

$+4H_2O$. (Gladstone, Chem. Soc. **8.** 211.)

3CuO, $CuCl_2+2H_2O$. (Miller and Kenrick, Trans. Roy. Soc. Can. 1901, (2) **8,** III. 35.)

$+3H_2O$. (Dupont and Jansen, Bull. Soc. 1893, (3), **9.** 193.)

$+3\frac{1}{2}H_2O$. Insol. in cold H_2O, sl. decomp. by boiling. (Reindel, J. pr. **106.** 378.)

Insol. in boiling H_2O. (Habermann, W. A. B. **90.** 2. 268.)

$+4H_2O$. Sol. in alkaline solution of KNa tartrate. (Gröger, Z. anorg. 1902, **31.** 327.)

(*Brunswick green*). Insol. in H_2O. Easily sol. in acids.

Min. *Atacamite.* Sol. in acids, and NH_4OH +Aq.

Sol. in cold sat. citric acid+Aq. (Bolton, B. 1880, **13.** 732.)

4CuO, $CuCl_2+6H_2O$. (Kane, Gm.—K. **5.** 1, 919.)

$+8H_2O$. Min. *Tallingite.* (Church, Gm. —K. **5.** 1, 919.)

$5Cu(OH)_2$, $Cu_2Cl_2Cl(OH)$. Insol. in H_2O. Decomp. by hot H_2O. (Kühling, B. 1901, **34.** 2852.)

7CuO, $2CuCl_2+9H_2O$. (Reindel.)

6CuO, $CuCl_2+9H_2O$. Insol. in H_2O. Sol. in acetic acid. (Neumann, Repert, **37.** 304.)

8CuO, $CuCl_2+12H_2O$. Min. *Footeite.* (König, Zeit. Kryst. 1891, **19.** 601.)

Cupric zinc oxychloride, ZnO, $2ZnCl_2$, $5CuO + 6H_2O$.

(André, C. R. 1888, **106.** 855.)

Cupric oxychloride ammonia, $2CuO$, $CuCl_2$, $2NH_3 + 3H_2O$.

(Dehérain, Gm.—K. **5.** 1, 932.)

Cupric oxyfluoride, CuO, $CuF_2 + H_2O$.

Insol. in H_2O. (Berzelius.) (Balbiano, Gazz. ch. it. **14.** 74.)

Cupric oxyfluoride ammonia (cuprammonium oxyfluoride), $Cu(OH)F$, $2NH_3$.

(Balbiano, Gazz. ch. it. **14.** 74.)

$3CuO$, $CuI_2 + xH_2O$. (Tschiriwinski, Gm. —K, **5.** 1, 1584.)

Cuprous oxyiodide, Cu_2I_2, $CuO + H_2O$.

(Spring and Lucion, Bull. Ac. Belg. (3) **24.** 21.)

Cupric oxyiodide, $2CuI_2$, $CuO + 4H_2O$.

Easily decomp. by H_2O. (Carnegie, Watts' Dict. II, 257.)

Copper oxysulphide, $2Cu_2S$, CuO.

Insol. in H_2O. (Maumené, A. ch. (3) **18.** 311.

$5CuS$, CuO. Ppt. (Pelouze.)

$2CuS$, CuO. Insol. in H_2O.

CuS, CuO. Insol. in H_2O.

Above comps. do not exist. (Pickering, Chem. Soc. **33.** 136.)

Copper phosphide, Cu_6P_2.

Easily sol. in HNO_3 or aqua regia; insol. in $HCl + Aq$. (Rose, Pogg. **6.** 209.)

Sol. in HNO_3 and $Br_2 + Aq$. Decomp. by hot conc. H_2SO_4. (Rubénovitch, C. R. 1899, **128.** 1399.)

Cu_2P. Sol. in $HNO_3 + Aq$. (Granger, A. ch. 1898, (7), **14.** 64.)

Crystallized. Completely sol. in hot HNO_3, aqua regia and $HF + HNO_3$. Slowly sol. in hot HCl or H_2SO_4. Not attacked by hot or cold HF or acetic acid. (Maronneau, C. R. 1899, **128.** 939.)

Cu_3P_2. Easily sol. in HNO_3. Sol. in hot conc. H_2SO_4. Sol. in conc. $HCl + Aq$ before the phosphide has been heated. (Rose, Pogg. **4.** 110.)

Cu_2P_2. Easily sol. in HNO_3, or $HCl + Aq$. Sol. in $NH_4OH + Aq$. (Granger, Bull. Soc. (3) **9.** 661.)

CuP_2. Decomp. by HNO_3; not readily sol. in HCl. Easily attacked by Cl_2 or $Br_4 + Aq$. (Granger, C. R. 1895, **120.** 924.)

Cu_5P_2. (Granger, C. N. 1898, **77.** 229.)

Very sol. in HNO_3 and $Br_2 + Aq$. Decomp. by hot conc. H_2SO_4. (Rubénovitch, C. R. 1899, **129.** 338.)

Cupric zinc phosphide, $10Cu_6P_2$, Zn_3P_2(?).

(Hvoslef, A. **100.** 99.)

Copper phosphoselenide, $CuSe$, P_2Se.

Insol. in H_2O or $HCl + Aq$; sol. in $HNO_3 + Aq$. Insol. in cold alkalies, but decomp. slowly when heated therewith. (Hahn, J. pr. **93.** 436.)

$2CuSe$, P_2Se_3. Attacked only by fuming HNO_3. (Hahn.)

$2CuSe$, P_2Se_5. Sol. only in $HNO_3 + Aq$. (Hahn.)

Copper phosphosulphide, $2Cu_2S$, P_2S.

Cu_2S, P_2S. (Berzelius.)

$2Cu_2S$, P_2S_3. (Berzelius.)

CuS, P_2S. Insol. in H_2O and dil. $HCl + Aq$. Sol. in conc. $HCl + Aq$, from which it is precipitated by H_2O. (Berzelius, A. **46.** 252.)

$8CuS$, P_2S_5. (Berzelius.)

Cu_4PS_3. Sol. in conc. HNO_3 and in aqua regia. Insol. in HCl. Not attacked by hot H_2SO_4 or conc. $NaOH + Aq$. (Ferrand, A. ch. 1899, (7), **17.** 407.)

Cuprous selenide, Cu_2Se.

Ppt. Sol. in HCl and in H_2SO_4.

Decomp. by HNO_3. Sol. in $NH_4OH + Aq$. (Fonzes-Diacon, C. R. 1900, **131.** 1207.)

Sol. in $KCN + Aq$. (Heyn and Bauer, Metall. 1906, **3.** 84.)

Min. *Berzelianite.*

Cupric selenide, $CuSe$.

(Little, A. **112.** 211.)

Ppt. Sol. in HCl and in H_2SO_4. Decomp. by HNO_3. (Fonzes-Diacon, C. R. 1900, **131.** 1207.)

Cuprocupric selenide, Cu_3Se_2.

Min. *Umangite.* Sol. in HNO_3. (Klockmann, Zeit. Kryst. **1891.** 19, 270.)

Cuprous lead selenide, $3Cu_2Se$, $PbSe$.

Min. *Zorgite.* Sol. in cold conc. $HNO_3 + Aq$ with separation of Se.

Cupric lead selenide, $CuSe$, $PbSe$.

Sol. in cold conc. HNO_3 with separation of Se. (Karsten.)

$CuSe$, $2PbSe$. As above.

$CuSe$, $4PbSe$. As above.

Cuprous silver selenide, Cu_2Se, Ag_2Se.

Min. *Eucainite.* Sol. in hot HNO_3 with decomp. (Berzelius.)

Cuprous silicide, Cu_4Si.

Sol. in warm dil. or conc. HNO_3. Only sl. sol. in HCl, H_2SO_4 and HF. Sol. in a mixture of HNO_3 and HF. Not attacked by solutions of alkalies. (Vigouroux, C. R. 1906, **142.** 88.)

Cu_2Si_3. Sol. in aqua regia and fused sodium potassium carbonate. (de Chalmot, Am. Ch. J. **1896**, 18, 95.)

Cu_2Si. Decomp. by water and moist air, and by acids and fused alkali. (Vigouroux, C. R. 1896, **122.** 319.)

Cuprous sulphide, Cu_2S.

More sol. in H_2O than Ag_2S, but much less than PbS. (Bodländer, Z. phys. Ch. **1898.** 27, 64.)

1 l. H_2O dissolves $3.1+10^{-6}$ moles Cu_2S at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Very slowly decomp. by dil. H_2SO_4 in presence of oxygen. (Thompson, Electrochem, Ind. **1904.** 2, 225.)

Decomp. by conc. H_2SO_4. (Pickering, C. N **1878,** 37, 37.)

Cold HNO_3+Aq dissolves out Cu and leaves CuS; hot HNO_2 dissolves with separation of S. Sl. sol. in boiling conc. HCl+Aq. Insol. in $(NH_4)_2S$+Aq.

5N-HCl dissolves Cu_2S very slightly (0.0038 g. Cu in 7½ hrs.) but it is more sol. in presence of Cl, when 0.672 g. are dissolved in 7½ hours. (Egli, Z. anorg. 1902, **30.** 46.)

Sol. with exclusion of air in NH_4OH+Aq. (Malzac, Pat. **1904.**)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Min. *Chalcocite.* Completely sol. in warm HNO_3 with separation of S.

Cupric sulphide, CuS.

Almost absolutely insol. in H_2O; sol. in 950,000 pts. H_2O. When exposed to the air, dissolves in H_2O as $CuSO_4$. Easily sol. in boiling HNO_3 with separation of S. Difficultly sol. in hot conc. HCl+Aq. Insol. in dil. H_2SO_4+Aq (1:6). (Hoffmann, A. **115.** 286.

Pptd. by H_2S or $(NH_4)_2S$+Aq in presence of 100,000 pts. H_2O (Pfaff), 200,000 pts. H_2O (Lassaigne), 15,000 pts. H_2O and 7500 pts. HCl, but with 40,000 pts. H_2O and 20,000 pts. HCl no colour is visible (Reinsch).

1 l. H_2O dissolves $3.51+10^{-6}$ moles CuS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in H_2SO_3+Aq. (Guerout, C. R. 1872, **75.** 1276.)

Decomp. by conc. H_2SO_4. (Kliche, J. B. **1890,** 593.)

Sol. in $(NH_4)_2CO_3$+Aq. (Berzelius.) Sol. in alkali bicarbonates +Aq.

Insol. in NH_4NO_3, or NH_4Cl+Aq. (Brett.)

Insol. in acidified conc. alkali chlorides+Aq. (Cushmann, Am. Ch. J. **1895,** 17, 382.)

Sol. in $FeCl_3$+Aq with separation of S. (Cumenge and Wimmer, Dingl. 1883, **250.** 123.)

Decomp. by boiling $CuCl_2$+Aq in presence of HCl or NaCl. (Raschig, Gm.—K. **5.** 1, 819.)

Sol. in $Fe_2(SO_4)_3$+Aq in presence of large excess of air. (Thómpson, Electrochem. Ind. **1904,** 2, 228.)

Insol. in KOH, or K_2S+Aq, especially if boiling; appreciably sol. in colourless and even more readily in hot yellow $(NH_4)_2S$+Aq.

Sl. sol. in Na_2S+Aq, more easily in NaSH+Aq. (Becker, Sill. Am. J. (3) **33.** 199.)

100 cc. sat. Na_2S+Aq (sp. gr. = 1.225) dissolve 0.0032 g. CuS. (Holland, Ann. Chim. Anal. 1897, **2.** 243.)

Sol. in K polysulphides (3-64%). (Prost, Bull. Soc. Belg. Chim. **1897.** 103.)

Appreciably sol. in alkali polysulphides + Aq. (Rössing, Z. anal. 1902, **41,** 1.)

Sol. in considerable quantity in alkali sulpharsenates, sulphantimonates, and sulphostannates+Aq. Therefore when a mixed ppt. of CuS and As_2S_3, Sb_2S_3, or SnS is treated with K_2S, a portion of the CuS is dissolved. (Wöhler, A. **34.** 236.)

Sol. in alkali sulphovandates, or sulphotungstates+Aq. (Storch, B. **16.** 2015.)

Sol. in alkali sulphomolybdates + Aq. (Debray, C. R. **96.** 1616.)

Insol. in K thiocarbonate + Aq. (Rosenbladt, Z. anal. **26.** 15.)

Sol. in KCN+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Insol. in Na xanthogenate. (Ragg, Ch. Z. 1908, **32.** 677.)

Solubility of CuS in sugar+Aq at t°.
g. CuS per l. of solution.

t°	10% sugar	30% sugar	50% sugar
17.5	0.5672	0.8632	0.9076
45	0.3659	0.7220	1.0589
75	1.1345	1.2033	1.2809

(Stolle, Z. Ver. Zuckerind. 1900, **50.** 331.)

Min. *Covellite.*

Colloidal. Aqueous solution is stable when it contains 5 g. CuS in a litre; when it contains 4 or 5 times that amount it is decomposed in an hour.

Solutions of salts of the following concentration cause a precipitate in the above solution. Salts of univalent elements—

Salts of univalent elements—

$K_3Fe(CN)_6$	1 : 62
$K_4Fe(CN)_6$	1 : 127
$Na_2S_2O_3$	1 : 157
Na_2CO_3	1 : 200
Na_2HPO_4	1 : 252
Na_2SO_4	1 : 333
$K_2Cr_2O_7$	1 : 2083
KI	1 : 80
KBr	1 : 133
$KClO_3$	1 : 166

Salts of univalent elements—*Continued.*

$NaC_2H_3O_2$	1 : 221
$(NH_4)_2C_2O_4$	1 : 255
NaCl	1 : 400
$NaHCO_3$	1 : 2500
K_2SO_4	1 : 117
K_2CrO_4	1 : 133
$NaC_7H_5O_2$	1 : 166
$K_2S_2O_6$	1 : 222
KCl	1 : 333
KNO_3	1 : 500

Salts of bivalent metals—

BaS_2O_6	1 : 2242
$Cd(NO_3)_2$	1 : 3483
$MgSO_4$	1 : 6830
$Ba(NO_3)_2$	1 : 2677
$BaCl_2$	1 : 3921
$Pb(ClO_3)_2$	1 : 6988
$CdSO_4$	1 : 3442
$MnSO_4$	1 : 5518

Salts of trivalent metals—

Ammonia alum	1 : 31,896
Chrome alum	1 : 58,889
$Al_2(SO_4)_3$	1 : 90,909

Acids—

Succinic	1 : 100
Oxalic	1 : 162
HCl	1 : 733
H_2SO_4	1 : 208
Citric	1 : 20
Acetic	Not at all
Tartaric	" "

(Spring and de Boeck, Bull. Soc. (2) **58.** 165.)

Copper *poly*sulphide, Cu_2S_3.

Amorphous. Ppt. Decomp. by boiling alcohol. (Rössing, Z. anorg. 1900, **25.** 413.)

Cu_4S_5. *Amorphous.* Ppt. can be boiled with H_2O without decomposition. (Rössing, Z. anorg. 1900, **25.** 4, 11.)

Cu_2S_5. Ppt.; insol. in alkali sulphides; decomp. by conc. HNO_3. (Bodroux, C. R. 1900, **130.** 1398.)

Could not be obtained. (Rössing, Z. anorg. 1900, **25.** 414.)

Cu_2S_6. Ppt. Decomp. by H_2O. Sol. in alkali and barium polysulphides+Aq. Decomp. by colorless alkali sulphides+Aq. (Rössing, Z. anorg. 1900, **25.** 407.)

Cuprous iron (ferric) sulphide, Cu_2S, Fe_2S_3.

Decomp. by conc. HCl+Aq. Sol. in boiling HNO_3+Aq of 1.2 sp. gr. (Schneider, J. pr. (2) **38.** 569.)

Min. *Chalcopyrite.* Insol. in HCl+Aq. When heated in a sealed tube with H_2S+Aq, a portion of it dissolves with difficulty and subsequent deposition of S. (Senarmont, A. ch. (3) **32.** 168.)

Cuprocupric iron (ferric) sulphide, Cu_2S, CuS, FeS.

Min. *Bornite.* Sol. in HCl+Aq with a residue of S.

Cupric iron (ferric) sulphide, CuS, Fe_2S_3.

Min. *Cubanite.*

Copper iron potassium sulphide, $K_2FeCu_2S_4$.

Sl. attacked by cold dil. HCl+Aq. Decomp. by warming. (Schneider, Pogg. **138.** 318.)

Copper iron sodium sulphide, $Na_2FeCu_2S_4$.

Sl. attacked by cold dil., easily decomp. by hot HCl+Aq. (Schneider, Pogg. **138.** 318.)

Cuprous lead sulphide, $9Cu_2S$, 2PbS.

$3Cu_2S$, 2PbS.

$2Cu_2S$, 2PbS. Min. *Cuproplumbite.*

Copper phosphorus sulphide.

See **Copper phosphosulphide.**

Cupric platinum sulphide.

See **Sulphoplatinate, cupric.**

Cuprous potassium sulphide, $4Cu_2S$, K_2S.

(Ditte, C. R. **98.** 1429.)

Cuprocupric potassium sulphide, $3Cu_2S$, 2CuS, K_2S.

Not decomp. by very dil. HCl+Aq, but easily by conc. HCl+Aq on warming. (Schneider, Pogg. **138.** 311.)

Copper potassium *poly*sulphide, $KCuS_4$.

Sl. sol. in cold H_2O. Decomp. by hot H_2O. Decomp. by conc. and dil. HCl, H_2SO_4 and HNO_3. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, **40.** 977.)

$2CuS_3$, K_2S. Decomp. by H_2O, NH_4OH, or NH_4SH+Aq. (Priwoznik, B. **5.** 1291.)

$K_2Cu_3S_{10}$. Easily sol. in H_2O. 1 g. is sol. in less than 5 ccm. H_2O. Rapidly decomp. by dil. acids, slowly by conc. acids. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, **40.** 983.)

Cupric rubidium *poly*sulphide, $RbCuS_4$.

As K salt. (Biltz and Herms, B. 1907, **40.** 978.)

$Rb_2Cu_3S_{10}$. Easily sol. in H_2O. Decomp. by acids. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, **40.** 985.)

Cuprous silver sulphide, Cu_2S, Ag_2S.

Min. *Stromeyerite.* Sol. in HNO_3+Aq with separation of S.

Cu_2S, $3Ag_2S$. Min. *Jalpaite.* As above.

Cuprous sodium sulphide, Na_2S, Cu_2S.

(Bodländer, Z. Elektrochem. 1905, **11.** 181.)

Na_2S, $2Cu_2S$. (Bodländer, Z. Elektrochem. 1905, **11.** 181.)

Cuprocupric sodium sulphide, Cu_2S, CuS, Na_2S.

Scarcely decomp. by cold dil. HCl+Aq; conc. HCl+Aq decomp. easily on warming, without, however, dissolving all the Cu_2S. Completely decomp. by warm HNO_3+Aq. (Schneider, Pogg. **138.** 315.)

Copper zinc sulphide, CuS, $3ZnS$.

Copper sulphophosphide.
See **Copper phosphosulphide.**

Cupric telluride, $CuTe$.

Cu_2Te_3. Insol. in H_2O. (Parkmann, Sill. Am. J. (2) **3.** 335.)

Cu_2Te. (Brauner, M. **1889.** 423.)

Croceocobaltic bromide,
$Co(NH_3)_4(NO_2)_2Br$.

Very sl. sol. in cold, easily in hot H_2O. (Gibbs, Proc. Am. Acad. **10.** 1.)

—— **chloraurate,** $2Co(NH_3)_4(NO_2)_2Cl, AuCl_3$.
Difficultly sol. in H_2O.

—— **chloride,** $Co(NH_3)_4(NO_2)_2Cl$.

Very sl. sol. in cold easily in hot H_2O, but more sol. than the sulphate. (Gibbs.)

—— **chloroplatinate,** $2Co(NH_3)_4(NO_2)_2Cl, PtCl_4$.

Can be recrystallised without decomp. with difficulty. (Gibbs and Genth, Sill. Am. J. (2) **24.** 91.)

—— **chromate,** $[Co(NH_3)_4(NO_2)_2]_2CrO_4$.
Sl. sol. in H_2O. (Gibbs.)

—— ***di*chromate,** $[Co(NH_3)_4(NO_2)_2]_2Cr_2O_7$
Sl. sol. in H_2O. (Gibbs.)

—— ***per*iodide,** $Co(NH_3)_4(NO_2)_2I, I_2$.

Difficultly sol. in cold H_2O and alcohol. Decomp. by hot H_2O. (Gibbs.)

—— **nitrate,** $Co(NH_3)_4(NO_2)_2NO_3$.

Sl. sol. in cold, easily sol. in hot H_2O or dil. acids. Much more sol. than the sulphate. (Gibbs.)

Sol. in about 400 pts. cold H_2O. (Jörgensen, Z. anorg. **5.** 163.)

—— **nitrite cobaltic nitrite,** $3Co(NH_3)_4(NO_2)_2, Co(NO_2)_3$.

Somewhat sol. in H_2O. (Jörgensen, Z. anorg. **5.** 178.)

—— **nitrite *di*amine cobaltic nitrite,** $Co(NH_3)_4(NO_2)_2, (NO_2)_2(NH_3)_2Co(NO_2)_2$.

Nearly insol. in cold, very sl. sol. in boiling H_2O. (Jörgensen.)

Croceocobaltic phosphomolybdate,
$[Co(NH_3)_4(NO_2)_2]_2O, 24MoO_3, P_2O_5$.

Sl. sol. in cold, easily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 317.)

—— **sulphate,** $[Co(NH_3)_4(NO_2)_2]_2SO_4$.

Very sl. sol. in cold or hot H_2O; more easily in hot dil. H_2SO_4+Aq.

Cuprammonium compounds.
See **Copper compounds, ammonia.**

Cupro*tetr*ammonium *tetra*iodide.
See **Cupric *tetra*iodide ammonia.**

Cupric acid.

Known only in solution. (Krüger, Pogg. **62.** 445.)

Calcium cuprate.

Decomp. by H_2O with evolution of oxygen. (Krüger and Crum, A. **55.** 213.)

Cyanhydric acid, HCN.

Miscible with H_2O, alcohol, and ether with absorption of heat.

Sp. gr. of HCN+Aq.

% HCN	Sp. gr.	% HCN	Sp. gr.
1.60	0.9979	4.0	0.9940
1.68	0.9978	4.6	0.9930
1.77	0.9975	5.0	0.9923
2.0	0.9974	5.3	0.9914
2.1	0.9973	5.8	0.9900
2.3	0.9970	6.4	0.9890
2.5	0.9967	7.3	0.9870
2.7	0.9964	8.0	0.9840
3.0	0.9958	9.1	0.9815
3.2	0.9952	10.6	0.9768
3.6	0.9945	16.0	0.9570

(Ure, Quar. J. Sci. **13.** 321.)

$2HCN$ mixed with $3H_2O$ causes a diminution of temp. of 9.75°. (Bussy and Buignet, A. ch. (4) **3.** 231.)

Miscible with volatile oils and other organic compounds.

Cyanhydric iodhydric acid, HI, HCN.

Easily sol. in H_2O or alcohol, with rapid decomp. Sl. sol. in ether. (Gal, A. **138.** 38.)

Cyanides.

The alkali cyanides are easily sol. in H_2O; those of the alkali-earths are less sol., while all others are insol. with the exception of $Hg(CN)_2$. All cyanides are sol. in KCN+Aq.

Ammonium cyanide, NH_4CN.

Unstable; easily sol. in H_2O and alcohol.

Ammonium cobaltic mercuric cyanide.
See **Cobalticyanide, ammonium mercuric.**

Ammonium cuprous cyanide, NH_4CN, $Cu_2(CN)_2$.
Ppt. Decomp. by acids.
$+H_2O$. Sol. in H_2O, less sol. in alcohol. Decomp. by acids and alkalies. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 90.)
$2NH_4CN, Cu_2(CN)_2$. Sl. sol. in H_2O, but decomp. by long boiling therewith. Sol. in HCN+Aq. (Dufau, A. **88.** 278.)

Ammonium cuprous cyanide ammonia, $NH_4CN, 2Cu_2(CN)_2, NH_3$.
Easily decomp. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 90.)
$+2H_2O$. Insol. in cold, decomp. by boiling H_2O. Sol. in NH_4OH+Aq. (Fleurent, C. R. 1893, **116.** 191.)
$NH_4CN, Cu_2(CN)_2, 3NH_3$. Insol. in cold, sl. sol. in boiling H_2O without decomp. Sol. in NH_4OH+Aq. (Fleurent, C. R. 1891, **113.** 1046.)
$NH_4CN, 2Cu_2(CN)_2, 2NH_3+2H_2O$. (Fleurent, B. **25.** 498R.)

Ammonium gold (aurous) cyanide NH_4CN, AuCN.
Easily sol. in cold or warm H_2O or in alcohol. Insol. in ether.

Ammonium gold (auric) mercuric cyanide, basic, $3NH_4CN, 2Au_2O, Hg(CN)_2, HgO$.
(Schmidt, Ch. Z. 1896, **20.** 633.)

Ammonium mercuric silver cyanide, basic, $NH_4CN, 2Ag_2O, 3AgCN, 4Hg(OH)CN+\frac{1}{2}H_2O$.
(Schmidt, Z. anorg. 1895, **9.** 431.)

Ammonium nickel cyanide, $2NH_4CN, Ni(CN)_2$.
Easily decomposed.

Ammonium tungsten cyanide.
See **Tungstocyanide, ammonium.**

Ammonium zinc cyanide, $2NH_4CN, Zn(CN)_2$.
Sol. in H_2O.

Ammonium cyanide mercuric nitrate silver cyanide basic, $2Hg(OH)NO_3, 3NH_4CN, 4AgCN$.
(Schmidt, Z. anorg. 1895, **9.** 431.)

Arsenic *tri*cyanide, $As(CN)_3$.
Decomp. by H_2O. Not attacked by cold conc. H_2SO_4. Decomp. on heating. (Guenez, C. R. 1892, **114.** 1188.)

Barium cyanide, $Ba(CN)_2$.
Rather sl. sol. in H_2O, more easily in KCN+Aq. (Schulz, J. pr. **68.** 257.)
10 pts. H_2O dissolve 8 pts., and 10 pts. 70% alcohol dissolve 1.8 pts. $Ba(CN)_2$ at 14°. (Joannis, A. ch. (5) **26.** 489.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
$+2H_2O$. Very deliquescent.
$Ba(CN)_2, BaO$. (Drechsel, J. pr. (2) **21.** 84.)

Barium cadmium cyanide, $Ba(CN)_2, Cd(CN)_2+H_2O$.
Easily sol. in H_2O and in NH_4OH+Aq.
Sl. sol. in alcohol. (Loebe, Dissert, **1902.**)
$2Ba(CN)_2, 3Cd(CN)_2+10H_2O$. Sol. in H_2O. (Weselsky, B. **2.** 590.)

Barium cobaltous cobaltic cyanide.
See **Cobaltocobalticyanide, barium.**

Barium cuprous cyanide, $Ba(CN)_2, Cu_2(CN)_2$.
Sol. in H_2O without decomp. (Traube, Z. anorg. 1894, **8.** 21.)
$+H_2O$. (Weselsky, B. **2.** 590.)
Could not be obtained. (Grossmann, Z. anorg. 1905, **43.** 101.)
$+4H_2O$. Decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 101.)
$2Ba(CN)_2, Cu_2(CN)_2+6H_2O$. Decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 105.)

Barium gold (aurous) cyanide, $Ba(CN)_2, 2AuCN+2H_2O$.
Sl. sol. in cold but easily sol. in hot H_2O. Sl. sol. in alcohol. (Lindbom, Lund Univ. Arsk. **12.** No.6.)

Barium iridium cyanide.
See **Iridicyanide, barium.**

Barium manganous cyanide, $Ba(CN)_2, 2Mn(CN)_2$.
Ppt. (Descamps.)
See also **Manganocyanide** *and* **Manganicyanide, barium.**

Barium mercuric cyanide, $(Ba(CN)_2, Hg(CN)_2+3H_2O$.
Very hygroscopic. Very sol. in H_2O. (Grossmann, B. 1904, **37.** 4142.)

Barium mercuric cyanide iodide, $Ba(CN)_2, HgI_2+6H_2O$.
(Varet, C. R. 1895, **121.** 499.)

Barium palladium cyanide, $Ba(CN)_2, Pd(CN)_2+4H_2O$.
See **Palladocyanide, barium.**

Barium nickel cyanide, $Ba(CN)_2, Ni(CN)_2+3H_2O$.
Sol. in H_2O; decomp. by acids with pptn. of $Ni(CN)_2$. (Weselsky, B. **2.** 590.)

Barium silver cyanide, $BaCN)_2$, $2AgCN+H_2O$.

Sol. in H_2O. (Weselsky, B. **2.** 589.)

Barium zinc cyanide, $Ba(CN)_2$, $Zn(CN)_2+2H_2O$.

Sol. in H_2O.

Cadmium cyanide, basic, CdO_2H_2, $2Cd(CN)_2+4H_2O$.

Sl. sol. in H_2O; insol. in alcohol. (Loebe, Dissert, **1902.**)

Cadmium cyanide, $Cd(CN)_2$.

Sl. sol. in H_2O. 100 pts. H_2O dissolve 1.7 pts. $Cd(CN)_2$ at 15°. (Joannis.)

Easily sol. in acids; sol. in $KCN+Aq$. Sol. in warm NH_4OH+Aq, but insol. in $(NH_4)_2CO_3+Aq$. (Wittstein.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Cadmium calcium cyanide, $Cd(CN)_2$, $4Ca(CN)_2+20H_2O$.

Sol. in H_2O and in alcohol. (Loebe, Dissert, **1902.**)

Cadmium chromic cyanide.

See **Chromicyanide, cadmium.**

Cadmium cobaltic cyanide.

See **Cobalticyanide, cadmium.**

Cadmium cuprous cyanide, $2Cd(CN)_2$, $Cu_2(CN)_2$.

Permanent. Insol. in H_2O. Sl. sol. in cold, easily in warm $HCl+Aq$ without decomp., except by long boiling. Insol. in NH_4OH, or NH_4 salts$+Aq$. (Schüler.)

Cadmium cupric cyanide, $Cd(CN)_2$, $Cu(CN)_2$.

Very unstable.

Cadmium gold (aurous) cyanide, $Cd(CN)_2$, $2AuCN$.

Nearly insol. in cold H_2O. Sl. sol. in boiling H_2O. Insol. in alcohol. (Lindbom.)

Cadmium mercuric cyanide, $2Cd(CN)_2$, $3Hg(CN)_2$.

Permanent. Readily sol. in cold H_2O. (Schüler.)

Cadmium mercuric cyanide mercuric iodide, $Cd(CN)_2$, $Hg(CN)_2$, HgI_2+8H_2O.

Very sol. in H_2O. (Varet, Bull. Soc. (3) **5.** 8.)

$+7H_2O$. Sol. in H_2O and in NH_4OH+Aq. (Varet, C. R. 1890, **111,** 679.)

Cadmium mercuric cyanide mercuric iodide, $Cd(CN)_2$, $Hg(CN)_2$, HgI_2+8H_2O.

Very sol. in H_2O. (Varet, Bull. Soc. (3) **5.** 8.)

$+7H_2O$. Sol. in H_2O and in NH_4OH+Aq. (Varet, C. R. 1890, **111.** 679.)

Cadmium mercuric cyanide mercuric iodide ammonia, $Cd(CN)_2$, $Hg(CN)_2$, HgI_2, $4NH_3$.

Very easily decomp. (Varet, Bull. Soc. (3) **6.** 22.)

Cadmium molybdenum cyanide.

See **Molybdocyanide, cadmium.**

Cadmium potassium cyanide, $Cd(CN)_2$, $2KCN$.

Sol. in 3 pts. cold, and 1 pt. boiling H_2O. Insol. in absolute alcohol. (Rammelsberg.)

Cadmium sodium cyanide, $Na_2Cd_2(CN)_6+3H_2O$.

Sol. in H_2O and in alcohol. (Loebe, Dissert, **1902.**)

Cadmium strontium cyanide, $Cd(CN)_2$, $2Sr(CN)_2+3H_2O$.

Sol. in H_2O and in alcohol. (Loebe, Dissert. **1902.**)

Cadmium tungsten cyanide, $Cd_2W(CN)_8+8H_2O$.

Nearly insol. in H_2O.

Sl. sol. in dil. HCl. Sol. in conc. NH_4OH+Aq.

Insol. in organic solvents. (Olsson, **Z.** anorg. 1914, **88.** 68.)

Cadmium cyanide ***di*****hydrazine,** $Cd(CN)_2$, $(N_2H_4)_2$.

Easily sol. in dil. acids. (Franzen, **Z.** anorg. 1911, **70.** 152.)

Cæsium cuprous cyanide, $CsCN$, $CuCN+1\frac{1}{2}H_2O$.

H_2O separates CuCN. (Grossmann, Z. anorg. 1905, **43.** 98.)

$2CsCN$, $CuCN+H_2O$. Sol. in H_2O. (Grossmann, Z. anorg. 1905, **43.** 98.)

$2CsCN$, $3CuCN$. Insol. in, and not decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 98.)

Cæsium tungsten cyanide.

See **Tungstocyanide, cæsium.**

Calcium cyanide, $Ca(CN)_2$.

Sol. in H_2O, but the solution is very unstable. (Schulz.)

$Ca(CN)_2$, $3CaO+15H_2O$. Decomp. by H_2O. (Joannis, A. ch. (5) **26.** 496.)

Calcium cuprous cyanide, $Ca(CN)_2$, $CuCN+4H_2O$.

Easily decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 106.)

$Ca(CN)_2$, $3CuCN+8H_2O$. Immediately

decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 99.)

Calcium gold (aurous) cyanide, $Ca(CN)_2$, $2AuCN+3H_2O$.
Easily sol. in hot or cold H_2O or in alcohol. (Lindbom.)

Calcium manganous cyanide, $Ca(CN)_2$, $2Mn(CN)_2$.
Ppt. (Descamps.)
See also **Manganocyanide, calcium.**

Calcium mercuric cyanide, $Ca(CN)_2$, $2Hg(CN)_2+8H_2O$.
Very deliquescent. (Grossmann, B. 1904, **37.** 4143.)
$2Ca(CN)_2$, $3Hg(CN)_2+6H_2O$. Very sol. in H_2O. (Grossmann, B. 1904, **37.** 4143.)

Calcium mercuric cyanide iodide, $Ca(CN)_2$, HgI_2, $Hg(CN)_2+7H_2O$.
(Varet, C. R. 1895, **121.** 499.)

Calcium nickel cyanide, $Ca(CN)_2$, $Ni(CN)_2+xH_2O$.
Sol. in H_2O.

Calcium tungsten cyanide.
See **Tungstocyanide, calcium.**

Calcium zinc cyanide, $(Ca(CN)_2$, $Zn(CN)_2+3\frac{1}{2}H_2O$.
Sol. in H_2O and in alcohol. (Loebe, Dissert. **1902.**)

Cerous cyanide (?).
Ppt. Very easily decomp. (Behringer, A. **42.** 139.)

Chromic cyanide, with MCN.
See **Chromicyanide, M.**

Chromous potassium cyanide.
See **Chromocyanide, potassium.**

Cobaltous cyanide, $Co(CN)_2+H_2O$.
Insol. in H_2O. Easily sol. in NH_4OH+Aq, and $KCN+Aq$; also in $(NH_4)_2CO_3$, or NH_4 succinate+Aq; insol. in NH_4NO_3, or NH_4Cl +Aq. (Wittstein.)

Cobaltous cyanide *with* **4MCN.**
See **Cobaltocyanide, M.**

Cobaltic cyanide *with* **3MCN.**
See **Cobaltocyanide, M.**

Cobalt gold (aurous) cyanide, $Co(CN)_2$, $2AuCN$.
Insol. in H_2O or cold HCl+Aq.

Cobalt hydrazine cyanide, $(N_2H_4)_4Co(CN)_2$.
Deliquescent. (Franzen, Z. anorg. 1911, **70.** 155.)

Cobaltous cyanide ammonia, $Co(CN)_2$, $2NH_3$.
Unstable. (Peters, B. 1908, **41.** 3178.)

Cuprous cyanide, $Cu_2(CN)_2$.
Insol. in H_2O and dil. acids. Sol. in NH_4OH, $(NH_4)_2SO_4$, or NH_4 succinate+Aq, and in hot NH_4Cl, or NH_4NO_3+Aq. Sol. in conc. HCl+Aq. Sol. in KCN+Aq.
Easily sol. in conc. NH_4SCN or KSCN+Aq
Sl. sol. in NaSCN+Aq. (Grossmann, Z. anorg. 1903, **37.** 408.)
Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Very sl. sol. in pyridine. (Schroeder, Dissert. **1902.**)
Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 20.)

Cupric cyanide, $Cu(CN)_2$.
Easily decomp. Insol. in H_2O.
Sol. in pyridine. (Schroeder, Dissert. **1901.**)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Cuprocupric cyanide, $Cu(CN)_2$, $Cu_2(CN)_2+5H_2O$.
Insol. in H_2O, but decomp. by boiling. Sol. in cold conc. HCl+Aq. Sol. in NH_4OH+Aq, $(NH_4)_2CO_3$+Aq, and in hot NH_4 salts+Aq. Easily sol. in KCN+Aq.
$+H_2O$. Ppt. (Dufau.)
$+Cu(CN)_2$, $2Cu_2(CN)_2+H_2O$. Ppt.

Cuprous hydrazine cyanide, $Cu_2(CN)_2$, N_2H_5CN.
Insol. in alcohol and H_2O. (Ferratini, C. C. **1912,** I. 1281.)

Cupric iridium cyanide.
See **Iridicyanide, cupric.**

Cuprous lithium cyanide, $Cu_2(CN)_2$, $LiCN+H_2O$.
Gradually decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 97.)

Cuprous magnesium cyanide, $Cu_2(CN)_2$, $Mg(CN)_2+11H_2O$.
Decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 103.)

Cuprous mercuric cyanide bromide, $Cu(CN)_2$, $2Hg(CN)_2$, $HgBr_2$.
Sol. in H_2O. (Varet, C. R. 1890, **110.** 148.)

Cupric molybdenum cyanide ammonia.
See **Molybdocyanide ammonia, cupric.**

Cuprous potassium cyanide, $Cu_2(CN)_2$, 2KCN.

Sl. sol. in H_2O, with partial decomp. Decomp. by acids, but not by alkalies.

Decomp. by boiling H_2O. Sol. in NH_4OH +Aq. (Fleurent, C. R. 1893, **116.** 191.)

Sol. without decomp. in conc. KSCN. (Grossmann, Z. anorg. 1903, **37.** 407.)

Sol. without decomp. in KCN+Aq. (Treadwell and Girsewald, Z. anorg. 1904, **38.** 94.)

$Cu_2(CN)_2$, KCN+H_2O. Almost insol. in cold H_2O. 100 cc. H_2O dissolve 0.0594 g. at 15°. Decomp. by much hot H_2O with separation of $Cu_2(CN)_2$. Sol. in KCN+Aq or in NH_4OH+Aq. (Treadwell and Girsewald, Z. anorg. 1904, **38.** 93.)

$3Cu_2(CN)_2$, 4KCN. Sol. in H_2O.

$Cu_2(CN)_2$, 6KCN. Sol. in H_2O.

Cuprous potassium cyanide ammonia, $Cu_2(CN)_2$, KCN, NH_3.

(Treadwell and Girsewald, Z. anorg. 1904, **39.** 88.)

Cuprous potassium cyanide potassium sulphocyanide, $Cu_2(CN)_2$, 4KCN, 2KSCN, H_2O.

Easily sol. in cold H_2O. (Itzig, B. 1902, **35.** 108.)

Cupric potassium cyanide, $Cu(CN)_2$, 2KCN.

Sol. in 3/4 pt. H_2O at 15° and 1/3 pt. at 100°. (Buignet, J. Pharm. 1859, (3), **35.** 168.)

Cuprocupric potassium cyanide. $Cu_2(CN)_2$, $Cu(CN)_2$, 2KCN.

(Straus, Z. anorg. 1895, **9.** 15.)

Cuprous rubidium cyanide, $Cu_2(CN)_2$, 2RbCN.

Sl. sol. in H_2O. Pure H_2O separates CuCN. (Grossmann, Z. anorg. 1905, **43.** 100.)

$3Cu_2(CN)_2$, 4RbCN. Sl. sol. in H_2O. Pure H_2O separates CuCN. (Grossmann, Z. anorg. 1905, **43.** 98.)

Cuprous silver cyanide, $Cu_2(CN)_2$, 2AgCN. Ppt.

$Cu_2(CN)_2$, 6AgCN. Sol. in excess of $Cu_2(CN)_2$, KCN+Aq. (Rammelsberg.)

Cuprous sodium cyanide, $Cu_2(CN)_2$, 2NaCN.

(Traube, Z. anorg. 1894, **8.** 21.)

+$4H_2O$. Decomp. by H_2O. Sol. in excess of NaCN+Aq. (Grossmann, Z. anorg. 1905, **43.** 96.)

$Cu_2(CN)_2$, NaCN+$2H_2O$. Decomp. by H_2O. (Grossmann, Z. anorg. 1905, **43.** 96.)

$Cu_2(CN)_2$, 4NaCN+$6H_2O$. Very sol. in H_2O without decomp. (Grossmann, Z. anorg. 1905, **43.** 96.)

$Cu_2(CN)_2$, 6NaCN+$6H_2O$. Very sol. in H_2O without decomp. (Grossmann, Z. anorg. 1905, **43.** 96.)

Cuprous strontium cyanide, $Cu_2(CN)_2$, $Sr(CN)_2$+$8H_2O$.

H_2O separates $Cu_2(CN)_2$. (Grossmann, Z. anorg. 1905, **43.** 103.)

Cuprous cyanide ammonia, $Cu_2(CN)_2$, $2NH_3$.

Nearly insol. in cold H_2O. Easily sol. in NH_4OH+Aq in absence of oxygen. Insol. in alcohol and ether. Decomp. by hot H_2O and acids. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 87.)

Cuprocupric cyanide ammonia, $Cu_2(CN)_2$, $Cu(CN)_2$, $2NH_3$.

(Malmberg, Arch. Pharm. 1898, **236.** 256.)

+H_2O. Sl. sol. in cold, decomp. by boiling H_2O. Sol. in NH_4OH+Aq. (Dufau, A. **88.** 278.)

$Cu(CN)_2$, $Cu_2(CN)_2$ $3NH_3$. (Mills, Z. Ch. **1867.** 545.)

Sl. decomp. by boiling H_2O. Sol. in NH_4OH+Aq and can be recryst. therefrom. Insol. in alcohol and ether. Decomp. by alkalies and acids. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 96.)

$Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3$. Insol. in cold, decomp. by hot H_2O. Sol. in NH_4OH, or $(NH_4)_2CO_3$+Aq. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 92.)

$2Cu_2(CN)_2$, $Cu(CN)_2$, $2NH_3$. Insol. in H_2O, alcohol and ether. Sol. in NH_4OH+Aq. Decomp. by boiling acids and alkalies. (Treadwell and Girsewald, Z. anorg. 1904, **39.** 92.)

+H_2O. (Monthier, J. Pharm. **11.** 257.)

$Cu(CN)_2$, $2Cu_2(CN)_2$, $4NH_3$. (Hillenkamp, A. **97.** 218.)

$Cu(CN)_2$, $2Cu_2(CN)_2$, $6NH_3$. (Schiff and Becchi, A. **134.** 33.)

$2Cu(CN)_2$, $Cu_2(CN)_2$, $2NH_3$+$3H_2O$. (Fleurent, C. R. **114.** 1060.)

$2Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3$+H_2O. Correct formula for $Cu(CN)_2$, $Cu_2(CN)_2$, $4NH_3$. (Bouveault, Bull. Soc. (3) **4.** 641.)

Cuprous cyanide ammonium sulphocyanide, $Cu_2(CN)_2$, $3NH_4SCN$.

Decomp. by H_2O. (Grossmann, Z. anorg. 1903, **37.** 409.

Cupric cyanide hydrazine, $Cu(CN)_2(N_2H_4)$.

Insol. in H_2O and cold dil. acids.

Sol. in warm dil. acids. (Franzen, Z. anorg. 1911, **70.** 154.)

Cuprous cyanide mercuric iodide, $Cu_2(CN)_2$, HgI_2.

Sol. in H_2O. (Varet, Bull. Soc. (3) **4.** 484.)

Cuprous cyanide potassium sulphocyanide, $Cu_2(CN)_2$, 3KSCN.

Decomp. by H_2O. (Grossmann, Z. anorg. 1903, **37.** 409.)

Gold (aurous) cyanide, AuCN.

Insol. in H_2O, alcohol, or ether. Not attacked by dil., or conc. acids, even boiling aqua regia.

Sol. in NH_4OH+Aq, also in soluble cyanides +Aq.

Slowly decomp. by boiling KOH+Aq, also by $(NH_4)_2S$+Aq.

Sol. in $K_4Fe(CN)_6$+Aq. (Bentel, Z. anorg. 1912, **78.** 152.)

Gold (auric) cyanide *with* **MCN.**

See **Auricyanide, M.**

Gold (auroauric) mercuric cyanide auric mercuric chloride, 4AuCN, $Au(CN)_3$, $5Hg(CN)_2$, $7AuCl_3$, $5HgCl_2$.

(Schmidt, Ch. Z. 1896, **20.** 633.)

Gold (aurous) potassium cyanide, AuCN, KCN.

Sol. in 7 pts. cold, and less than 0.5 pt. boiling H_2O. Sl. sol. in cold, and somewhat more sol. in boiling alcohol. Insol. in ether. (Himly, A. **42.** 160.)

Decomp. by warm acids, even tartaric, and acetic acids.

Gold (aurous) sodium cyanide, AuCN, NaCN.

Sl. sol. in cold, more easily in hot H_2O. Sl. sol. in alcohol. (Lindbom.)

Gold (aurous) strontium cyanide, 2AuCN, $Sr(CN)_2+3H_2O$.

As the Na salt.

Gold (aurous) zinc cyanide, 2AuCN, $Zn(CN)_2$.

Nearly insol. in hot or cold H_2O.

Insol. in cold HCl+Aq.

Gold (auric) cyanide auric mercuric chloride, $Au(CN)_3$, $AuCl_3$, $2HgCl_2$.

(Schmidt, Ch. Z. 1896, **20.** 633.)

Gold (auroauric) cyanide aurous mercuric chloride, 12AuCN, $3Au(CN)_3$, 4AuCl, $2HgCl_2$.

(Schmidt, Ch. Z. 1896, **20.** 633.)

Gold (auroauric) cyanide mercuric chloride. 15AuCN, $2Au(CN)_3$, $5HgCl_2$.

(Schmidt, Ch. Z. 1896, **20.** 633.)

Iridium cyanide, $Ir(CN)_3$.

Insol. in H_2O. Sol. in HCN+Aq.

Iridium cyanide *with* **MCN.**

See **Iridicyanide, M**

Lanthanum cyanide, $La(CN)_3$.

Ppt. (Frerichs and Smith, B. **11.** 910, 1151.)

Lead cyanide, $Pb(CN)_2$.

Sl. sol. in cold, more in hot H_2O. Sol. in HNO_3+Aq, and KCN+Aq. Partially sol. in NH_4OH+Aq, and NH_4 salts+Aq. Not pptd. in presence of Na citrate.

Above compound is 2PbO, $Pb(CN)_2+H_2O$. (Joannis, A. ch. (5) **26.** 204.)

2PbO, $Pb(CN)_2+H_2O$. Insol. in H_2O.

Lead tungsten cyanide.

See **Tungstocyanide, lead.**

Lead zinc cyanide, $Pb(CN)_2$, $2Zn(CN)_2$.

Ppt. (Rammelsberg.)

Lead cyanide chloride, $2Pb(CN)_2$, $PbCl_2$.

Insol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Lithium mercuric cyanide mercuric iodide, $2Li(CN)_2$, $Hg(CN)_2$, HgI_2+7H_2O.

Deliquescent; sol. in H_2O. (Varet, C. R. **111.** 526.)

Magnesium cyanide, $Mg(CN)_2$.

Known only in aqueous solution which decomposes on evaporation. (Schulz.)

Magnesium mercuric cyanide, $2Mg(CN)_2$, $3Hg(CN)_2+5H_2O$.

(Grossmann, B. 1904, **37.** 4143.)

Magnesium mercuric cyanide mercuric bromide, $Mg(CN)_2$, $Hg(CN)_2$, $HgBr_2+8H_2O$.

Very sol. in H_2O. (Varet, Bull. Soc. (3) **7.** 170.)

Magnesium mercuric cyanide mercuric iodide, $Mg(CN)_2$, $Hg(CN)_2$, $HgI+8H_2O$.

Sol. in H_2O. (Varet, Bull. Soc. (3) **7. 170.**)

Magnesium platinum cyanide.

See **Platinocyanide, magnesium.**

Magnesium tungsten cyanide.

See **Tungstocyanide, magnesium.**

Manganous *and* **manganic cyanides.**

See **Manganocyanhydric,** *and* **Manganicyanhydric acids.**

Manganous strontium cyanide, $2Mn(CN)_2$, $Sr(CN)_2$.

Ppt. (Descamps.)

See also **Manganocyanide, strontium.**

Manganous tungsten cyanide.
See **Tungstocyanide, manganous.**

Manganic cyanide, with MCN.
See **Manganicyanide, M.**

Manganous cyanide with MCN.
See **Manganocyanide, M.**

Mercuric cyanide, basic, $Hg(CN)_2$, HgO.

Sl. sol. in cold, moderately sol. in hot H_2O. Sol. with decomp. in KOH, KCN, or KCl+Aq. (Johnston.)

Decomp. by H_2O over 80°. (Holdermann, Arch. Pharm. 1906, **244.** 135.)

Cold H_2O dissolves about 1%, boiling H_2O about 5%. (Borelli, Gazz. ch. it. 1908, **38.** (1), 361.)

1.1% dissolves in H_2O at ord. temp. (Richard, J. Chim. Phys. (6) **18.** 555.)

At 0°	1/100	mol. dissolve in 1 l. H_2O.
At 25°	1/32	" " " " "
At 90°	1/10	" " " " "

(Borelli, Gazz. ch. it. 1908, **38.** (1), 361.)

1000 cc. cold H_2O dissolve 1.35g. (Holdermann, Arch. Pharm. 1906, **244.** 135.)

Less sol. in cold H_2O than $Hg(CN)_2$. (Pieverling, J. B. **1899,** 783.)

Somewhat sol. in dil. alcohol.

Practically insol. in alcohol, ether, C_6H_6 and all organic solvents. (Borelli, Gazz. ch. it. 1908, **38,** (1), 361.)

Sol. in 110 pt. alcohol of 90° Bé. (Richard, J. Chim. Phys. (6), **18.** 555.)

$3Hg(CN)_2$, HgO. (Joannis, A. ch. (5) **26.** 469.)

Moderately sol. in H_2O. (Barthe, J. Pharm. 1896, (6), **3.** 186.)

Very sol. in hot, less sol. in cold H_2O. (Holdermann, Arch. Pharm. 1904, **242.** 32.)

Easily sol. in HCl. (Joannis, A. ch. 1882, (5) **26.** 511.)

$Hg(CN)_2$, 3HgO. More sol. in H_2O than $Hg(CN)_2$, HgO.

Mercuric cyanide, $Hg(CN)_2$.

Moderately sol. in H_2O.

100 pts. $Hg(CN)_2$+Aq sat. at 101.1° contain 35 pts. $Hg(CN)_2$, or 100 pts. H_2O dissolve 53.85 pts. $Hg(CN)_2$ at 101.1°. (Griffiths.)

Sol. in 8 pts. H_2O at 15°. (Abl.)

Sol. in 11 pts. cold, and 2.5 pts. boiling H_2O. (Wittstein.)

8 g. are sol. in 100 g. H_2O at −0.45°. (Guthrie, Phil. Mag. 1878, (5) **6.** 40.)

100 g. H_2O dissolve 9.3 g. at 13.5°. (Timofeiev, Dissert. **1894.**)

100 cc. sat. solution contain 9.3 g. at 20°. (Konowalow, J. russ. Soc. 1898, (4) **30.** 367.)

Solubility in H_2O at 25° = 0.44 mol. l. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

1 l. H_2O dissolves 0.3956 mol. (Hofmann and Wagner, Z. Elektrochem. 1909, **15.** 444.)

100 g. H_2O dissolve 12.5 g. at 15°. (Marsh and Struthers, Chem. Soc. 1905, **87.** 1879.)

100 g. H_2O dissolve 11.27 g. at 25°. Sp. gr. of solution = 1.0813. (Herz and Anders, Z. anorg. 1907, **52.** 164.)

$Hg(CN)_2$+Aq containing 7.23% $Hg(CN)_2$ has sp. gr. 20°/20° = 1.0572.

$Hg(CN)_2$+Aq containing 9.07% $Hg(CN)_2$ has sp. gr. 20°/20° = 1.0743.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. at 16°/4° of $Hg(CN)_2$+Aq containing 7.8921% $Hg(CN)_2$ = 1.06376; containing 5.4037% = 1.04246; containing 7.5009% = 1.06049. (Schönrock, Z. phys. Ch. 1893, **11.** 770.)

Not decomp. by acids except hot conc. H_2SO_4.

Sol. without decomp. in HNO_3+Aq. (Berzelius.)

1 l. NH_4OH+Aq (5.2% NH_3) dissolves 204.3 g. at about 25°. (Konowalow.)

Solubility in bases.

1 l. H_2O containing 0.3286 mols. KOH dissolves 0.5179 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.2350 mols. NaOH dissolves 0.4840 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.4775 mols. NaOH dissolves 0.5977 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.9475 mols. NaOH dissolves 0.79603 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.970 mols. LiOH dissolves 0.6543 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.480 mols. LiOH dissolves 0.5500 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.243 mols. LiOH dissolves 0.4840 mols. $Hg(CN)_2$.

(Hofmann and Wagner, Z. Elektrochem. 1909, **15.** 444.)

Solubility in KCN+Aq at 25°.

Concentration of KCN Mols. per litre	Solubility of $Hg(CN)_2$ Mols. per litre
0.0493	0.4855
0.0985	0.5350
0.1970	0.627.

(Sherrill, Z. phys. Ch. 1903, **43.** 719.)

Solubility in Na_2CO_3+Aq.

1 l. H_2O containing 0.4923 mols. Na_2CO_3 dissolves 0.4956 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.2443 mols. Na_2CO_3 dissolves 0.4464 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.1250 mols. Na_2CO_3 dissolves 0.4147 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.0000 mols. Na_2CO_3 dissolves 0.3952 mols. $Hg(CN)_2$.

(Hofmann and Wagner, Z. Elektrochem. 1909, **15.** 444.)

Solubility in KNO_3+Aq at 25°.

1 l. H_2O containing 0.9574 mols. KNO_3 dissolves 0.5383 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.4614 mols. KNO_3 dissolves 0.4619 mols. $Hg(CN)_2$.

1 l. H_2O containing 0.0000 mols. KNO_3 dissolves 0.3956 mols. $Hg(CN)_2$.

(Hofmann and Wagner, Z. Elektrochem. 1909, **15.** 444.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Solubility of $Hg(CN)_2$ in ethyl alcohol at t°.

t°	% $HgCl_2$
0	8.3
10	8.8
20	9.25
30	9.8
40	10.3

(Timofeiev, Dissert. **1894.**)

Solubility of $Hg(CN)_2$ in methyl alcohol at t°.

$Hg(CN)_2$ = g. $Hg(CN)_2$ in 100 g. of the solution.

t°	$Hg(CN)_2$
0.0	26.10
14.7	29.17
23.4	32.01
27.4	31.77
31.7	32.53
38.1	33.29
44.5	34.05

(Dukelski, Z. anorg. 1907, **53.** 337.)

100 pts. methyl alcohol dissolve 44.2 pts. $Hg(CN)_2$ at 19.5°; 100 pts. ethyl alcohol dissolve 2.09 pts. at 19.5°. (de Bruyn, Z. phys. Ch. 1892, **10.** 784.)

Sol. in 2.5 pts. methyl alcohol at 14°; in 20 pts. ethyl alcohol at 15°. (Marsh, Chem. Soc. 1905, **87.** 1878.)

Solubility of $Hg(CN)_2$ in methyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.

$Hg(CN)_2$ = millimols. $Hg(CN)_2$ in 10 cc. of the solution.

P	$Hg(CN)_2$	Sp. gr.
0	4.34	1.0813
10.60	4.37	1.0642
30.77	4.94	1.0484
37.21	5.40	1.0430
47.06	6.49	1.0426
64.00	8.13	1.0441
78.05	9.75	1.0484
100	13.60	1.0762

(Herz and Anders, Z. anorg. 1907, **52.** 165.)

Solubility of $Hg(CN)_2$ in ethyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.

$Hg(CN)_2$ = millimols $Hg(CN)_2$ in 10 cc. of the solution.

I	$Hg(CN)_2$	Sp. gr.
0	4.34	1.0813
20.18	3.47	1.0339
40.69	3.58	1.0006
70.01	3.80	0.9419
100	3.25	0.8552

(Herz and Anders, l. c.)

Solubility of $Hg(CN)_2$ in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.

$Hg(CN)_2$ = g. $Hg(CN)_2$ in 10 ccm. of the solution.

S 25°/4° = Sp. gr. of the sat. solution.

P	$Hg(CN)_2$	S 25°/4°
0	0.819	0.8552
4.37	0.902	0.8618
10.4	1.01	0.8707
41.02	1.67	0.9267
80.69	2.82	1.024
84.77	2.96	1.034
91.25	3.09	1.052
100	3.43	1.076

(Herz and Kuhn, Z. anorg. 1908, **58.** 166.)

100 g. propyl alcohol dissolve 3.79 g. $Hg(CN)_2$ at 13.5°. (Timofeiev, Dissert. **1894.**)

Solubility in mixtures of propyl and methyl alcohol at 25°.

P = % propyl alcohol in the solvent.

G = g. $Hg(CN)_2$ in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	3.43	1.0760
11.11	2.952	1.0327
23.8	2.448	0.9891
65.2	1.048	0.8800
91.8	0.504	0.8376
93.97	0.423	0.8335
96.6	0.398	0.8322
100	0.344	0.8283

(Herz and Kuhn, Z. anorg. 1908, **60.** 158.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. $Hg(CN)_2$ in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.819	0.8552
8.1	0.790	0.8549
17.85	0.730	0.8527
56.6	0.521	0.8386
88.6	0.387	0.8311
91.2	0.384	0.8306
95.2	0.364	0.8293
100	0.344	0.8283

(Herz and Kuhn, l. c.)

Sp. gr. at 16°/4° of $Hg(CN)_2$+alcohol, containing 8.2206 %$Hg(CN)_2$ = 0.85273; containing 5.8652% = 0.8348+.

Sp. gr. of 16°/4° of $Hg(CN)_2$+ pyridine containing 29.6018% $Hg(CN)_2$ = 1.28155; containing 23.2275% = 1.20198.

(Schönrock, Z. phys. Ch. 1893, **11.** 771.)

1 l. ether dissolves 0.01 mol. at 25°. (Sherrill, Z. phys. Ch. 1903, **43.** 735.).)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 84.)

100 g. glycerol dissolve 27 g. $Hg(CN)_2$ at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Nearly insol. in C_6H_6. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

100 g. boiling methyl acetate dissolve 3.2 g. (Steiner, Dissert, 1906.)

Solubility of $Hg(CN)_2$ in ethyl acetate+Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate +Aq.

$Hg(CN)_2$ = millimols $Hg(CN)_2$ in 10 cc. of the solution.

P	$Hg(CN)_2$	Sp. gr.
0	4.34	1.0810
4.[illegible]9	4.295	1.0797
96.76	1.056	1.9374
100	0.714	0.09097

(Herz and Anders, Z. anorg. 1907, **52.** 165.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Solubility in organic solvents at 18–20°.

100 g. tetrachlormethane dissolve 0.001 g. $Hg(CN)_2$.

100 g. bromoform dissolve 0.005 g. $Hg(CN)_2$.

100 g. ethyl bromide dissolve 0.013 g. $Hg(CN)_2$

100 g. ethylene dibromide dissolve 0.001 g. $Hg(CN)_2$.

(Sulc, Z. anorg. 1900, **25.** 401.)

100 g. acetonitrile dissolve 9.58 g. $Hg(CN)_2$ at 18°. (Naumann and Schier, B. 1914, **47.** 249.)

Solubility in benzonitrile at 18° = 1.093 g. in 100 g. (Naumann, B. 1914, **47.** 1370.)

Sl. sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Very sol. in liquid methyl amine. (Gibbs, J. Am. Chem. Soc. 1906, **28.** 1419.)

Sol. in paratoluidine. (Werner, Z. anorg. 1897, **15.** 7.)

Mol. weight determined in pyridine and benzonitrile. (Werner, Z. anorg. 1897, **15.** 20 and 32.)

100 g. pyridine dissolve 64.8 g. $Hg(CN)_2$ at 18°. (Schroeder, Z. anorg. 1905, **44.** 6.)

Solubility in pyridine.

Mols. per 100 $Hg(CN)_2$	Temp. of Solidification	Mols. per 100 $Hg(CN)_2$	Temp. of Solidification
7.1	9	22.9	45
8.7	11	23.7	46
10.1	12.3	25.3	53
10.4	12.2	26.0	54.5
11.3	13	26.6	56.6
12.9	13.5	27.5	68
13.8	14.5	27.7	70
15.8	16.5	29.0	86
15.9	20.5	32.0	111
17.3	22.5	33.8	122.5
18.4	28.5	34.4	125
19.3	32	38.3	141
20.6	38	....	....
22.3	42	....	....

(Staronka, Anz. Ak. Wiss. Krakau, **1910.** 372.)

Solubility in quinoline.

Mols. per 100 $Hg(CN)_2$	Temp of Solidification	Mols. per 100 $Hg(CN)_2$	Temp. of Solidification
4.2	45°	13.2	137°
6.0	54	17.4	161
8.2	89(61)	22.5	180
9.2	99(61)	27.1	192

(Staronka, l. c.)

Solubility in aniline.

Mols. per 100 $Hg(CN)_2$	Temp. of Solidification	Mols. per 100 $Hg(CN)_2$	Temp. of Solidification
3.7	....	14.2	77° (?)
4.9	26° (?)	18.2	83.5(?)
5.7	30.5(?)	19.7	84 (?)
7.7	35 (?)	23.4	88.5(?)
9.2	38.5(?)	....	....

(Staronka, l. c.)

Mercuric nickel cyanide ammonia, $2Hg(CN)_2$, $4Ni(CN)_2$, $5NH_3+2H_2O$.

(Papiermeister, Dissert. **1898.**)

$5Hg(CN)_2$, $18Ni(CN)_2$, $8NH_3+15H_2O$. (Papiermeister, Dissert. **1898.**)

Mercuric potassium cyanide, $Hg(CN)_2$, $2KCN$.

Sol. in 4.4 pts. cold H_2O; sl. sol. in alcohol; decomp. by acids.

100 g. H_2O dissolve 22.7 g. (Fronmüller B. 1878, **11.** 92.)

Abundantly sol. in liquid NH_3. (Franklin, Z. phys. Ch. 1909, **69.** 295.)

Mercuric silver cyanide, basic, $Hg(CN)_2$, HgO, $7AgCN$.

Ppt. (Bloxam, B. **16.** 2669.)

Mercuric silver cyanide mercuric sulphate, $Hg(CN)_2$, $2AgCN$, $HgSO_4+H_2O$.

Mercuric sodium cyanide, $Hg(CN)_2$, $NaCN+1\frac{1}{2}H_2O$.

Sol. in H_2O. (Grossmann, B. 1904, **37.** 4141.)

Mercuric strontium cyanide, $Hg(CN)_2Sr(CN)_2+5H_2O$.

Very hygroscopic. Sol. in H_2O. (Grossmann, B. 1904, **37.** 4142.)

Mercuric strontium cyanide iodide, $Sr(CN)_2$ HgI_2, $Hg(CN)_2+7H_2O$.

(Varet, C. R. 1895, **121.** 499.)

Mercuric thallium cyanide, $Hg(CN)_2, 2TlCN$.

Easily sol. in H_2O. 100 pts. H_2O dissolve 7.9 pts. at 1°, and 10.3 pts. at 10°. (Fronmüller, B. **11.** 92.)

Mercuric zinc cyanide, $4Zn(CN)_2$, $Hg(CN)_2$.

Insol. in H_2O. (Dunstan, Chem. Soc. **6.** 666.)

Mercuric zinc cyanide mercuric bromide ammonia, $Hg(CN)_2$, $Zn(CN)_2$, $HgBr_2$, $4NH_3$.

Decomp. by H_2O. Sl. sol. in cold NH_4OH+Aq. (Varet, C. R. 1889, **109.** 810.)

Mercuric cyanide ammonia, $Hg(CN)_2$, NH_3.

Very sol. in H_2O, NH_4OH+Aq, and alcohol. (Varet, C. R. 1889, **109.** 903.)

Sl. sol. in H_2O. (Schmidt, B. 1894, **27.** 232.)

$8Hg(CN)_2$, $2NH_3+\frac{1}{2}H_2O$. Easily decomp. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide bromide, $Hg(CN)_2$, $HgBr_2$.

Very sl. sol. even in boiling H_2O. (Prussia, Gazz. ch. it. 1898, **28,** (2), 114.)

Mercuric cyanide barium bromide, $2Hg(CN)_2$ $BaBr_2+6H_2O$.

Easily sol. especially in hot H_2O and alcohol. (Varet, C. R. 1895, **121.** 398.)

Mercuric cyanide cadmium bromide, $Hg(CN)_2$, $CdBr_2+3H_2O$.

Sol. in H_2O and NH_4OH+Aq. (Varet, Bull. Soc. (3) **5.** 8.)

$2Hg(CN)_2$, $CdBr_2+4.5\ H_2O$. Sol. in H_2O and in NH_4OH+Aq. (Varet, C. R. 1890, **111.** 680.)

Mercuric cyanide cadmium bromide ammonia $2Hg(CN)_2$, $CdBr_2$, $4NH_3+2H_2O$.

Decomp. by H_2O.

Sl. sol. in NH_4OH+Aq. (Varet, C. R. 1891, **112.** 535.)

Mercuric cyanide calcium bromide, $2Hg(CN)_2$, $CaBr_2+5H_2O$.

Sol. in 1 pt. cold, and 0.25 pt. boiling H_2O; also in 2 pts. cold, and 1 pt. boiling 90% alcohol. (Custer.)

$+7H_2O$. (Varet, C. R. 1895, **121.** 399.)

Mercuric cyanide cupric bromide ammonia, $2Hg(CN)_2$, $CuBr_2$, $4NH_3$.

Decomp. by H_2O; sl. sol. in NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide lithium bromide, $2Hg(CN)_2$ $2LiBr+7H_2O$.

Deliquescent. (Varet, C. R. **111.** 526.)

Mercuric cyanide magnesium bromide.

See **Magnesium mercuric cyanide mercuric bromide.**

$Hg(CN)_2$, $2KBr$. Very sol. in H_2O. (Harth, Z. anorg. 1897, **14.** 351.)

Mercuric cyanide potassium bromide, $Hg(CN)_2$, $KBr+2H_2O$.

Sol. in 13.34 pts. H_2O at 18°, and less than 1 pt. boiling H_2O. (Brett.)

Sol. without decomp. in hot dil. H_2SO_4, HNO_3, or $HCl+Aq$. (Brett.)

Contains $1\frac{1}{2}H_2O$. (Berthelot, A. ch. (5) **29.** 226.)

Mercuric cyanide sodium bromide, $Hg(CN)_2$, $NaBr+1\frac{1}{2}H_2O$.

Sol. in H_2O and alcohol.

Mercuric cyanide strontium bromide, $2Hg(CN)_2$, $SrBr_2+6H_2O$.

Sol. in H_2O and in alcohol. (Varet, C. R. 1895, **121.** 399.)

Mercuric cyanide zinc bromide, $HgBr_2$ $Hg(CN)_2$, $Zn(CN)_2+8H_2O$.

Sol. in H_2O and NH_4OH+Aq. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide zinc bromide ammonia, $HgBr_2$, $Hg(CN)_2$, $Zn(CN)_2$, $4NH_3$.

As the corresponding chloride. (Varet.)

Mercuric cyanide chloride, $Hg(CN)_2$, $HgCl_2$.

Sol. in H_2O. Decomp. by alcohol, which dissolves out $HgCl_2$.

Mercuric cyanide ammonium chloride, $Hg(CN)_2$, NH_4Cl.

Sol. in H_2O and alcohol. (Poggiale.)
$Hg(CN)_2$, $4NH_4Cl$.

Mercuric cyanide barium chloride, $2Hg(CN)_2$, $BaCl_2+4H_2O$.

Efflorescent. Easily sol. in H_2O and alcohol $+6H_2O$. (Dexter.)

Mercuric cyanide barium chloride ammonia, $2Hg(CN)_2$, $BaCl_2$, $4NH_3$.

Decomp. by H_2O. Sl. sol. in NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide cadmium chloride, $Hg(CN)_2$, $CdCl_2+2H_2O$.

Sol. in H_2O and NH_4OH+Aq. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide calcium chloride, $2Hg(CN)_2$, $CaCl_2+6H_2O$.

Efflorescent. Very sol. in H_2O. (Varet, C. R. 1895, **121.** 349.)

Mercuric cyanide cerium chloride, $3Hg(CN)_2$, $CeCl_3+8H_2O$.

Very sol. in H_2O. (Ahlén, Bull. Soc. (2) **27.** 365.)

Mercuric cyanide cobaltous chloride, $Hg(CN)_2$, $2CoCl_2+4H_2O$.

Sol. in H_2O. (Poggiale.)
$2Hg(CN)_2$, $CoCl_2+7H_2O$. (Dexter.)

Mercuric cyanide cupric chloride, $Hg(CN)_2$, $CuCl_2+6H_2O$.

Efflorescent.
Sol. in H_2O and in NH_4OH+Aq. (Varet, C. R. 1888, **107.** 1002.)
$2Hg(CN)_2$, $CuCl_2+6H_2O$. Efflorescent. Very sol. in H_2O and in NH_4OH+Aq. (Varet, C. R. 1888, **107.** 1002.)

Mercuric cyanide cupric chloride ammonia, $2Hg(CN)_2$, $CuCl_2$, $4NH_3$.

Decomp. by H_2O. Sl. sol. in cold NH_4OH +Aq. (Varet, Bull. Soc. (3) **6.** 221.)

Mercuric cyanide didymium chloride, $3Hg(CN)_2$, $DiCl_3+8H_2O$.

Very sol. in H_2O. (Ahlén.)

Mercuric cyanide erbium chloride, $3Hg(CN)_2$, $ErCl_3+8H_2O$.

Easily sol. in H_2O. (Ahlén.)

Mercuric cyanide hydrazine chloride, $Hg(CN)_2$, N_2H_4, HCl.

Very sol. in H_2O. Nearly insol. in alcohol and ether. (Ferratini, Gazz. ch. it. 1912, **42.** (1), 154.)

Mercuric cyanide ferric chloride, $2Hg(CN)_2$, $FeCl_3+3\frac{1}{2}H_2O$.

(Dexter.)

Mercuric cyanide lanthanum chloride, $3Hg(CN)_2$, $LaCl_3+8H_2O$.

Very sol. in H_2O. (Ahlén.)

Mercuric cyanide magnesium chloride, $2Hg(CN)_2$, $MgCl_2+2H_2O$.

Easily sol. in H_2O and dil. alcohol. (Poggiale.)

Mercuric cyanide manganous chloride, $Hg(CN)_2$, $MnCl_2+3H_2O$.

Efflorescent. Very sol. in H_2O. (Poggiale.)

Mercuric cyanide nickel chloride, $Hg(CN)_2$, $NiCl_2+6H_2O$.

Deliquescent. Sol. in H_2O. (Poggiale.)
$2Hg(CN)_2$, $NiCl_2+7H_2O$. (Dexter.)

Mercuric cyanide chloride nickel chloride oxychloride, $11Hg(CN)_2$, $8HgCl_2$, $2NiCl_2$, $8Ni(OH)Cl+76H_2O$.

(Papiermeister, Dissert. **1898.**)

Mercuric cyanide potassium chloride, $Hg(CN)_2$, $KCl+H_2O$.

Sol. in 6.75 pts. H_2O at 18°. (Brett.)
Sol. in alcohol.

Mercuric cyanide sodium chloride, $Hg(CN)_2$, $NaCl$.

Easily sol. especially in hot H_2O; insol. in alcohol. (Poggiale.)

Mercuric cyanide strontium chloride, $2Hg(CN)_2$, $SrCl_2+6H_2O$.

Easily sol. in H_2O and dil. alcohol. (Varet, C. R. 1895, **121.** 349.)

Mercuric cyanide yttrium chloride, $3Hg(CN)_2$ YCl_3+8H_2O.

Easily sol. in H_2O. (Ahlén, Bull. Soc. (2) **27.** 365.)

Mercuric cyanide zinc chloride, $2Hg(CN)_2$, $ZnCl_2+6H_2O$.

Efflorescent. Sol. in H_2O. (Kane.)
$HgCl_2$, $Hg(CN)_2$, $Zn(CN)_2+7H_2O$. Efflorescent. Very sol. in H_2O. (Varet, Bull. Soc. (3) **5.** 8.)

Mercuric cyanide zinc chloride ammonia, $HgCl_2$, $Hg(CN)_2$, $ZnCl_2$, $4NH_3$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Varet, Bull. Soc. (3) **6.** 221.)
$Hg(CN)_2$, $Zn(CN)_2$, $HgCl_2$, $6NH_3$. (Varet, C. R. **106.** 1080.)

Mercuric cyanide potassium chromate.
See **Chromate mercuric cyanide, potassium.**

Mercuric cyanide potassium ferrocyanide, $3Hg(CN)_2$, $K_4Fe(CN)_6+4H_2O$.
Readily sol. in H_2O.

Mercuric cyanide hydrazine, $Hg(CN)_2$, N_2H_4.
Very sol. in H_2O with partial decomp. (Hofmann and Marburg, A. 1899, **305.** 215.)
$Hg(CN)_2$, N_2H_4. Ppt. (Franzen, Z. anorg. 1911, **70.** 154.)

Mercuric cyanide potassium hydroxide, $Hg(CN)_2$, KOH.
(Hofmann and Wagner, B. 1908, **41.** 321.)
$+1\frac{1}{2}H_2O$. (Hofmann and Wagner, B 1908, **41.** 1630.)
$2Hg(CN)_2$, $KOH+H_2O$. Very sol. in H_2O. (Hofmann and Wagner, B. 1908, **41** 320.)

Mercuric cyanide sodium hydroxide, $Hg(CN)_2.NaOH+1\frac{1}{2}H_2O$ or H_2O.
(Hofmann and Wagner, B. 1908, **41.** 1631.)

Mercuric cyanide barium iodide, $2Hg(CN)_2$, BaI_2+4H_2O.
Slowly deliquescent. Sol. in 16.5 pts. cold, and 0.4 pt. boiling H_2O. Sol. in 22.5 pts. cold, and 1.6 pts. hot 90% alcohol. Solution is decomp. on boiling. (Custer.)

Mercuric cyanide cadmium iodide, $Hg(CN)_2$, $Cd(CN)_2$, HgI_2+8H_2O.
See **Cadmium mercuric cyanide mercuric iodide.**

Mercuric cyanide cæsium iodide, $Hg(CN)_2$, CsI.
Recryst. from H_2O without decomp.
Decomp. by acids. (Mathewson and Wells, Am. Ch. J. 1903, **30.** 433.)

Mercuric cyanide calcium iodide, $2Hg(CN)_2$, CaI_2+6H_2O.
Sl. efflorescent. More sol. in H_2O than corresponding Sr. comp. (Custer.)

Mercuric cyanide lithium iodide, $Hg(CN)_2$, $2Li(CN)_2$, HgI_2+7H_2O.
See **Cyanide, lithium mercuric mercuric iodide.**

Mercuric cyanide magnesium iodide, $Hg(CN)_2$, $Mg(CN)_2$, HgI_2+8H_2O.
See **Cyanide, magnesium mercuric mercuric iodide.**

Mercuric cyanide potassium iodide, $Hg(CN)_2$, KI.
Sol. in 16 pts. cold, and less hot H_2O. Sol. in 96 pts. cold alcohol of 34° Baumé. (Caillot.) Sl. sol. in ether. Decomp. by acids.
$3Hg(CN)_2$, $2KI+\frac{1}{2}H_2O$. (Berthelot.)

Mercuric cyanide sodium iodide, $Hg(CN)_2$, $NaI+2H_2O$.
Sol. in $4\frac{1}{2}$ pts. H_2O at 18°, and $^6/_7$ pt. boiling H_2O.
Sol. in 2 pts. boiling, and $6\frac{1}{2}$ pts. cold 90% alcohol. (Custer.)

Mercuric cyanide strontium iodide, $2Hg(CN)_2$, SrI_2+6H_2O.
Sol. in 7 pts. H_2O at 18°, and $\frac{1}{2}$ pt. at b.-pt. Sol. in 4 pts. 90% alcohol at 18°, and $\frac{1}{2}$ pt. at b.-pt. (Custer.)

Mercuric cyanide zinc iodide, $2Hg(CN)_2$, ZnI_2+6H_2O.
Efflorescent; sol. in H_2O.

Mercuric cyanide iodide potassium cyanide, HgI_2, $Hg(CN)_2$, 2KCN.
Easily decomp. by dil. acids. (Rupp. Apoth. Ztg., **23.** 374.)

Mercuric cyanide cadmium nitrate, $2Hg(CN)_2$, $Cd(NO_3)_2+7H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander, J. B. **1859** 271.)

Mercuric cyanide cobalt nitrate, $2Hg(CN)_2$, $Co(NO_3)_2+7H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide copper nitrate, $Hg(CN)_2$, $Cu(NO_3)_2+5H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide ferrous nitrate, $2Hg(CN)_2$, $Fe(NO_3)_2+7H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide manganous nitrate, $Hg(CN)_3$, $Mn(NO_3)_2+5H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander.)
$2Hg(CN)_2$, $Mn(NO_3)_2+7H_2O$. As above.

Mercuric cyanide nickel nitrate, $2Hg(CN)_2$, $Ni(NO_3)_2+7H_2O$.
Decomp. by H_2O, not by alcohol. (Nylander.)

Mercuric cyanide silver nitrate, $2Hg(CN)_2$, $AgNO_3+2H_2O$.
Sl. sol. in cold, more readily in hot H_2O. Sol. with decomp. in HNO_3+Aq.
As sol. in alcohol as in H_2O.

Mercuric cyanide zinc nitrate, $2Hg(CN)_2$, $Zn(NO_3)_2+7H_2O$.
Sol. in H_2O with decomp. Not decomp. by alcohol. (Nylander, J. B. **1859.** 271.)

Mercuric cyanide nitrate silver cyanide, basic, $Hg(NO_3)CN, 10AgCN, Hg(OH)NO_3$.

(Schmidt, Z. anorg. 1895, **9.** 431.)

Mercuric cyanide potassium selenocyanide, $Hg(CN)_2$, KSeCN.

Sl. sol. in cold, much more easily sol. in hot H_2O or alcohol. Traces dissove in ether. (Cameron and Davy, C. N. **44.** 63.)

Mercuric cyanide nickel sulphate, $Hg(CN)_2$, $NiSO_4+9H_2O$.

(Papiermeister, Dissert. **1898.**)

Mercuric cyanide ammonium sulphocyanide, $Hg(CN)_2$, NH_4SCN.

Easily sol. in hot H_2O. (Cleve, Bull. Soc. (2) **23.** 71.)

Mercuric cyanide barium sulphocyanide, $2Hg(CN)_2$, $Ba(SCN)_2+4H_2O$.

Permanent. Sol. in hot H_2O. (Cleve.)

Mercuric cyanide cadmium sulphocyanide, $2Hg(CN)_2$, $Cd(SCN)_2+4H_2O$.

Permanent. Sol. in hot H_2O. (Cleve.)

Mercuric cyanide calcium sulphocyanide, $2Hg(CN)_2$, $Ca(SCN)_2+8H_2O$.

Sol. in H_2O. (Cleve.)

Mercuric cyanide cerium sulphocyanide, $3Hg(CN)_2$, $Ce(SCN)_3+12H_2O$.

Easily sol. in hot H_2O. (Jolin.)

Mercuric cyanide didymium sulphocyanide, $3Hg(CN)_2$, $Di(SCN)_3+6H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Cleve.)

Mercuric cyanide erbium sulphocyanide, $3Hg(CN)_2$, $2Er(SCN)_3+12H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Cleve.)

Mercuric cyanide lanthanum sulphocyanide, $3Hg(CN)_2$, $La(SCN)_3+12H_2O$.

Very sol. in H_2O. (Cleve.)

Mercuric cyanide magnesium sulphocyanide, $2Hg(CN)_2$, $Mg(SCN)_2+4H_2O$.

Permanent. Easily sol. in hot H_2O. (Cleve.)

Mercuric cyanide potassium sulphocyanide, $Hg(CN)_2$, KSCN.

Permanent. Easily sol. in hot H_2O. (Cleve.)

$+2H_2O$. (Philip, Z. Ch. **1867.** 552.)

Mercuric cyanide rubidium sulphocyanide, $Hg(CN)_2$ Rb(SCN).

Sol. in hot H_2O without decomp. (Grossmann, B. 1904, **37.** 1259.)

Mercuric cyanide samarium sulphocyanide, $3Hg(CN)_2$, $Sm(SCN)_2+12H_2O$.

Easily sol. in H_2O. (Cleve.)

Mercuric cyanide sodium sulphocyanide, $Hg(CN)_2$, $NaSCN+2H_2O$.

Efflorescent. Sol. in H_2O. (Cleve, Bull. Soc. (2) **23.** 71.)

Mercuric cyanide strontium sulphocyanide, $2Hg(CN)_2$, $Sr(SCN)_2+4H_2O$.

Efflorescent. (Cleve.)

Mercuric cyanide yttrium sulphocyanide, $3Hg(CN)_2$, $Y(SCN)_3+12H_2O$.

Sl. sol. in warm, much less in cold H_2O. (Cleve.)

Mercuric cyanide zinc sulphocyanide, $2Hg(CN)_2$, $Zn(SCN)_2+4H_2O$.

Sl. sol. in H_2O. (Cleve.)

Mercuric cyanide zinc sulphocyanide ammonia, $2Hg(CN)_2$, $Zn(SCN)_2$, $3NH_3$.

Not efflorescent. Decomp. by H_2O.

Mercuric cyanide potassium thiosulphate, $Hg(CN)_2$, $K_2S_2O_3$.

Permanent. Sol. in H_2O. (Kessler.)

$+H_2O$. (Fock and Kluss, B. **24.** 1355.)

Molybdenum hydroxyl potassium cyanide, $K_3Mo(OH)_2(CN)_5$.

(Rosenheim and Koss, Z. anorg. 1906, **49.** 155.)

$K_5Mo(OH)_2(CN)_7$. Very sol. in H_2O. (Rosenheim and Koss.)

Molybdenum cyanide with MCN.

See **Molybdocyanide M.**

Molybdenyl potassium cyanide, $MoO_2(CN)_2$, 2KCN.

Very sol. in H_2O. Aqueous solution is stable in presence of alkalies.

Insol. in alcohol. (Péchard, C. R. 1894, **118.** 805.)

$MoO_2(CN)_2$, 3KCN. Sol. in H_2O. Insol. in alcohol. (Hofmann, Z. anorg. 1896, **12.** 287.)

$+H_2O$. Sol. in H_2O. Insol. in alcohol. (Hofmann.)

$+4H_2O$. Sol. in H_2O. Insol. in alcohol. (Hofmann.)

Nickel cyanide, $Ni(CN)_2+xH_2O$.

Insol. in H_2O. Insol. in conc. HCl, H_2SO_4, or HNO_3+Aq, but decomp. by heating therewith. Sol. in NH_4OH, warm $(NH_4)_2SO_4$, or NH_4 succinate+Aq; also in KCN+Aq. Sl. sol. in NH_4Cl, or NH_4NO_3+Aq. (Wittstein.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+3H_2O$, $+3\frac{1}{4}H_2O$, $+3\frac{3}{4}H_2O$, $+4\frac{1}{4}H_2O$, and $+5\frac{1}{4}H_2O$. (Papiermeister, Dissert. **1898.**)
$+4H_2O$. (Hofmann and Höchtlen, B. 1903, **36.** 1149.)

Nickel potassium cyanide, $Ni(CN)_2$, $2KCN + H_2O$.
Sol. in H_2O. Decomp. by acids with residue of insol. $Ni(CN)_2$.
$+\frac{1}{2}H_2O$. (Rammelsberg.)

Nickel sodium cyanide, $Ni(CN)_2$, $2NaCN + 3H_2O$.
Sol. in H_2O; decomp. by acids with residue of $Ni(CN)_2$.

Nickel strontium cyanide, $Ni(CN)_2$, $Sr(CN)_2 + xH_2O$.
Sol. in H_2O. (Handl, J. B. **1859.** 273.)

Nickel cyanide ammonia, $Ni(CN)_2$, $NH_3 + \frac{1}{2}H_2O$.
Scarcely attacked by H_2O or dil. acids.
Sol. in conc. H_2SO_4. Sol. in $(NH_4)_2CO_3$+Aq, conc. NH_4OH+Aq, $(NH_4)_2C_2O_4$+Aq, $(NH_4)_2S$+Aq, and KCN+Aq. Decomp. by boiling with NaOH or KOH. (Bernoulli and Grether, Ch. Z. 1901, **25.** 436.)

Nickel cyanide *tri***hydrazine,** $Ni(CN)_2$, $(N_2H_4)_3$.
Ppt. (Franzen, Z. anorg. 1911, **70.** 155.)

Osmium cyanide, $Os(CN)_2$(?).
Insol. in H_2O; not attacked by acids.
See also **Osmocyanhydric acid.**

Osmium potassium cyanide.
See **Osmocyanide, potassium.**

Palladous cyanide, $Pd(CN)_2$.
Insol. in H_2O. Insol. in dil. acids. Sol. in KCN or NH_4OH+Aq, also in conc. HCN +Aq.

Platinous cyanide, $Pt(CN)_2$.
Insol. in H_2O, alkalies, or acids. Sol. in **KCN**+Aq. When freshly pptd., sol. in NH_4OH+Aq.

Platinous cyanide *with* **MCN.**
See **Platinocyanide, M.**

Potassium cyanide, KCN.
Deliquescent. Very sol. in H_2O.
100 pts. KCN+Aq, sat. at b.-pt. 103.3,° contain 55 pts. KCN, *i. e.* 100 pts. H_2O dissolve 122.2 pts. KCN at 103.3.° (Griffiths.)
KCN+Aq containing 3.25% KCN has sp. gr.=1.0154; 6.5% KCN, 1.0316. (Kohlrausch, W. Ann. **1879.** 1.)
KCN+Aq containing 9.64% KCN has sp. gr. 20°/20°=1.0514.
KCN+Aq containing 14.42% KCN has sp. gr. 20°/20°=1.0768. (Le Blanc and Rohland, Z. phy. ch. 1896, **19.** 278.
Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
Almost insol. in absolute alcohol.
Sol. in 80 pts. 95% alcohol when boiling, and easily sol. in 35% alcohol. (Geiger, A. **1.** 50.)
100 pts. absolute methyl alcohol dissolve 4.91 pts. at 19.5°. 100 pts absolute ethyl alcohol dissolve 0.87 pt. at 19.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)
Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
100 g. glycerol dissolve 32 g. KCN at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)
Sol. in CS_2 when pure. (Loughlin, J. B. **1875.** 234.)
Wholly insol. in CS_2. (Moldenhauer, Z. anal. **16.** 199.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Potassium chromium *tetr***oxide** *penta***cyanide,** $K_5[(CrO_4)_2(CN)_6] + 5H_2O$.
Very hygroscopic.
Sol. in H_2O. (Riesenfeld, B. 1908, **41.** 3548.)

Potassium chromium *tetr***oxide** *di***cyanide ammonia,** $K_2[CrO_4(CN)_2NH_3] + 5H_2O$.
Hygroscopic in the air.
Easily sol. in H_2O and in NH_4OH+Aq. (Riesenfeld, B. 1908, **41.** 3545.)

Potassium rhodium cyanide.
See **Rhodocyanide, potassium.**

Potassium ruthenium cyanide.
See **Ruthenocyanide, potassium.**

Potassium silver cyanide, KCN, AgCN.
Sol. in 4.7 pts. H_2O at 15°, 4 pts. at 20°, and in much less at higher temp. Sol. in 25 pts. 85% alcohol. (Baup, A. ch. (3) **53.** 464.)

Potassium silver sodium cyanide, 2KCN, NaCN, 3AgCN.
Sol. in 4.4 pts. H_2O at 15°, and 22 pts. 85% alcohol at 17°. (Baup.)

Potassium tungsten cyanide.
See **Tungstocyanide, potassium.**

Potassium uranyl cyanide,
$(UO_2)(CN)_2$, 2KCN.
Ppt. Sol. in H_2O. Sl. sol. in presence of large excess of KCN. (Aloy, A. ch. 1901, (7) **24.** 417.)

Potassium vanadium cyanide, $K_3V(CN)_6$.
Readily sol. in H_2O; decomp. slowly in neutral aq. solution, rapidly in acid aq. solution;

insol. in alcohol. (Locke, Am. Ch. J. 1898, **20.** 601.)

$K_4V(CN)_6+3H_2O$. Sol. in H_2O.

Insol. in alcohol and ether. (Petersen, Z. anorg. 1904, **38.** 345.)

Potassium zinc cyanide, $2KCN, Zn(CN)_2$.

100 pts. H_2O dissolve 11 pts. at 20°. (Sharwood, Eng. Min. J. 1904, **77.** 845.)

Potassium cyanide molybdenum *di*oxide, $4KCN, MoO_2+5H_2O$.

Sol. in H_2O. Insol. in alcohol. (Hofmann, Z. anorg. 1896, **12.** 287.)

$+6H_2O$. "Potassium dioxotetracyanomolybdate."

Very sol. in H_2O. (Winkler, Dissert. **1909.**)

$+8H_2O$. (Rosenheim, Kohn and Garfunkel, Z. anorg. 1910, **65.** 174.)

$+10H_2O$. Decomp. by conc. HCl, HNO_3 and H_2SO_4.

Not acted upon by cold dil. acids. (v. der Heide and Hofmann, Z. anorg. 1896, **12.** 285.)

$5KCN, MoO_2+8H_2O$. Sol. in H_2O. Insol. in alcohol. (Kalischer, Dissert. **1902.**)

Potassium cyanide molybdenum *di*oxide hydroxylamine, $4KCN, MoO_2, NH_2OH +H_2O$.

Sol. in H_2O.

Decomp. by dil. acids. (v. der Heide and Hofmann, Z. anorg. 1896, **12.** 282.)

Potassium cyanide molybdenum sulphide, $6KCN, Mo_2S_3+5H_2O$.

Easily sol. in H_2O. Decomp. by dil. acids. (Hofmann, Z. anorg. 1896, **12.** 289.)

Very sol. in H_2O. Slowly decomp. in the cold by dil. mineral acids. (v. der Heide and Hofmann, Z. anorg. 1896, **12.** 289.)

Potassium cyanide molybdenum sulphocyanide, $2KCN, MoS_2(CN)_2$.

(Péchard, C. R. 1894, **118,** 806.)

$5KCN, Mo_3S_4(CN)_3+7H_2O$. Sol. in H_2O. Stable toward dil. acids and alkalies. (Hofmann, Z. anorg. 1896, **12.** 289.)

Potassium cyanide molybdenum sulphoxycyanide, $4KCN, Mo_2SO(CN)_2+4H_2O$.

Sol. in H_2O. Stable toward dil. acids. (Hofmann, Z. anorg. 1896, **12.** 289.)

Potassium cyanide nitrite, $KCN, KNO_2+\frac{1}{2}H_2O$.

Sol. in H_2O; decomp. slowly by H_2O; explosive. (Hofmann, Z. anorg. 1895, **10.** 260-261.)

Potassium cyanide sulphur *di*oxide, KCN, SO_2+H_2O.

Much more sol. in hot than cold H_2O. (Étard, C. R. **88.** 649.)

$KCN, HCN, 2SO_2+3H_2O$. Very sl. sol. in cold H_2O; decomp. by hot H_2O. (Étard.)

Rubidium tungsten cyanide.

See **Tungstocyanide, rubidium.**

Rhodium cyanide, $Rh(CN)_3$.

Ppt. Not decomp. by acids. Sol. in KCN+Aq. (Martius, A. **117.** 361.)

Rhodium cyanide *with* 3KCN.

See **Rhodicyanide, potassium.**

Ruthenium cyanide *with* 4MCN.

See **Ruthenocyanide, M.**

Silver cyanide, AgCN.

Sl. sol. in H_2O.

$2.2+10^{-4}$ g. sol. in 1 liter of H_2O at 19.96°. (Böttger, Z. phys. ch. 1903, **46.** 603.)

1 l. solution in H_2O contains 0.000043 g. AgCN at 17.5°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

Solubility in H_2O at 25° = $2.22+10^{-6}$ mol. per l. (Lucas, Z. anorg. 1904, **41.** 198.)

Insol. in dil. acids. Decomp. by conc. acids. Not sol. to any extent in HCN+ Aq.

Freshly pptd. AgCN is not dissolved by cold dil. HNO_3, but is attacked by very dil. HNO_3 on boiling. From dry AgCN is dissolved 5% by boiling 1 hour with 1% HNO_3 +Aq. Conc. HNO_3 dissolves more. (Brunck, B. 1901, **34.** 1605.)

Sol. in NH_4OH+Aq. Sol. in boiling KCl, NaCl, $CaCl_2$, $BaCl_2$, or $MgCl_2$+Aq, but very slowly sol. therein at ord. temp. Sol. in $Na_2S_2O_3$, $K_4Fe(CN)_6$, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, NH_4NO_3, and NH_4 succinate+Aq, and in large amt. of hot NH_4Cl+Aq. (Wittstein.)

Sol. in KCN, NaCN, $Ba(CN)_2$, $Ca(CN)_2$, or $Sr(CN)_2$+Aq. Insol. in KOH, or NaOH +Aq. Sol. in conc. boiling $AgNO_3$+Aq. (Wöhler.)

Sol. in 431.7 pts. 5% NH_4OH+Aq (sp. gr. 0.998) at 12°; in 184.5 pts. 10% NH_4OH+ Aq (sp. gr. 0.96) at 18°. (Longi, Gazz, ch. it. **13.** 87.)

Sl. sol. in Na citrate+Aq.

Sol. in $Hg(NO_3)_2$+Aq.

1 l. of a 3–N solution of $AgNO_3$ dissolves 1.216 g. AgCN at 25°. (Hellwig, Z. anorg. 1900, **25.** 177.)

Very sol. in $(NH_4)_2S_2O_8$+Aq. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 105.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Abundantly sol. in quinoline at 60°. (Varet, C. R. 1893, **116.** 60.)

Sl. sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in methyl acetate. (Bezold, Dissert. **1906**; Naumann, B. 1909, **42.** 3790); ethyl

acetate. (Hamers, Dissert. **1906**; Naumann, B. 1910, **43.** 314.)

Silver hydrogen cyanide, AgCN, HCN.
(Euler, B. 1903, **36.** 1859.)

Silver sodium cyanide, AgCN, NaCN.
Sol. in 5 pts. H_2O at 20° and in much less hot H_2O. Sol. in 24 pts. 85% alcohol at 20°. (Baup, A. ch. (3) **53.** 468.)

Silver thallous cyanide, AgCN, TlCN.
Easily sol. in H_2O. 100 pts. H_2O dissolve 4.7 pts. at 0°, and 7.4 pts. at 16°. (Fronmuller, B. **11.** 92.)

Silver tungsten cyanide.
See **Tungstocyanide, silver.**

Silver cyanide ammonia, AgCN, NH_3.
Efflorescent. Decomp. on air.
Very sol. in ammonia at -10°. (Joannis, C. R. 1894, **118.** 1151.)

Silver cyanide hydrazine, AgCN, N_2H_4.
Decomp. in the air.
Decomp. by H_2O. (Franzen, Z. anorg. 1911, **70.** 153.)

Silver cyanide nitrate, 2AgCN, $AgNO_3$.
Decomp. by H_2O.

Sodium cyanide, NaCN.
Sol. in H_2O and 75% alcohol.
$+\frac{1}{2}H_2O$, and $2H_2O$. Very sol. in H_2O; sl. sol. in alcohol. (Joannis, A. ch. (5) **26.** 484.)

Sodium tungsten cyanide.
See **Tungstocyanide, sodium.**

Sodium zinc cyanide, NaCN, $Zn(CN)_2+2\frac{1}{2}H_2O$.
Much more sol. in H_2O than the corresponding K Zn salt. (Rammelsberg.)
$+8H_2O$. (Loebe, Dissert. 1902.)

Sodium cyanide molybdenum *di*oxide, 4NaCN, MoO_2+6H_2O.
(Winkler, Dissert. **1909.**)
$+14H_2O$. Sol. in H_2O. (Rosenheim, Garfunkel and Kohn, Z. anorg. 1910, **65.** 174.)

Sodium cyanide molybdenum *di*oxide hydroxylamine, 4NaCN, MoO_2, NH_2OH+H_2O.
As K comp. (Winkler, Dissert. **1909.**)

Strontium cyanide, $Sr(CN)_2+4H_2O$.
Very unstable; very deliquescent, and sol. in H_2O. (Joannis, A. ch. (5) **26.** 496.)

Strontium tungsten cyanide.
See **Tungstocyanide, strontium.**

Strontium zinc cyanide, $2Sr(CN)_2$, $3Zn(CN)_2+H_2O$.
Sol. in H_2O and alcohol. (Loebe, Dissert. **1902.**)

Thallous cyanide, TlCN.
100 pts. H_2O dissolve 16.8 pts. at 28.5°. (Fronmüller, B. **6.** 1178.)

Thallothallic cyanide, $Tl_2(CN)_4$=TlCN, $Tl(CN)_3$.
Easily sol. in H_2O.
100 pts. H_2O dissolve 27.3 pts. at 30°, 15.3 pts. at 12°, 9.7 pts. at 0°. (Fronmüller, B. **11.** 92.)

Thallous tungsten cyanide.
See **Tungstocyanide, thallous.**

Thallous zinc cyanide, 2TlCN, $Zn(CN)_2$.
Easily sol. in H_2O. 100 pts. H_2O dissolve 8.7 pts. at 0°; 15.2 pts. at 14°; and 29.6 pts. at 31°. (Fronmüller, B. **11.** 92.)

Tungsten cyanide with MCN.
See **Tungstocyanide, M.**

Zinc cyanide, $Zn(CN)_2$.
Insol. in H_2O and alcohol. Sol. in alkalies. Easily sol. in KCN+Aq. Sol. in hot NH_4 salts+Aq. (Wittstein.)
Easily sol. in $(NH_4)_2CO_3$+Aq. (Gore.)
Sol. in KOH+Aq. Solution is stable when less than 1 mol. $Zn(CN)_2$ to 2 mols. KOH is present. When proportion is 1:1, ZnO_2H_2 soon separates.
Sol. in dil. KCN+Aq. (Sharwood, J. Am. Chem. Soc. 1903, **25.** 587.)
Sl. sol. in conc. Zn salts+Aq. 1 l. conc. $Zn(C_2H_3O_2)_2$+Aq dissolves 4 g., and 1 l. conc. $ZnSO_4$+Aq dissolves 2 g. $Zn(CN)_2$. Insol. in HCN+Aq. Easily sol. in dil. acids. (Joannis.)
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Zinc cyanide ammonia, $Zn(CN)_2$, $2NH_3$.
Decomp. on air. (Varet, C. R. **105.** 1070.)
$+H_2O$. Decomp. on air. Decomp. by H_2O. Sol. in NH_4OH+Aq. (Varet.)

Zinc cyanide *di*hydrazine, $Zn(CN)_2$, $2N_2H_4$.
Decomp. by H_2O. (Franzen, Z. anorg. 1911, **70.** 153.)

Cyanogen, CN.
H_2O absorbs $4\frac{1}{2}$ vols. CN gas at 20°. Alcohol absorbs 23 vols., and ether 5 vols. at the same temperature. (Gay-Lussac.)
The solution gradually decomposes, but this is prevented by traces of acids.

0.221 mol. litre are dissolved in H_2O at 0°. (Naumann, Z. Electrochem. 1910, **16.** 177.)

Oil of turpentine absorbs 5 vols. (Gay-Lussac.) Absorbed by many essential oils.

Very sol. in $CuCl_2$+Aq.

Absorbed with decomp. by NH_4OH+Aq and other alkaline liquids.

Absorbed by aniline. (Jacquemain, C. R. **100.** 1006.)

Cyclotriborene, B_3H_3.

Insol. in H_2O. (Ramsay and Hatfield, Proc. Chem. Soc. 1901, **17.** 152.)

Decamine cobaltic sulphite, $Co_2(NH_3)_{10}(SO_3)_3+3H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2636.)

Decamine cobaltisulphurous acid.

Cobaltic decamine cobaltisulphite, $Co_2(NH_3)_{10}(SO_3)_6Co_2+8H_2O$.

Ppt. (Vortmann and Magdeburg, B. **22.** 2635.)

Sodium decamine cobaltisulphite, $Co_2(NH_3)_{10}(SO_3Na)_6+2H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2635.)

Diamide, N_2H_4.

See **Hydrazine.**

Diamine chromium sulphocyanhydric acid, $Cr(NH_3)_{12}(SCN)_3$, $HSCN+H_2O$.

Sol. in H_2O. (Nordenskiöld, Z. anorg. **1.** 130.)

Diamine chromium *di*aquo sulphocyanide, $Cr(NH_3)_2(SCN)_3+2H_2O$.

Sol. in H_2O, from which it is pptd. by con. HCl+Aq. (Nordenskiöld, Z. anorg. **1.** 137.)

Ammonium diamine chromium sulphocyanide, $Cr(NH_3)_2(SCN)_3$, NH_4SCN.

(*Reinecke's salt.*) Quite easily sol. in H_2O, less in alcohol, and insol. in benzene. Slowly decomp. by boiling H_2O or dil. acids. (Nordenskiöld, Z. anorg. **1.** 130.)

+H_2O. Insol. in absolute ether. (Christensen, J. pr. (2) **45.** 218.)

Ammonium diamine chromium sulphocyanide iodide, $Cr(NH_3)_2(SCN)_3$, NH_4SCN, I.

Barium —— —— ——, $[Cr(NH_3)_2(SCN)_3]_2$, $Ba(SCN)_2$.

Sol. in H_2O and alcohol. (N.)

Cadmium diamine chromium sulphocyanide, $Cd(SCN)_2$, $[Cr(NH_3)_2(SCN)_3]_2+H_2O$.

Nearly insol. in cold, sl. sol. in hot H_2O. Sl. sol. in boiling alcohol. (Christensen, J. pr. (2) **45.** 371.)

Cupric —— —— ——, $Cu(SCN)_2$, $[Cr(NH_3)_2(SCN)_3]_2$.

Insol. in H_2O or dil. acids. (Reinecke, A. **126.** 116.)

Ferric —— —— ——, $[Cr(NH_3)_2(SCN)_3]_3$, $Fe(SCN)_3$. (N.)

Luteocobaltic —— —— ——, $Co(NH_3)_6(SCN)_3[Cr(NH_3)_2(SCN)_3]_3$.

As good as insol. in cold H_2O. Sl. sol. in hot H_2O and alcohol. (Christensen, J. pr. (2) **45.** 370.)

Mercuric —— —— ——, $[Cr(NH_3)_2(SCN)_3]_2$, $Hg(SCN)_2$.

Insol. in H_2O. (N.)

Insol. in H_2O and dil. acids. (Reinecke.)

Potassium —— —— ——, $Cr(NH_3)_2(SCN)_3$, KSCN.

Properties as the NH_4 salt. (N.)

$Cr(NH_3)_2(SCN)_3$, KSCN, I. As the NH_4 salt. (N.)

Sodium —— —— ——, NaSCN, $Cr(NH_3)_2(SCN)_3$.

Sol. in H_2O, alcohol, and ether. (Reinecke.)

Diamine cobaltic nitrite ammonium nitrite, $CO(NH_3)_2(NO_2)_3$, NH_4NO_2.

Sol. in H_2O. (Erdmann.)

—— —— **nitrite lead nitrite,** $2Co(NH_3)_2(NO_2)_3$, $Pb(NO_2)_2$.

Sol. in hot H_2O with partial decomp.

—— —— **nitrite mercurous nitrite,** $2Co(NH_3)_2(NO_2)_3$, $Hg_2(NO_2)_2$.

Ppt. Not sol. in hot H_2O without decomp.

—— —— **nitrite potassium nitrite,** $Co(NH_3)_2(NO_2)_3$, KNO_2.

Sol. in H_2O. (Erdmann, J. pr. **97.** 385.)

—— —— **nitrite silver nitrite,** $Co(NH_3)_2(NO_2)_3$, $AgNO_2$.

Ppt. Crystallises out of hot H_2O. (Erdmann.)

—— —— **nitrite thallium nitrite,** $Co(NH_3)_2(NO_2)_3$, $TlNO_2$.

Crystallises out of hot H_2O without decomp.

Dichrocobaltic carbonate, $Co(NH_3)_3(OH)CO_3+1\frac{1}{2}H_2O$.

Sol. in H_2O. (Vortmann, B. **15.** 1901.)

Dichrocobaltic chloride, $Co(NH_3)_3Cl_3+H_2O$.

Quite sol. in cold H_2O, dil. acids, conc. H_2SO_4, or dil. alcohol.

From solution in conc. H_2SO_4, the salt is precipitated by much HCl+Aq. Composition is $Co(NH_3)_3(OH_2)Cl_3$. (Jorgensen, Z. anorg. **5.** 189.)

—— **nitrate,** $Co(NH_3)_3(NO_3)_3+4H_2O$.

Deliquescent. Sol. in H_2O. More sol. in dil. HNO_3+Aq than praseocobaltic nitrate. (Vortmann, B. **15.** 1897.)

Anhydrous. Insol. in H_2O as such, but converted into above salt thereby. (Jorgensen, Z. anorg. **5.** 186.)

—— **nitrite,** $Co(NH_3)_3(NO_2)_3$.

Difficultly sol. in cold, but rather easily sol. in hot H_2O.

—— **sulphate,** $[Co(NH_3)_3]_2(SO_4)_3+6H_2O$.

Easily sol. in H_2O. (Vortmann, B. **15.** 1900.)

—— **sulphite,** $[Co(NH_3)_3]_2(SO_3)_3+H_2O$.

Nearly insol. in cold, slowly decomp. by hot H_2O. Decomp. by acids or KOH+Aq. Insol. in cold, sol. in warm NH_4OH+Aq. (Kunzel, J. pr. (1) **72.** 209.) According to Geuther (A. **128.** 157), is a double salt—

$[Co(NH_3)_3]_2(SO_3)_3$, $Co_2(SO_3)_3+2H_2O$.

Didymium, Di.

Slowly decomp. by H_2O. Insol. in cold conc. H_2SO_4. Sol. in dil. acids.

Compound of two elements, neodymium and praseodymium. (v. Welsbach, W. A. B. **92.** 317.)

Didymium bromide, $DiBr_3+6H_2O$.

Very deliquescent, and sol. in H_2O. (Cleve.)

Didymium nickel bromide, $2DiBr_3$, $3NiBr_2+18H_2O$.

Deliquescent. Very sol. in H_2O. (Frerichs and Smith, A. **191.** 342.)

Didymium zinc bromide, $DiBr_3$, $3ZnBr_2+12H_2O$.

Extremely deliquescent. (Cleve, Bull. Soc. (3) **43.** 361.)

$2DiBr_3$, $3ZnBr_2+36H_2O$. (F. and S.)

Didymium chloride, $DiCl_3$.

Anhydrous. Deliquescent. Sol. in H_2O and alcohol. (Marignac.)

$+6H_2O$. Deliquescent. Easily sol. in H_2O and alcohol. (Marignac.)

Didymium mercuric chloride, $2DiCl_3$, $9HgCl_2+24H_2O$.

More sol. in H_2O than the corresponding La salt. (Marignac.)

$DiCl_3$, $4HgCl_2+11H_2O$. Not deliquescent. Easily sol. in H_2O.

Didymium stannic chloride.

See **Chlorostannate, didymium.**

Didymium fluoride. $DiF_3+\frac{1}{2}H_2O$.

Precipitate. (Cleve.)

Didymium hydrogen fluoride, $2DiF_3$, 3HF.

Precipitate. (Smith.)

Does not exist. (Cleve.)

Didymium potassium fluoride, DiF_3, $KF+H_2O$.

Sol. in H_2O. (Brauner, B. **15.** 114.)

$+\frac{1}{3}H_2O$. As above. (B.)

$2DiF_3$, $3KF+H_2O$. As above. (B.)

Didymium hydroxide, $Di_2O_6H_6$.

Insol. in KOH, or NaOH+Aq, but is sl. sol. in NH_4Cl+Aq. (Rose.)

See also Di_2O_3.

Didymium *pent***hydroxide,** $DiO_4H_3=Di_2O_5$, $3H_2O$.

Precipitate. (Brauner, B. **15.** 113.)

Didymium zinc iodide, $2DiI_3$, $3ZnI_2+24H_2O$.

Very deliquescent. (Frerichs and Smith.)

Didymium oxide, Di_2O_3.

With H_2O slowly forms $Di_2O_6H_6$.

Sol. in conc., or dil. mineral acids (Marignac), and in acetic acid (Hermann). Sol. in ammonium salts+Aq.

Slightly more slowly sol. in conc. NH_4NO_3+Aq than La_2O_3. (Damour and Deville.)

A solution of NH_4NO_3 in H_2O that can dissolve 2.9 mols. La_2O_3 dissolves 1 mol. Di_2O_3. (Brauner, B. **15.** 114.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Didymium *per***oxide,** Di_4O_9.

Sol. in acids with decomp. (Frerichs, B. **7.** 799.)

Not obtained by Cleve. (B. **11.** 910.)

The contradictory statements concerning the composition of Di peroxide are owing to the fact that praseodidymium is the only one of the constituents of Di which easily forms a peroxide. (v. Welsbach.)

Didymium *pent***oxide,** Di_2O_5.

Sol. in dil. HNO_3, or H_2SO_4+Aq in the cold without evolution of gas, but gas is evolved if treated with conc. acids. Insol. in HF+Aq. Sl. sol. in cold NH_4NO_3+Aq. $=Di_4O_9$. (Cleve.)

Didymium oxybromide, DiOBr.
(Frerichs and Smith.)

Didymium oxychloride, DiOCl.
Anhydrous. Insol. in H_2O. (Smith.)
$+3H_2O$. Sol. in cold dil. HNO_3+Aq. (Marignac.) Sl. sol. in HCl+Aq. (Hermann.)

Didymium oxysulphide, Di_2O_2S.
Insol. in H_2O. Sol. in HCl+Aq without residue. (Marignac.)

Didymium sulphide, Di_2S_3.
Insol. in H_2O. Decomp. by dil. acids. (Marignac, A. ch. (3) **38.** 159.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Disulphuric acid, $H_2S_2O_7$.
*See Di***sulphuric acid.**

Dithionic acid (Hyposulphuric acid), $H_2S_2O_6$.
Known only in aqueous solution, which is stable only when dil. Can be evaporated in vacuo until sp. gr. = 1.347, but decomp. upon further evaporation. (Welter and Gay-Lussac, A. ch. **10.** 312.)

Dithionates.
All dithionates are sol. in H_2O.

Aluminum dithionate, $Al_2(S_2O_6)_3+18H_2O$.
Extremely deliquescent. Easily sol. in H_2O or absolute alcohol. (Klüss, A. **246.** 218.)

Aluminum ammonium dithionate, $Al_2(S_2O_6)_3$, $(NH_4)_2S_2O_6+27H_2O$.
Sl. deliquescent. Sol. in H_2O. (Klüss, A. **246.** 303.)

Ammonium dithionate, $(NH_4)_2S_2O_6$.
Very sol. in H_2O. Sol. in 0.79 pt. H_2O at 16°, with reduction of temp. Not decomp. on boiling. Insol. in absolute alcohol. (Heeren, Pogg. **7.** 172.)
Contains $\frac{1}{2}H_2O$. Sol. in 0.56 pt. H_2O at 19°. (Klüss, A. **246.** 194.)

Ammonium cadmium dithionate, $2(NH_4)_2S_2O_6$, $CdS_2O_6+4\frac{1}{2}H_2O$.
Sol. in H_2O. (Klüss, A. **246.** 298.)

Ammonium cobalt dithionate, $9(NH_4)_2S_2O_6$, $2CoS_2O_6+16\frac{1}{2}H_2O$.
Sol. in H_2O. (Klüss.)

Ammonium cupric dithionate, $(NH_4)_2S_2O_6$, $2CuS_2O_6+8H_2O$.
Sol. in H_2O.

Ammonium ferrous dithionate, $3(NH_4)_2S_2O_6$, $Fe_2S_2O_6+6H_2O$.
Sol. in H_2O. (Klüss, A. **246.** 300.)
$9(NH_4)_2S_2O_6$, $2Fe_2S_2O_6+16\frac{1}{2}H_2O$. Sol. in H_2O. (Klüss.)

Ammonium manganous dithionate, $9(NH_4)_2S_2O_6$, $2MnS_2O_6$.
Sol. in H_2O. (Klüss, A. **246.** 301.)

Ammonium nickel dithionate, $9(NH_4)_2S_2O_6$, $2NiS_2O_6+16\frac{1}{2}H_2O$.
Sol. in H_2O. (Klüss.)

Ammonium zinc dithionate, $5(NH_4)_2S_2O_6$, $ZnS_2O_6+9H_2O$.
Easily sol. in H_2O. (Klüss, A. **246.** 296.)
$9(NH_4)_2S_2O_6$, $2ZnS_2O_6+16\frac{1}{2}H_2O$. Easily sol. in H_2O. (Klüss.)

Ammonium dithionate chloride, $(NH_4)_2S_2O_6$, NH_4Cl.
Sol. in H_2O. (Fock and Klüss, B. **24.** 3017.)

Barium dithionate, $BaS_2O_6+2H_2O$.
Not efflorescent. Sol. in 7.17 pts. H_2O at 8°, 4.04 pts. at 18°, and 1.1 pts. H_2O at 100°.
Insol. in alcohol. (Gay-Lussac, Heeren.)
Sol. in 0.994 pt. H_2O at 102°, the boiling-point of the sat. solution. (Baker, Bull. Soc. (2) **44.** 166.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
$+4H_2O$. Very efflorescent. (Heeren.)

Barium magnesium dithionate, $BaMg(S_2O_6)_2+4H_2O$.
Sol. in H_2O. (Schiff, A. **118.** 97.)

Barium rubidium dithionate, $BaRb_4(S_2O_6)_3+H_2O$.
Sol. in H_2O. Solubility is diminished by presence of excess of Rb_2SO_4, but increased by BaS_2O_6. (Bodlander, Chem. Ztg. **14.** 1140.)

Barium sodium dithionate, $BaNa_4(S_2O_6)_3+4H_2O$.
Sol. in H_2O. Decomp. by recrystallisation. (Kraut, A. **118.** 95.)
$+6H_2O$. (Schiff.)

Barium dithionate chloride, BaS_2O_6, $BaCl_2+4H_2O$.
(Fock and Klüss, B. **23.** 3001.)

Bismuth dithionate, basic, Bi_2O_3, $S_2O_5++5H_2O$.
Efflorescent. Insol. in H_2O, but decomp. thereby into the following salt. Easily sol. in dil. acids, especially HCl+Aq. (Klüss, A. **246.** 183.)
$4Bi_2O_3$, $3S_2O_5+5H_2O$. Insol. in H_2O. Sol. in dil. acids. (Klüss.)

Cadmium dithionate.

Deliquescent in moist air; very sol. in H_2O. (Heeren, Pogg. **7.** 183.)

Cadmium dithionate ammonia, CdS_2O_6, $4NH_3$.

Decomp. by alcohol; sol. in NH_4OH+Aq, but decomp. on heating. (Rammelsberg, Pogg. **58.** 298.)

Cæsium dithionate, $Cs_2S_2O_6$.

Easily sol. in H_2O. (Chabrié, C. R. 1901, **133.** 297.)

Calcium dithionate, $CaS_2O_6+4H_2O$.

Sol. in 2.46 pts. H_2O at 19°; 0.8 pt. at 100.° Insol. in alcohol. (Heeren, Pogg. **7.** 178.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Cerous dithionate, $Ce_2(S_2O_6)_3+24H_2O$.

Very sol. in H_2O. (Jolin.)

+3, and $5H_2O$. (Wyrouboff.)

Chromic dithionate, $Cr_2(S_2O_6)_3+18H_2O$.

Sol. in H_2O and alcohol. (Klüss, A. **246.** 189.)

$3Cr_2O_3$, $4S_2O_5+24H_2O$. Easily sol. in H_2O or alcohol. Insol. in ether. (Klüss.)

Cobaltous dithionate, $CoS_2O_6+6H_2O$.

Not deliquescent. Very sol. in H_2O. (Heeren.)

$+8H_2O$. Sol. in 0.49 pt. H_2O at 19°. Sol. in absolute alcohol. (Klüss, A. **246.** 203.)

Cupric dithionate basic, $4CuO$, $S_2O_5+4H_2O$.

Very sl. sol. in H_2O. (Heeren, Pogg. **7.** 18.)

Insol. in H_2O; easily sol. in dil. acids. (Klüss, A. **246.** 208.)

$+3H_2O$. Insol. in H_2O and $NaC_2H_3O_2$+Aq; sol. in traces in conc. CuS_2O_6+Aq. Easily sol. in dil. acids, even $HC_2H_3O_2$, or $H_2S_2O_6$+Aq. (Klüss.)

Cupric dithionate, $CuS_2O_6+4H_2O$.

Not efflorescent. Very sol. in H_2O. Insol. in alcohol. (Heeren.)

$+5H_2O$. (Efflorescent. Sol. in 0.64 pt. H_2O at 18.5.° (Klüss, A. **246.** 204.)

Cupric dithionate ammonia, CuS_2O_6, $4NH_3$.

Difficultly sol. in cold H_2O, moderately sol. in H_2O at 40°. Decomp. by much H_2O or by heating the solution above 60°. Decomp. by HCl+Aq. (Heeren.)

Can be recryst. from NH_4OH+Aq.

Sol. in liquid NH_3. (Horn, Am. Ch. J. 1908, **39.** 213.)

CuS_2O_6, $9NH_3$. Decomp. at ord. temp. in the air.

Insol. in liquid NH_3. (Horn, Am. Ch. J. 1908, **39.** 213.)

Didymium dithionate, $Di_2(S_2O_6)_3+24H_2O$.

Extremely sol. in H_2O. (Cleve.)

Erbium dithionate, $Er_2(S_2O_6)_3+18H_2O$.

Very sol. in H_2O or alcohol; insol. in ether. (Höglund.)

Glucinum dithonate, basic, $5GlO$, $2S_2O_5$+$14H_2O$.

Easily sol. in H_2O and absolute alcohol. (Klüss, A. **246.** **196.**)

Iron (ferrous) dithionate, $FeS_2O_6+5H_2O$.

Very sol. in H_2O. Insol. in alcohol. Decomp. in aqueous solution into $FeSO_4$ by boiling. (Heeren, Pogg. **7.** 181.)

$+7H_2O$. Sol. in 0.59 pt. H_2O at 18.5°. (Klüss, A. **246.** 198.)

Iron (ferric) dithionate, basic, $8Fe_2O_3$, S_2O_5+$20H_2O$.

Insol. in H_2O or alcohol. Very sl. sol. in $H_2S_2O_6$+Aq; easily sol. in HCl+Aq. (Heeren.)

Contains $14H_2O$. (Klüss, A. **246.** 200.)

$3Fe_2O_3$, $S_2O_5+8H_2O$. Insol. in H_2O. Easily sol. in acids. (Klüss, A. **246.** 201.)

Lanthanum dithionate, $La_2(S_2O_6)_3+16H_2O$, and $24H_2O$.

Sol. in H_2O. (Cleve.)

Lead dithionate, basic, $2PbO$, $S_2O_5+2H_2O$.

Very difficultly sol. in H_2O. (Heeren, Pogg. **7.** 171.)

$10PbO$, $S_2O_5+2H_2O$. Sl. sol. in H_2O. (Heeren.)

Lead dithionate, $PbS_2O_6+4H_2O$.

Easily sol. in H_2O. (Heern.)

Sol. in 0.869 pt. H_2O at 20.5°. (Baker, C. N. **36.** 203.)

Lead strontium dithionate, $(Pb,Sr)S_2O_6$+$4H_2O$.

(Rammelsberg.)

Lithium dithionate, $Li_2S_2O_6+2H_2O$.

Sl. deliquescent, and easily sol. in H_2O. Insol. in alcohol. (Rammelsberg.)

Magnesium dithionate, $MgS_2O_6+6H_2O$.

Sol. in 0.85 pt. H_2O at 13°. Solution can be boiled without decomp. (Heeren, Pogg. **7.** 179.)

Sol. in 0.692 pt. H_2O at 17°. (Baker, C. N. **36.** 203.)

Manganous dithionate, $MnS_2O_6+3H_2O$.

Sol. in H_2O. (Kraut, A. **118.** 98.)

$+6H_2O$. Efflorescent. Sol. in H_2O. (Marignac, J. B. **1855.** 380.)

Mercurous dithionate, $Hg_2S_2O_6$.

Sl. sol. in cold, decomp. by hot H_2O. *(Rammelsberg.)*

Mercuric dithionate, basic, $5HgO, 2S_2O_5$.

Sl. sol. in cold, decomp. by hot H_2O. Easily sol. in HNO_3+Aq. (Rammelsberg, Pogg. **59.** 472.)

Mercuric dithionate, $HgS_2O_6+6H_2O$.

Decomp. by H_2O or on standing. (Klüss, A. **246.** 216.)

Nickel dithionate, $NiS_2O_6+6H_2O$.

Sol. in H_2O. (Topsöe.)

Sol. in 0.897 pt. H_2O at 12°. (Baker, C. N. **36.** 203.)

Nickel dithionate ammonia, $NiS_2O_6, 6NH_3$.

Can be recryst. from warm NH_4OH+Aq.

Decomp. by H_2O. (Rammelsberg, Pogg. **58.** 295.)

Nickel dithionate hydrazine, $NiS_2O_6, 3N_2H_4$.

Unstable.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 267.)

Potassium dithionate, $K_2S_2O_6$.

Not deliquescent. Sol. in 16.5 pts. H_2O at 16°, and 1.58 pts. at 100°. Insol. in alcohol. (Heeren.)

Sol. in 2.65 pts. H_2O at 16°. (Dumas.)

Sol. in 16.5 pts. H_2O at 16°; in 1.58 pts. boiling H_2O.

Insol. in alcohol. (Heeren, Pogg. 1826, **7.** 72.)

Praseodymium dithionate, $Pr_2(S_2O_6)_3+12H_2O$.

Deliquescent; very sol. in H_2O. (von Schule, Z. anorg. 1898, **18.** 361.)

Rubidium dithionate, $Rb_2S_2O_6$.

Sol. in H_2O. (Topsöe and Christiansen.)

Ruthenium dithionate, RuS_2O_6.

Ppt. from aq. sol. by alcohol. (Antony, Gazz. ch. it. 1898, **28.** 139–142.)

Silver dithionate, $Ag_2S_2O_6+2H_2O$.

Sol. in 2 pts. H_2O at 16°. Sol. in NH_4OH+Aq. (Heeren, Pogg. **7.** 191.)

Silver sodium dithionate, $AgS_2O_6, Na_2S_2O_6+4H_2O$.

Sol. in H_2O. (Kraut, A. **118.** 96.)

Silver dithionate ammonia, $Ag_2S_2O_6, 4NH_3$.

Sol. in H_2O without decomp. (Rammelsberg, Pogg. **58.** 298.)

Sodium dithionate, $Na_2S_2O_6+2H_2O$.

Sol. in 2.1 pts. H_2O at 16°, and in 1.1 pts. boiling H_2O. Insol. in alcohol.

Fuming HCl+Aq precipitates the salt from aqueous solution. (Heeren, Pogg. **7.** 76.)

$+6H_2O$. (Kraut, A. **117.** 97.)

Strontium dithionate, $SrS_2O_6+4H_2O$.

Sol. in 4.5 pts. H_2O at 16°, 1.5 pts. boiling H_2O. Insol. in alcohol. (Heeren, Pogg. **7.** 177.)

Thallous dithionate, $Tl_2S_2O_6$.

Very easily sol. in H_2O. (Werther.)

Thallous dithionate sulphate, $3Tl_2S_2O_6, Tl_2SO_4$.

Sol. in H_2O. (Wyrouboff, Ann. Phys. Beibl. **8.** 802.)

Thorium dithionate, $Th(S_2O_6)_2+4H_2O$ (?).

Very unstable. (Klüss, A. **246.** 188.)

Tin (stannous) dithionate, SnS_2O_6.

Known only in solution.

$8SnO, S_2O_5+9H_2O$. Insol. in H_2O. Sol. in dil. acids, even dithionic acid+Aq. (Klüss, A. **246.** 186.)

Uranous dithionate, $6UO_2, S_2O_5+10H_2O$.

Insol. in H_2O; sol. in warm HCl+Aq. (Klüss, A. **246.** 191.)

$7UO_2, S_2O_5+8H_2O$. As above.

$8UO_2, S_2O_5+21H_2O$. As above.

***Di*vanadyl dithionate,** $(VO_2)_2S_2O_6$.

Sol. in H_2O. (Bevan, C. N. **38.** 294.)

Yttrium dithionate, $Y_2(S_2O_6)_3+18H_2O$.

Not deliquescent. Easily sol. in H_2O, but difficultly sol. in alcohol. Insol. in ether. (Cleve, Bull. Soc. (2) **21.** 344.)

Zinc dithionate, $ZnS_2O_6+6H_2O$.

Very sol. in H_2O; decomp. on boiling. (Heeren, Pogg. **7.** 183.)

Zinc dithionate ammonia, $ZnS_2O_6, 4NH_3$.

Decomp. with H_2O; sol. in warm, less sol. in cold NH_4OH+Aq. (Rammelsberg, Pogg. **58.** 297.)

$+H_2O$. Ppt. (Ephraim, B. 1915, **48.** 640.)

Dysprosium, Dy.

(Lecoq de Boisbaudran, C. R. **102.** 1005.)

Dysprosium chloride, $DyCl_3+6H_2O$.

Deliquescent, sol. in H_2O. (Urbain, C. R. 1908, **146.** 129.)

Europium.

Europium chloride, $EuCl_2$.

Sol. in H_2O. Stable in very dil. aqueous solution, but decomp. when the solution is concentrated at 100°. (Urbain, C. R. 1911, **153.** 1157.)

Erbium, Er.

Decomposes H_2O. (Höglund.)

The so-called element "erbium" can be further decomp. into simple substances. (Krüss, Z. anorg. **3.** 353.)

Erbium bromide, $ErBr_3+9H_2O$.

Very deliquescent.

Erbium chloride, $ErCl_3+6H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Hoglund.)

Erbium mercuric chloride, $ErCl_3$, $5HgCl_2+xH_2O$.

Deliquescent. (Cleve.)

Erbium fluoride, ErF_3.

Insol. in H_2O. Very sl. sol. in HF+Aq. (Höglund, Bull. Soc. (2) **18.** 193.)

Erbium hydroxide, $Er_2O(OH)_4$.

Insol. in KOH, or NaOH+Aq.

Easily sol. in acids. Decomp. ammonium salts by boiling therewith.

Erbium iodide, ErI_3.

Very deliquescent. Very sol. in H_2O and alcohol. Insol. in ether. (Höglund.)

Erbium oxide, Er_2O_3.

Difficultly but completely sol. in warm HNO_3, H_2SO_4, or HCl+Aq. Decomp. NH_4 salts by boiling therewith.

Erbium ***per*****oxide,** Er_2O_5.

Precipitate. (Cleve, Bull. Soc. (2) **43.** 53.)

Erbium sulphide.

Decomp. in moist air and with acids.

Erythrochromium bromide, $HOCr_2(NH_3)_{10}Br_5+H_2O$.

Very easily sol. in H_2O. Insol. in HBr+Aq. Sol. in NH_4OH+Aq. (Jörgensen, J. pr. (2) **25.** 398.)

—— **bromide, basic,** $HOCr_2(NH_3)_{10}(OH)Br_4+H_2O$.

Very sol. in H_2O. (Jörgensen.)

—— **chloroiodide,** $HOCr_2(NH_3)_{10}ClI_4+H_2O$.

Sol. in H_2O and in alcohol. (Jorgensen.)

Erythrochromium chloroplatinate, $[HOCr_2(NH_3)_{10}]_2(PtCl_6)_5+10H_2O$.

Nearly insol. in H_2O. (Jörgensen.)

—— **dithionate, basic,** $HOCr_2(NH_3)_{10}(S_2O_6)_2(OH)+2H_2O$.

Insol. in H_2O. Easily sol. in very dil. HNO_3, HBr, HCl+Aq. Sol. in conc. NH_4Cl+Aq. (Jörgensen.)

—— **nitrate,** $HOCr_2(NH_3)_{10}(NO_3)_5+H_2O$.

Easily sol. in H_2O. Insol. in dil. HNO_3+Aq. Sol in conc. HNO_3 with decomp. Very sl. in dil. NH_4OH+Aq. Insol. in alcohol. (Jörgensen.)

—— **nitrate, basic,** $HOCr_2(NH_3)_{10}(NO_3)_4OH+3\frac{1}{2}H_2O$.

Sol. in cold H_2O. (Jörgensen.)

—— **sulphate,** $[HOCr_2(NH_3)_{10}]_2(SO_4)_5$.

Nearly insol. in H_2O. (Jörgensen.)

Tetra**ferriammonium,** Fe_2N.

See **Iron nitride.**

Ferric acid.

Barium ferrate, $BaFeO_4+H_2O$.

Ppt. Can be boiled for some time with H_2O without decomp. Decomp. by mineral acids. Sol. in dil. acetic acid. (Fremy, A. ch. (3) **12.** 373.)

Insol. in H_2O; not readily acted upon by acids when dry. (Rosen, J. Am. Chem. Soc. 1895, **17.** 766.)

Ppt. Easily decomp. by acids. (Moeser, Arch. Pharm. 1895, **233.** 526.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Calcium ferrate, CaF_2O_4.

Sol. in H_2O. (Rosell, J. Am. Chem. Soc. 1895, **17.** 760–69.)

Potassium ferrate, K_2FeO_4.

Very deliquescent. Easily sol. in cold H_2O with evolution of much heat. Decomp. by standing or warming. Decomp. by acids or alkalies. (Fremy, A. ch. (3) **12.** 369.)

Sol. in H_2O; insol. in alcohol. (Moeser, Arch. Pharm. 1895, **233.** 524.)

Quickly decomp. by potassium tartrate or racemate, sugar, or albumen without separation of $Fe_2O_6H_6$, by alcohol with separation of $Fe_2O_6H_6$. Potassium oxalate, acetate, formate, and benzoate, also citrate decomp. much more slowly. Insol. in conc. KOH+Aq. (Wackenroder, A. **33.** 41.)

Sodium ferrate, Na_2FeO_4.

Sol. in H_2O and in conc. NaOH+Aq. (Fremy, l. c.)

Strontium ferrate, $SrFeO_4$.

Sl. sol. in H_2O by which it is decomp.

Decomp. by acids.

Sol. in aqueous solutions of Na aud K salts with partial decomp.

Insol. in sat. $SrBr_2$+Aq., alcohol and ether. (Eidmann, B. 1903, **36**, 2290.)

Ferricomolybdic acid.

Ammonium ferricomolybdate, $3(NH_4)_2O$, Fe_2O_3, $12MoO_3+19H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 697.)

Ferricyanhydric acid,

$H_3Fe(CN)_6$, (or $H_6Fe_2(CN)_{12}$).

Easily sol. in H_2O or alcohol. Solution decomposes slowly by standing, more rapidly by heating. Insol. in ether.

Ferricyanides.

The alkali, and alkaline-earth ferricyanides are sol. in H_2O; the others are insol. The ferricyanides of metals, the oxides of which are sol. in NH_4OH, or KOH+Aq, are themselves sol. in those reagents.

Ammonium ferricyanide, $(NH_4)_3Fe(CN)_6+3H_2O$.

Permanent. Readily sol. in H_2O (and alcohol?).

Ammonium ferrous ferricyanide, $NH_4FeFe(CN)_6+1\frac{1}{2}H_2O$.

Sol. in H_2O and not pptd. by alcohol from aqueous solution. More stable than the corresponding K salt.

Ammonium lead ferricyanide, $NH_4PbFe(CN)_6+3H_2O$.

Ammonium potassium ferricyanide, $(NH_4)_2KFe(CN)_6$.

Sol. in H_2O. (Schaller, Bull. Soc. (2) **1.** 275.)

Barium ferricyanide, $Ba_3[Fe(CN)_6]_2+20H_2O$.

Easily sol. in H_2O; insol. in alcohol. (Schuler, W. A. B. **77.** 692.)

Barium potassium ferricyanide, $BaKFe(CN)_6+3H_2O$.

Permanent. Easily sol. in H_2O, less in alcohol.

Barium ferricyanide bromide, $Ba_3[Fe(CN)_6]_2$, $2BaBr_2+20H_2O$.

Easily sol. in H_2O. Boiling alcohol does not dissolve out $BaBr_2$. (Rammelsberg, J. pr. (2) **39.** 463.)

Bismuth ferricyanide, $Bi_3[Fe(CN)_6]_5$.

Insol. in H_2O, but decomp. by boiling therewith. (Muir, Chem. Soc. **32.** 40.)

Cadmium ferricyanide ammonia, $Cd_3[Fe(CN)_6]_2$, $6NH_3+3H_2O$.

Effloresces to form—

$Cd_3[Fe(CN)_6]_2$, $4NH_3+2H_2O$. Insol. in H_2O. (Wyrouboff, A. ch. (5) **10.** 413.)

Calcium ferricyanide, $Ca_3[Fe(CN)_6]_2+10$, or $12H_2O$.

Deliquescent. Sol. in H_2O and dil. alcohol.

Calcium potassium ferricyanide, $CaKFe(CN)_6$.

Sol. in H_2O.

Cerous ferricyanide, $CeFe(CN)_6+4H_2O$.

Sol. in H_2O; easily decomp. (Jolin.)

Chromic ferricyanide (?).

Ppt.

Cobaltous ferricyanide, $Co_3[Fe(CN)_6]_2$.

Insol. in H_2O and HCl+Aq. Sol. in NH_4OH+Aq.

Cobaltous ferricyanide ammonia, $Co_3[Fe(CN)_6]_2$, $4NH_3+6H_2O$.

Cobaltic ferricyanide ammonia.

See **Luteo,- purpureo,- etc. cobaltic ferricyanide.**

Cuprous ferricyanide, $(Cu_2)_3[Fe(CN)_6]_2$.

Sol. in NH_4OH+Aq; insol. in NH_4 salts+Aq. (Wittstein.)

Cupric ferricyanide, $Cu_3[Fe(CN)_6]_2$.

Insol. in H_2O or NH_4 salts+Aq. Sol. in NH_4OH, and $(NH_4)_2CO_3$+Aq. (Wittstein.) Insol. in HCl+Aq.

Iron (ferrous) ferricyanide, $Fe_3[Fe(CN)_6]_2+xH_2O$.

(*Turnbull's blue.*) Properties as ferric ferrocyanide (Prussian blue), with which it is perhaps identical. (Gintl, Z. anal. **21. 110.**)

Iron (ferrosoferric) ferricyanide, $Fe_{13}(CN)_{36}=Fe^{III}_4Fe^{II}_3[Fe(CN)_6]_6$.

(*Prussian green.*) Insol. in H_2O or conc. HCl+Aq, but slowly decomp. by boiling therewith.

$Fe_3(CN)_8+4H_2O=Fe^{II}_3Fe^{III}_2[Fe(CN)_6]_4+12H_2O$. Properties as above. (Reynolds, Chem. Soc. **54.** 767.)

Iron (ferrous) potassium ferricyanide, $KFe_2(CN)_6=KFeFe(CN)_6+4$, or $3H_2O$.

(*Soluble Prussian blue.*) Sol. in H_2O, but insol. in salts+Aq or alcohol.

Salt of the same composition, called "Williamson's blue," is insol. in H_2O.

Lead ferricyanide, basic, $Pb_6[Fe(CN)_6]$, $3PbO_2H_2+11H_2O$.

(Schuler.)

Lead ferricyanide, $Pb_3[Fe(CN)_6]_2+16H_2O$.

Sl. sol. in H_2O; more sol. in hot, than cold H_2O, but decomp. on boiling. (Gmelin.)

$+4H_2O$. Easily sol. in H_2O; sl. sol. in alcohol. (Schuler, W. A. B. **77.** 692.)

Lead potassium ferricyanide, $PbKFe(CN)_6+3H_2O$.

Sol. in 4.75 pts. H_2O at 16°, and the solution decomp. on standing. (Schuler.)

$+1\frac{1}{2}H_2O$. Efflorescent. Much more sol. in H_2O than the Pb salt. Insol. in alcohol. (Wyrouboff.)

Lead ferricyanide nitrate, $Pb_3[Fe(CN)_6]_2$, $Pb(NO_3)_2+12H_2O$.

Sol. in 13.31 pts. H_2O at 16°. (Schuler.)

$+11H_2O$. (Joannis, A. ch. (5) **26.** 528.)

Magnesium ferricyanide, $Mg_3[Fe(CN)_6]_2$.

Sol. in H_2O.

Magnesium potassium ferricyanide, $MgKFe(CN)_6$.

(Reindel, J. pr. **103.** 166.)

Manganous ferricyanide, $Mn_3[Fe(CN)_6]_2$.

Insol. in H_2O, acids, NH_4OH, or NH_4 salts +Aq.

Mercurous ferricyanide, $Hg_3Fe(CN)_6$.

Ppt. (Fernekes, J. Am. Chem. Soc. 1906, **28.** 604.)

Mercuric ferricyanide, $Hg_3[Fe(CN)_6]_2$.

Very sol. in H_2O. Solution quickly decomp. (Fernekes, J. Am. Chem. Soc. 1906, **28.** 603.)

Nickel ferricyanide ammonia, $Ni_3[Fe(CN)_6]_2$, $4NH_3+H_2O$.

Sol. in NH_4OH+Aq. (Reynoso, A. ch.(3) **30.** 254.)

Nickel ferricyanide, $Ni_3[Fe(CN)_6]_2$(?).

Ppt. Insol. in HCl+Aq.

Potassium ferricyanide, $K_3Fe(CN)_6$, (or $K_6Fe_2(CN)_{12}$).

Permanent. Easily sol. in H_2O.

100 pts. H_2O dissolve pts. $K_3Fe(CN)_6$ at t°.

t°	Pts. salt	t°	Pts. salt	t°	Pts. salt
4.4	33.0	15.6	40.8	100	77.5
10	36.6	37.8	58.8	104.4	82.6

(Wallace, Chem. Soc. **7.** 80.)

100 pts. H_2O at 13° dissolve 38 pts., and the solution has sp. gr.=1.1630. (Schiff, A. **113.** 350.)

1 l. sat. solution in H_2O at 25° contains 385.5 g. $K_3Fe(CN)_6$. (Grube, Z. Electrochem. 1914, **20.** 342.)

Sp. gr. of $K_3Fe(CN)_6$+Aq at 13°.

% salt	Sp. gr.	% salt	Sp. gr.	% salt	Sp. gr.
1	1.0051	11	1.0595	21	1.1202
2	1.0103	12	1.0653	22	1.1266
3	1.0155	13	1.0712	23	1.1331
4	1.0208	14	1.0771	24	1.1396
5	1.0261	15	1.0831	25	1.1462
6	1.0315	16	1.0891	26	1.1529
7	1.0370	17	1.0952	27	1.1596
8	1.0426	18	1.1014	28	1.1664
9	1.0482	19	1.1076	29	1.1732
10	1.0538	20	1.1039	30	1.1802

(Schiff.)

Sp. gr. of $K_3Fe(CN)_6$+Aq at 25°.

Concentration of $K_3Fe(CN)_6$ +Aq.	Sp. gr.
1—normal	1.0574
1/2— "	1.0289
1/4 "	1.0143
1/8— "	1.0092

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

Sat. $K_3Fe(CN)_6$+Aq boils at 104.4°. (Wallace.)

1 l. sat. solution at 25° of $K_3Fe(CN)_6$+$K_4Fe(CN)_6$ contains 338.1 g. $K_3Fe(CN)_6$ and 79.02 g. $K_4Fe(CN)_6$. (Grube.)

Solubility of $K_3Fe(CN)_6$+$K_4Fe(CN)_6$ in KOH+Aq at 25°.

KOH Normality	g. per l.	
	$K_3Fe(CN)_6$	$K_4Fe(CN)_6$
0.4687	309	66.64
0.9628	275.3	55.19
1.949	200.8	35.95

(Grube.)

Solubility in KOH+Aq at 25°.

KOH Normality	g. $K_3Fe(CN)_6$ per l.
0.4687	342.7
0.9628	302.3
1.949	215.1

(Grube, Z. Electrochem, 1914, **20.** 342.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in absolute alcohol, and only sl. sol. in dil. alcohol.
Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)
Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Potassium sodium ferricyanide, $KNa_2Fe(CN)_6$.
Sol. in H_2O.
$K_2NaFe(CN)_6$. Sol. in H_2O.
$K_3Na_3[Fe(CN)_6]_2$. Sol. in H_2O.
$+3H_2O$.

Potassium ferricyanide iodide, $K_3Fe(CN)_6$, KI.
Very unstable.

Silver ferricyanide, $Ag_3Fe(CN)_6$.
1 l. H_2O dissolves 0.00066 g. $Ag_3Fe(CN)_6$ at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)
Sol. in NH_4OH, and hot $(NH_4)_2CO_3$+Aq, but insol. in NH_4 salts+Aq.
Insol. in $Hg(NO_3)_2$+Aq. (Wackenroder, A. **41.** **317.**)

Silver ferricyanide ammonia, $2Ag_3Fe(CN)_6$, $3NH_3+\frac{1}{2}H_2O$.
Insol. in H_2O. Sol. in NH_4OH+Aq. (Gintl.)
$2Ag_3Fe(CN)_6$, $5NH_3$. (Carlo, Gazz. ch. it. 1910, **40.** (2) 477.)

Sodium ferricyanide, $Na_3Fe(CN)_6+H_2O$.
Deliquescent. Sol. in 5.3 pts. cold, and 1.5 pts. boiling H_2O. Insol. in alcohol, but not pptd. thereby from aqueous solution. (Bette.)

Ferrinitrososulphydric acid.
See **Ferro*heptan*itrososulphydric acid.**

Ferrocyanhydric acid, $H_4Fe(CN)_6$.
Sol. in H_2O and alcohol.
100 pts. H_2O dissolve 15 pts. acid at 14°. (Joannis, A. ch. (5) **26.** 514.)
Insol. in ether, and much less sol. in ether-alcohol than in alcohol. Insol. in conc. HCl+Aq.

Ferrocyanides.
The ferrocyanides of the alkali and alkaline-earth metals are sol. in H_2O; the others are insol., but sol. in alkalies+Aq in case the base is sol. therein.

Aluminum ferrocyanide, $Al_4[Fe(CN)_6]_3+17H_2O$.
Sl. sol. in H_2O.
Sl. sol. in HCl+Aq with partial decomp. (Wyrouboff, A. ch. (5) **8.** 446.)

Ammonium ferrocyanide, $(NH_4)_4Fe(CN)_6+3H_2O$.
Very sol. in H_2O; insol. in alcohol.
$+H_2O$. (Berzelius.)

Ammonium cadmium ferrocyanide ammonia, $(NH_4)_2Cd_3[Fe(CN)_6]_2$, $2NH_3+H_2O$.
Sol. in H_2O. (Wyrouboff, A. ch. (5) **10.** 413.)

Ammonium calcium ferrocyanide, $(NH_4)_2CaFe(CN)_6$.
Sl. sol. in H_2O. (Kunheim and Zimmerman, Dingl. **252.** 478.)
100 g. sat. solution in H_2O contain 0.258 g. at 16°. (Brown, J. phys. Ch. 1898, **2.** 51.)

Ammonium cuprous ferro cyanide, $(NH_4)_2Cu_2Fe(CN)_6$.
Insol. in H_2O and alcohol.
Decomp. in the air. (Messner, Z. anorg. 1895, **8.** 382.)

Ammonium cupric ferrocyanide, $(NH_4)_2CuFe(CN)_6$.
Ppt.
$+xH_2O$. Very unstable. Insol. in H_2O; decomp. by boiling H_2O. (Messner, Z. anorg. 1895, **8.** 384.)

Ammonium lithium ferrocyanide, $(NH_4)_2Li_2Fe(CN)_6+3H_2O$.
Sol. in H_2O. (Wyrouboff, A. ch. (4) **21.** 270.)

Ammonium magnesium ferrocyanide, $(NH_4)_2MgFe(CN)_6$.
1 l. sat. solution at 17° contains 2.48 g. $(NH_4)_2MgFe(CN)_6$. (Robinson, Chem. Soc. 1909, **95.** 1353.)

Ammonium manganous ferrocyanide, $(NH_4)_2MnFe(CN)_6$.
Ppt. (Blum, Z. anal. **30.** 284.)

Ammonium potassium ferrocyanide, $NH_4K_3Fe(CN)_6+3H_2O$.
Easily sol. in cold, more easily in hot H_2O. Insol. in alcohol.
$(NH_4)_2K_2Fe(CN)_6+3H_2O$. Sol. in H_2O.

Ammonium potassium ferrocyanide ammonium chloride, $(NH_4)_3KFe(CN)_6$, $2NH_4Cl$.
Sol. in H_2O. (Étard, J. pr. (2) **31.** 430.)

Ammonium ferrocyanide bromide, $(NH_4)_4Fe(CN)_6$, $2NH_4Br$.
Permanent. Very sol. in H_2O.

Ammonium ferrocyanide chloride, $(NH_4)_4Fe(CN)_6$, $2NH_4Cl+3H_2O$.
Permanent. Very sol. in H_2O, but less so than NH_4Cl. (Bunsen.)

Antimony ferrocyanide, $Sb_4[Fe(CN)_6]_3+25H_2O$.

Ppt. (Atterberg.)

Barium ferrocyanide, $Ba_2Fe(CN)_6+6H_2O$.

Permanent. Sl. sol. in H_2O.

Sol. in 584 pts. cold, and 116 pts. boiling H_2O (Duflos, **1832**); sol. in 1800 pts. cold H_2O (Porrett, **1814**); sol. in 1920 pts. cold, and about 100 pts. boiling H_2O (Thomson); sol. in 2000 pts. cold, and 100 pts. boiling H_2O. (Ure's Dict.)

Sol. in 1000 pts. H_2O at 15°, and 100 pts. at 75°. (Wyrouboff, A. ch. (4) **16.** 292.)

Sol. in HNO_3, HCl, or conc. H_2SO_4+Aq.

Barium cupric ferrocyanide, $BaCuFe(CN)_6$.

Insol. in H_2O. (Messner, Z. anorg. 1895, **8.** 389.)

Barium potassium ferrocyanide, $BaK_2Fe(CN)_6+3H_2O$.

Sol. in 38 pts. cold, and 9.5 pts. boiling H_2O (Duflos, **1832**); in 36.4 pts. H_2O at 14°, and 11.9 pts. at b.-pt. (Mosander.)

Not more sol. in NH_4Cl+Aq than in H_2O. Sol. in dil., insol. in conc. HCl+Aq. (Rose.)

$+5H_2O$. Sol. in 300 pts. H_2O at ord. temp. (Wyrouboff.)

Bismuth ferrocyanide, $Bi_2Fe(CN)_6+5H_2O$ (?).

Sl. sol. in pure H_2O. (Wyrouboff.)

$Bi_4[Fe(CN)_6]_5$. Ppt. (Muir, Chem. Soc. **31.** 657.)

Bismuth potassium ferrocyanide, $BiKFe(CN)_6+7H_2O$, or $4H_2O$.

Ppt.

Cadmium potassium ferrocyanide, $CdK_2Fe(CN)_6+H_2O$.

Insol. in H_2O.

Formula given by Wyrouboff is $Cd_5K_6[Fe(CN)_6]_4+11H_2O$(?).

Calcium ferrocyanide, $Ca_2Fe(CN)_6+12H_2O$.

Very sol. in H_2O. Sol. in 0.66 pt. H_2O at 90° and not pptd. by cooling, and is apparently less sol. in warm than cold H_2O. (Wyrouboff, A. ch. (4) **16.** 280.)

Calcium cuprous ferrocyanide, $CaCu_2Fe(CN)_6$. (Messner, Z. anorg. 1894, **8.** 387.)

Calcium cupric ferrocyanide, $CaCuFe(CN)_6$.

Insol. in H_2O. (Messner, Z. anorg. 1895 **8.** 388.)

Calcium potassium ferrocyanide, $CaK_2Fe(CN)_6$.

Sl. sol. in H_2O. (Kunheim and Zimmerman, Dingl. **252.** 478.)

$+3H_2O$. Sol. in 795 pts. H_2O at 15°, and 145 pts. at b-pt., with decomp. in the latter case.

Sol. in dil., insol. in conc. HCl+Aq. Sol. in HNO_3 of 1.2 sp. gr. (Mosander.)

Insol. in NH_4Cl+Aq.

Calcium sodium ferrocyanide, $CaNa_2[Fe(CN)_6]_2$.

Sol. in H_2O.

Calcium strontium ferrocyanide. $CaSrFe(CN)_6+10H_2O$.

Efflorescent. Sol. in about 3 pts. H_2O. (Wyrouboff, A. ch. (4) **21.** 278.)

Cerium ferrocyanide, $Ce_4[Fe(CN)_6]_3+30H_2O$.

Ppt. (Wyrouboff.)

Cerium potassium ferrocyanide, $CeKFe(CN)_6+3H_2O$.

Ppt. (Jolin.)

$+4H_2O$. (Wyrouboff.)

Chromic ferrocyanide, $Cr_2[Fe(CN)_6]_3+20H_2O$.

Ppt.

Cobaltous ferrocyanide, $Co_2Fe(CN)_6+7H_2O$.

Wholly insol. in H_2O.

Sol. in H_2SO_4 with decomp. Insol. in HCl+Aq. Sl. sol. in NH_4OH+Aq. Sol. in $(NH_4)_2CO_3$+Aq. Insol. in NH_4Cl+Aq. Sol. in KCN+Aq.

Cobaltous ferrocyanide ammonia, $Co_2Fe(CN)_6$, $8NH_3+10H_2O$.

Ppt. Decomp. on standing. (Curda, Z. Ch. **1869.** 369.)

$Co_2Fe(CN)_6$, $12NH_3+9H_2O$. As above. (Curda.)

Cobaltous potassium ferrocyanide, $CoK_2Fe(CN)_6$.

Ppt. (Wyrouboff.)

$Co_5K_6[Fe(CN)_6]_4$ (?). Ppt. Insol. only in presence of an excess of $K_4Fe(CN)_6$. (Wyrouboff.)

Columbium potassium ferrocyanide, $Cb_{16}K[Fe(CN)_6]_2+67H_2O$ (?).

Sol. in H_2O. (Wyrouboff.)

$Cb_{12}K_2Fe(CN)_6 + 39H_2O$ (?). Sol. in H_2O. (W.)

$(CbO)_5K_9[Fe(CN)_6]_6+10H_2O$ (?). Ppt. (Atterberg.)

Cuprous ferrocyanide, $Cu_4Fe(CN)_6$.

Insol. in H_2O; sol. in NH_4OH+Aq; insol. in NH_4Cl+Aq.

Cupric ferrocyanide, basic, $CuFe(OH)_4(CN)_4$.
Ppt. (Bong, Bull. Soc. **23.** 231.)

Cupric ferrocyanide, $Cu_2Fe(CN)_6+7H_2O$.
Insol. in H_2O or acids. Insol. in NH_4 salts+Aq. Sol. in NH_4OH+Aq. Sol. in $(NH_4)_2C_2O_4$+Aq and in KCN+Aq.
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
$+10H_2O$. Sol. in excess of $K_4Fe(CN)_6$+Aq, especially if hot. (Wyrouboff.)

Cupric ferrocyanide ammonia (cuprammonium ferrocyanide), $Cu_2Fe(CN)_6$, $4NH_3+H_2O$.
Insol. in H_2O or alcohol. Sol. in NH_4OH+Aq. (Bunsen.)
$Cu_2Fe(CN)_6$, $8NH_3+H_2O$.

Cuprous magnesium ferrocyanide, $Cu_2MgFe(CN)_6$.
Very unstable. Decomp. in air.
Insol. in H_2O. (Messner, Z. anorg. 1895, **8.** 385.)

Cupric magnesium ferrocyanide, $CuMgFe(CN)_6$.
Insol. in H_2O. Decomp by boiling H_2O. Very unstable. (Messner, Z. anorg. 1895, **8.** 387.)

Cuprous potassium ferrocyanide, $Cu_2K_2Fe(CN)_6$.
Insol. in H_2O. Decomp. by boiling H_2O. Decomp. by acids. Insol. in alcohol. (Messner, Z. anorg. 1895, **8.** 378.)
$+1\frac{1}{2}H_2O$. Insol. in H_2O, alcohol, or ether. Decomp. by acids. Sol. in KCN+Aq.
$K_3Cu_2Fe(CN)_6+4H_2O$.
$+5H_2O$. (Wonfor.)
$+6H_2O$. (Wyrouboff.)

Cupric potassium ferrocyanide, $K_2CuFe(CN)_6+H_2O$.
Insol. in cold, sl. decomp. by boiling H_2O.
$K_2Cu_3[Fe(CN)_6]_2+12H_2O$. Ppt.

Cuprous sodium ferrocyanide, $Cu_2Na_2Fe(CN)_6$.
Decomp. by boiling H_2O; insol. in alcohol; insol. in H_2O; decomp. by acids. (Messner, Z. anorg. 1895, **8.** 373.)

Cupric sodium ferrocyanide, $CuNa_2Fe(CN)_6$.
Insol. in cold H_2O. Decomp. by boiling H_2O. (Moissan, Z. anorg. 1895, **8.** 376.)

Cupric strontium ferrocyanide, $CuSrFe(CN)_6$.
Insol. in H_2O. (Messner, Z. anorg. 1895, **8.** 389.)

Didymium potassium ferrocyanide, $DiKFe(CN)_6+4H_2O$.
Ppt. (Cleve.)
$+2H_2O$. (Wyrouboff.)

Erbium potassium ferrocyanide, $ErKFe(CN)_6+xH_2O$.
(Höglund.)

Gallium ferrocyanide.
Sol. in boiling HCl+Aq. (de Boisbaudran, C. R. **99.** 526.)

Glucinum ferrocyanide, $Gl_2Fe(CN)_6$, $4GlO_2H_2+7H_2O$ (?).
Sol. in H_2O. (Atterberg.)

Iron (ferric) ferrocyanide, $Fe_7(CN)_{18}=Fe_4[Fe(CN)_6]_3+xH_2O$.
(*Prussian blue.*) Insol. in H_2O, alcohol, ether, or oils. Decomp. slowly by boiling H_2O. Insol. in dil. mineral acids. Sol. in conc. HCl+Aq, and conc. H_2SO_4 without decomp. Sol. in $H_2C_2O_4$ or NH_4 tartrate+Aq. Insol. in NH_4OH+Aq. Decomp. by NaOH, or KOH+Aq. Not pptd. in presence of tartrates or citrates.

Iron (ferrous) potassium ferrocyanide, $FeK_2Fe(CN)_6$.
Insol. in H_2O. Decomp. on air.

Iron (ferric) potassium ferrocyanide, $FeKFe(CN)_6$.
Is probably ferrous potassium ferricyanide, which see.

Iron (ferric) ferrocyanide ammonia, $Fe_4[Fe(CN)_6]_3$, $6NH_3+9H_2O$.
Insol. in NH_4 tartrate+Aq.

Lanthanum potassium ferrocyanide, $LaKFe(CN)_6+4H_2O$.
Ppt.

Lead ferrocyanide, $Pb_2Fe(CN)_6+3H_2O$.
Insol. in H_2O, acids, or NH_4OH+Aq. (Wyrouboff, A. ch. (5) **8.** 480.)
Sl. sol. in conc. H_2SO_4, from which it is pptd. by H_2O. (Berzelius.)
Sol. in hot NH_4Cl, or NH_4 succinate+Aq; insol. in other NH_4 salts+Aq. (Wittstein.)
Insol. in NH_4Cl+Aq. (Brett.)
Not pptd. in presence of Na citrate. (Spiller.)

Lithium ferrocyanide, $Li_4Fe(CN)_6+9H_2O$.
Deliquescent. Very sol. in H_2O.

Lithium potassium ferrocyanide, $Li_2K_2Fe(CN)_6+3H_2O$.
Very sol. in H_2O. Sol. in 1.5 pts. H_2O at ord. temp. (Wyrouboff, A. ch. (4) **21.** 274.)

Magnesium ferrocyanide, $Mg_2Fe(CN)_6+6H_2O$.

Sol. in 3 pts. cold H_2O. (Bette, A. **22.** 148.)

Magnesium potassium ferrocyanide, $MgK_2Fe(CN)_6$.

Sol. in 1575 pts. H_2O at 15°, and 238 pts. at 100°. Solution is decomp. by boiling. (Storer's Dict.)

1 l. sat. solution at 17° contains 1.95 g. $MgK_2Fe(CN)_6$. (Robinson, Chem. Soc. 1909, **75.** 1353.)

Manganous ferrocyanide, $Mn_2Fe(CN)_6+7H_2O$.

Insol. in H_2O. Sol. in HCl+Aq. Insol. in NH_4Cl, or NH_4NO_3+Aq.

Manganic ferrocyanide, $Mn_2Fe_3(CN)_{12}$.

Insol. in H_2O. Easily decomp. in the air. Sol. in HCl. (Straus, Z. anorg. 1895, **9.** 8.)

Manganous potassium ferrocyanide, $MnK_2Fe(CN)_6$.

Ppt. (Berzelius.)

$5Mn_2Fe(CN)_6$, $4K_4Fe(CN)_6+4H_2O$(?). Ppt. Sol. in dil. HCl+Aq. (Wyrouboff.)

Mercuric potassium ferrocyanide, $K_2HgFe(CN)_6$.

Insol. in H_2O. Appreciably sol. in $K_4Fe(CN)_6$+Aq. (Fernekes, J. Am. Chem. Soc. 1906, **28.** 87.)

Molybdenum ferrocyanide, $Mo_4Fe(CN)_6+20H_2O$(?).

Very sol. in NH_4OH+Aq. (Wyrouboff.)

$Mo_2Fe(CN)_6+8H_2O$ (?). (W.)

$+14H_2O$ (?). Very sol. in H_2O; insol .in alcohol. (W.)

Molybdenum potassium ferrocyanide, $K_4Mo_8[Fe(CN)_6]_2+40H_2O$ (?). (Wyrouboff.)

$K_2(MoO_2)_3[Fe(CN)_6]_2$, $2MoO_3+20H_2O$ (?). (Atterberg.)

$K_6Mo_2[Fe(CN)_6]_2$, $2MoO_3+12H_2O$ (?). (Atterberg.)

Nickel ferrocyanide, $Ni_2Fe(CN)_6+11H_2O$, or $14H_2O$.

Ppt. Insol. in H_2O or HCl+Aq. Sol. in NH_4OH+Aq; insol. in NH_4 salts+Aq. Sol. in KCN+Aq.

Nickel ferrocyanide ammonia, $Ni_2Fe(CN)_6$, $4NH_3+H_2O$.

Completely insol. in H_2O and not attacked thereby; sol. in NH_4OH+Aq to form—

$Ni_2Fe(CN)_6$, $10NH_3+4H_2O$. Decomp. by hot H_2O. (Reynoso, A. ch. (3) **30.** 252.)

$Ni_2Fe(CN)_6$, $2NH_3$+4, and $9H_2O$. Hygroscopic. Easily decomp. (Gintl, J. B. **1868.** 304.)

$Ni_2Fe(CN)_6$, $8NH_3+4H_2O$. Sol. in NH_4OH+Aq. (G.)

$Ni_2Fe(CN)_6$, $12NH_3+9H_2O$. Sol. in NH_4OH+Aq, but less so than the above compounds. (G.)

Nickel potassium ferrocyanide, $NiK_2Fe(CN)_6+3H_2O$.

Ppt. (Wyrouboff.)

Osmium ferrocyanide, $Os_2Fe(CN)_6$.

Ppt. (Martius, A. **117.** 368.)

Potassium ferrocyanide, $K_4Fe(CN)_6$.

Permanent. Easily sol. in cold, and more easily in hot H_2O.

Sol. in 4.23 pts. H_2O at 15°, or 100 pts. H_2O dissolve 23.6 pts. salt at 15°. (Schiff, A. **113.** 350.)

100 pts. H_2O dissolve 27.8 pts. at 12.2°; 65.8 pts. at 37.7°; 87.6 pts. at 65.5°; and 90.6 pts. at 96.3°. (Thomson.)

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Wittstein.)

100 pts. H_2O dissolve 29.2 pts. salt at 15°, and solution has sp. gr. = 1.1441. (Michel and Kraft, A. ch. (3) **41.** 478.)

Solubility of $K_4Fe(CN)_6$ in H_2O at t°.

—2°	+7°	14°	30°	56°
10.8	15.4	17.9	23.0	31.7%
60°	75°	89°	98°	157°
34.0	39.1	41.9	42.6	46.8%

(Étard, A. ch. 1894, (7) **2.** 546.)

$K_4Fe(CN)_6$+Aq sat. at 8° has sp. gr. = 1.13. (Anthon.)

Sp. gr. of $K_4Fe(CN)_6$+Aq at 15°.

% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.
1	1.0058	8	1.0479	15	1.0932
2	1.0116	9	1.0542	16	1.0999
3	1.0175	10	1.0605	17	1.1067
4	1.0234	11	1.0669	18	1.1136
5	1.0295	12	1.0734	19	1.1205
6	1.0356	13	1.0800	20	1.1275
7	1.0417	14	1.0866	..	....

(Schiff, A. **113.** 199.)

Sp. gr. of $K_4Fe(CN)_6$+Aq at 25°.

Concentration of $K_4Fe(CN)_6$+Aq.	Sp. gr.
1—normal	1.0617
1/2— "	1.0300
1/4— "	1.0150
1/8— "	1.0074
1/16— "	1.0037

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

Solubility in KOH+Aq at 25°.

KOH Normality	g. $K_4Fe(CN)_6+3H_2O$ per l.
0.09984	308.5
0.2496	283.5
0.4963	247.1
0.7036	217.4
0.9415	184.8
1.395	132.1
1.883	86.12

(Grube, Z. Electrochem, 1914, **20.** 342.)

$K_4Fe(CN)_6+NaCl+Aq$ sat. at 20° contains 26.6 g. NaCl and 17.8 g. $K_4Fe(CN)_6$ per 100 g. H_2O; sat. at 93° it contains 27.4 g. NaCl and 35.9 g. $K_4Fe(CN)_6$ per 100 g. H_2O. (Conroy, J. Soc. Chem. Ind. 1898, **17.** 105.)

$K_4Fe(CN)_6+KCl+Aq$ sat. at 21° contains 27.2 g. KCl and 4.2 g. $K_4Fe(CN)_6$ per 100 g. H_2O; sat. at 99° it contains 39.6 g. KCl and 17.0 g. $K_4Fe(CN)_6$ per 100 g. H_2O. (Conroy.)

$K_4Fe(CN)_6+Na_2CO_3+Aq$. sat. at 22° contains 29.9 g. Na_2CO_3 and 26.7 g. $K_4Fe(CN)_6$ per 100 g. H_2O; sat. at 97° it contains 42.0 g. Na_2CO_3 and 27.5 g. $K_4Fe(CN)_6$ per 100 g. H_2O. (Conroy.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol even when dilute.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+3H_2O$. 1 l. sat. solution in H_2O contains 319.4 g. $K_4Fe(CN)_6+3H_2O$. (Grube, Electrochem. Z. 1914, **20.** 342.)

Two modifications with different solubilities.

25.0 g. of α modification are contained in 100 g. of solution at 20°.

24.6 g. of β modification are contained in 100 g. of solution at 20°. (Briggs, Chem. Soc. 1911, **99.** 1024.)

32.0 g. $K_4Fe(CN)_6$ (anhydrous) are dissolved in 100 g. H_2O at 25°. (Wagner, Z. phys. Ch. 1910, **71.** 428.)

Potassium samarium ferrocyanide, $KSmFe(CN)_6+5H_2O$.

Precipitate. (Cleve.)

Potassium sodium ferrocyanide, $KNa_3Fe(CN)_6+12H_2O$.

Sol. in H_2O.

$K_2Na_2Fe(CN)_6+8H_2O$. Easily sol. in H_2O.

$K_3NaFe(CN)_6+3H_2O$. Permanent. Easily sol. in H_2O; insol. in alcohol.

Potassium sodium ferrocyanide nitrate, $K_2Na_2Fe(CN)_6, 4KNO_3$.

Sol. in H_2O. (Martius.)

Potassium strontium ferrocyanide, $K_2SrFe(CN)_6+3H_2O$.

Easily decomp. Sol. in H_2O; sl. sol. in alcohol. (Wyrouboff, A. ch. (4) **21.** 276.)

Potassium stannic ferrocyanide, $KSn_3[Fe(CN)_6]_3+68H_2O$ (?).

Ppt. (Wyrouboff.)

$K_4Sn_{10}[Fe(CN)_6]_{11}+230H_2O$ (?). (Atterberg.)

Potassium titanium ferrocyanide, $K_3Ti_3[Fe(CN)_6]_2+11H_2O$ (?).

Ppt. Sol. in $K_4Fe(CN)_6+Aq$. (Wyrouboff.)

$K_4Fe(CN)_6$, $11Ti_2Fe(CN)_6+43H_2O$ (?). Ppt. (Wyrouboff.)

$K_2(TiO)_3[Fe(CN)_6]_2+23H_2O$ (?). Ppt. (Atterberg.)

$K_2(TiO)_{11}[Fe(CN)_6]_6+110H_2O$ (?). Ppt. (Atterberg.)

Potassium tungsten ferrocyanide, $KW_2Fe(CN)_6+7H_2O$ (?).

Sol. in H_2O. (Wyrouboff.)

$K_2W_5Fe(CN)_6+20H_2O$ (?). Sol. in H_2O. (W.)

Potassium uranium ferrocyanide, $K_2U_3[Fe(CN)_6]_2+6H_2O$ (?).

Ppt. (Wyrouboff.)

$K_2(UO_2)_3[Fe(CN)_6]_2+6H_2O$. Ppt. (Atterberg.)

$K_6(UO_2)_5[Fe(CN)_6]_4+12H_2O$. Sol. in H_2O. (Atterberg.)

Potassium vanadium ferrocyanide, $K_{18}V[Fe(CN)_6]_6+39H_2O$ (?).

Ppt. Sl. sol. in H_2O. (Wyrouboff.)

$K_6(VO)_5[Fe(CN)_6]_4+60H_2O$(?). Ppt. (Atterberg.)

Potassium ytterbium ferrocyanide, $KYbFe(CN)_6+3H_2O$.

Ppt. Sol. in excess $K_4Fe(CN)_6+Aq$. (Cleve, Z. anorg. 1902, **32.** 140.)

Potassium yttrium ferrocyanide, $KYFe(CN)_6+2H_2O$.

Ppt. (Wyrouboff, A. ch. (5) **8.** 444.)

Potassium zinc ferrocyanide, $K_4Zn_6[Fe(CN)_6]_4+12H_2O$.

Absolutely insol. in H_2O. (Wyrouboff, A. ch. (5) **8.** 485.)

Potassium ferrocyanide carbonyl, $K_3Fe(CN)_5(CO)+3\frac{1}{2}H_2O$.

See **Carbonyl ferrocyanide, potassium.**

Rubidium ferrocyanide, $Rb_4Fe(CN)_6+2H_2O$.

Sol. in less than 1 pt. H_2O at ord. temp. with great absorption of heat. (Wyrouboff, A. ch. (4) **16.** 307.

Silver ferrocyanide, $Ag_4Fe(CN)_6+H_2O$.

Insol. in H_2O or dil. acids. Insol. in NH_4OH, or NH_4 salts + Aq. Sol. in KCN + Aq.

Decomp. by warm NH_4OH+Aq. (Weith, Z. Ch. (2) **5.** 381.)

Silver ferrocyanide ammonia, $Ag_4Fe(CN)_6, 2NH_3+H_2O$.

(Wyrouboff.)

$+6H_2O$. (Gintl.)

Sodium ferrocyanide, $Na_4Fe(CN)_6+12H_2O$.

Efflorescent. Less sol. in H_2O than $K_4Fe(CN)_6$. Sol. in 4.5 pts. H_2O at 12°. (John.)

100 pts. H_2O at 15.5° dissolve 22 pts. (Ure's Dict.)

100 pts. H_2O dissolve at:

18°	20°	42°	53°	
16.7	17.875	30.2	37.1	pts. Na_4FeCN_6,
58°	60°	77°	80°	
41.7	42.5	54.8	59.2	pts. Na_4FeCN_6,
96°	98°	98.5°		
62.1	61.6	6.30		pts. Na_4FeCN_6.

(Conroy, J. Soc. Chem. Ind. 1898, **17.** 104.)

$+10H_2O$.

100 pts. H_2O dissolve at:

18°	20°	42°	
29.45	31.85	58.5	pts. $Na_4Fe(CN)_6+10H_2O$,
53°	58°	60°	
75.9	88.4	90.2	pts. $Na_4Fe(CN)_6+10H_2O$,
77°	80°	96°	
129.5	146.0	157.0	pts. $Na_4Fe(CN)_6+10H_2O$,
98°	98.5°		
156.5	161 0		pts. $Na_4Fe(CN)_6+10H_2O$.

(Conroy.)

Strontium ferrocyanide, $Sr_2Fe(CN)_6+15H_2O$.

Efflorescent. Sol. in 2 pts. cold, and less than 1 pt. boiling H_2O. (Bette.)

Excessively sol. in H_2O. (Wyrouboff, A. ch. (4) **16.** 280.)

$+8H_2O$. (Wyrouboff.)

Thallous ferrocyanide, $Tl_4Fe(CN)_6+2H_2O$.

100 pts. H_2O dissolve 0.37 pt. at 18°, and 3.93 pts. at 101°. (Lamy.)

Sol. in KCN+Aq. (Kühlmann.)

Thorium ferrocyanide, $ThFe(CN)_6+4H_2O$.

Ppt. (Cleve, Bull. Soc. (2) **24.** 355.)

Tin (stannous) ferrocyanide, $Sn_2Fe(CN)_6+4H_2O$.

Insol. in H_2O or acids; sl. sol. in NH_4OH+Aq. (Wyrouboff.)

Tin (stannic) ferrocyanide, $Sn_5[Fe(CN)_6]_2+18\frac{1}{2}H_2O$ (?).

(Wyrouboff.)

Titanium ferrocyanide, $Ti_7[Fe(CN)_6]_2$ (?).

Ppt. (Wyrouboff.)

Uranium ferrocyanide, $UFe(CN)_6+10H_2O$.

Ppt. (Wyrouboff.)

Vanadyl ferrocyanide, $(VO)_2Fe(CN)_6+11H_2O$

Ppt. (Atterberg.)

Yttrium ferrocyanide, $Y_4[Fe(CN)_6]_3$.

Easily sol. in H_2O; insol. in alcohol. (Popp, A. **131.** 179.)

Zinc ferrocyanide, $Zn_2Fe(CN)_6+3H_2O$.

Insol. in H_2O or acids.

Insol. in HCl+Aq. (Lea, Sill. Am. J. (2) **31.** 191.)

Sol. in NH_4OH, or NH_4 salts+Aq. (Wittstein.)

Insol. in NH_4Cl, or NH_4NO+Aq. (Brett.)

Sl. sol. in boiling $K_4Fe(CN)_6$, or $K_3Fe(CN)_6$ +Aq. (Gore.)

$Na_4Fe(CN)_6+NaCl$+Aq sat. at 21° contains 29.0 g. NaCl and 5.8 g. $Na_4Fe(CN)_6$ per 100 g. H_2O; sat. at 90° it contains 24.7 g. NaCl and 21.3 g. $Na_4Fe(CN)_6$ per 100 g. H_2O. (Conroy, J. Soc. Chem. Ind. 1898, **17.** 105.)

$Na_4Fe(CN)_6+Na_2CO_3$+Aq sat. at 22° contains 22.6 g. Na_2CO_3 and 6.5 g. $Na_4Fe(CN)_6$ per 100 g. H_2O; sat. at 95° it contains 29.8 g. Na_2CO_3 and 36.8 g. $Na_4Fe(CN)_6$ per 100 g. H_2O. (Conroy.)

Very sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Insol. in alcohol.

$+4H_2O$. Absolutely insol. in H_2O. (Wyrouboff, A. ch. (5) **8.** 485.)

$+8H_2O$. (Weith, A. **147.** 329.)

$+10H_2O$. (Pebal, A. **233.** 165.)

Ferro*tetra*nitrososulphydric acid, $H_2S_2(NO)_4Fe_2$.

Insol. in H_2O; sl. sol. in alcohol; more easily in ether; very sol. in CS_2 or $CHCl_3$. Not obtained in a pure state. (Pawel, B. **15.** 2600.)

Ethyl ferro*tetra*nitrososulphide, $(C_2H_5)S_2(NO)_4Fe_2$.

Insol. in H_2O, difficultly sol. in alcohol, more easily in ether, and very easily in CS_2, $CHCl_3$, C_2H_5I, or C_6H_6. (Pawel, B. **15.** 2609.)

Ferrous ——, $FeS_2(NO)_4Fe_2$.

More difficultly sol. in H_2O and alcohol than the *hepta* salt.

Sol. in ether.

Potassium ——, $K_2S_2(NO)_4Fe_2+4H_2O$.

Sol. in H_2O. Easily sol. in alcohol; insol. in ether. (Pawel, B. **15.** 2600.)

True composition of "nitrosulphide of

iron and potassium" of Roussin. (A. ch. (3) **52.** 297.) (Pawel, B. **13.** 1949.)

Sodium ferro*tetra*nitrososulphide, $Na_2S_2(NO)_4Fe_2+8H_2O$.

Sol. in H_2O; easily sol. in alcohol; insol. in ether. (Pawel.)

True composition of "nitrosulphide of iron and sodium" of Roussin. (Pawel.)

Thallium ——, $Tl_2S_2(NO)_4Fe_2$.

Insol. in H_2O, alcohol, or ether. (Pawel.)

Ferro*hepta*nitrososulphydric acid, $HS_3(NO)_7 Fe_4$.

Insol. in H_2O, alcohol, and ether. Easily sol. in CS_2 or $CHCl_3$. (Pawel, B. **15.** 2604.)

May be called Ferrinitrososulphydric acid.

Ammonium ferro*hepta*nitrososulphide, $NH_4S_3(NO)_7 Fe_4+H_2O$.

Less easily sol. in H_2O than the K compound. (Pawel, B. **15.** 2600.)

"*Bi*nitrosulphide of iron" of Roussin. Sol. in about 2 pts. boiling H_2O; very sl. sol. in cold H_2O. Very sol. in alcohols, methyl, ethyl, or amyl, and in $HC_2H_3O_2$. Miscible with ether. Insol. in CS_2 or $CHCl_3$.

Decomp. by conc. HCl, HNO_3, or H_2SO_4.

Not attacked by $H_2C_2O_4$, or $H_2C_4H_4O_6$+Aq.

Insol. in NH_4OH, and KOH+Aq. (Roussin, A. ch. (3) **52.** 286.)

Sol. in H_2O. Insol. in alcohol. (Hofmann, Z. anorg. 1895, **9.** 299.)

Barium ——.

Easily sol. in H_2O. (Pawel.)

Cæsium ——, $Fe_4(NO)_7 S_3Cs+H_2O$.

Insol. in H_2O. Difficultly sol. in alcohol and ether. (Pawel.)

Sparingly sol. in H_2O. (Hofmann, Z. anorg. 1895, **9.** 298.)

Calcium ——.

Easily sol. in H_2O. (Pawel.)

Ferrous ——, $Fe[S_3(NO)_7 Fe_4]_2+8H_2O$.

More easily sol. in H_2O than Na salt. (Pawel.)

Lead ——.

Difficultly sol. in H_2O. (Pawel.)

Magnesium ——.

Easily sol. in H_2O. (Pawel.)

Potassium ——, $KS_3(NO)_7 Fe_4$.

Sol. in H_2O, alcohol, and very sol. in ether with slight decomp. (Pawel, B. **15.** 2600.)

Rubidium ferro*hepta*nitrososulphide, $RbS_3(NO)_7 Fe_4$.

Less soluble in H_2O than the NH_4 salt. (Pawel.)

$+H_2O$. Ppt. (Hofmann, Z. anorg. 1895, **9.** 298.)

Sodium ——, $NaS_3(NO)_7 Fe_4+2H_2O$.

More sol. in H_2O than the potassium salt. (Pawel.)

Thallium ——, $TlS_3(NO)_7 Fe_4+H_2O$.

Very difficultly sol. in H_2O. More easily sol. in alcohol. (Pawel.) (Hofmann, Z. anorg. 1895, **9.** 297.)

Ferro*di*nitrosothiosulphonic acid.

Ammonium ferro*di*nitrosothiosulphonate, $Fe(NO)_2S_2O_3NH_4+H_2O$.

Can be cryst. from warm H_2O without decomp. (Hofmann, Z. anorg. 1895, **8.** 321.)

Cæsium ——, $Fe(NO)_2S_2O_3Cs$.

Sparingly sol. in H_2O. (Hofmann.)

Potassium ——, $Fe(NO)_2S_2O_3K+H_2O$.

Sl. sol. in H_2O without decomp. at 80°.

Sol. in 50% alcohol.

Sol. in H_2SO_4 without decomp. (Hofmann).

Rubidium ——, $Fe(NO)_2S_2O_3Rb+H_2O$.

Less sol. in H_2O than the corresponding Na salt. (Hofmann.)

Sodium ——, $Fe(NO)_2S_2O_3Na+2H_2O$.

Closely resembles K salt, but is more sol. in H_2O and alcohol. (Hofmann.)

Ferrotungstic acid.

Sol. in H_2O. (Laurent, C. R. **31.** 693.)

Ammonium manganous ferrotungstate, $12(NH_4)_2O$, $6MnO$, $2Fe_2O_3$, $3H_2O$, $45WO_3+81H_2O$.

Sol. in H_2O. (Laurent.)

Barium ferrotungstate, $21BaO$, $2Fe_2O_3$, $45WO_3+27H_2O$.

Sol. in H_2O. (Laurent.)

Potassium ferrotungstate, $9K_2O$, $2Fe_2O_3$, $12H_2O$, $45WO_3+54H_2O$.

Sol. in H_2O. (Laurent.)

$18K_2O$, $2Fe_2O_3$, $3H_2O$, $45WO_3+54H_2O$. (Laurent.)

Ferrous acid.

Barium ferrite, BaO, Fe_2O_3.

Ppt. (List, B. **11.** 1512.)

Calcium ferrite, $4CaO, Fe_2O_3$.

Insol. in H_2O, or sugar+H_2O. Decomp. by the weakest acids, but not by boiling KOH+Aq. (Pelouze, A. ch. (3) **33.** 5.)

CaO, Fe_2O_3. (List.)

$3CaO, Fe_2O_3$. Much less readily attacked by H_2O and acids than the silicates. (Hilpert, B. 1909, **42.** 4581.)

$3CaO, 2Fe_2O_3$. As above. (Hilpert, B. 1909, **42.** 4581.)

Calcium ferrite chloride, $CaO, Fe_2O_3, CaCl_2$.

Not decomp. by H_2O. (Chatelier, C. R. **99.** 276.)

Cupric ferrite, CuO, Fe_2O_3.

Ppt. (List.)

$+5H_2O$. (List.)

Ferrous argentous ferrite, $2FeO, Ag_4O, Fe_2O_3$ (?).

Easily decomp. by HCl+Aq. Not completely sol. in dil. HNO_3+Aq. Easily sol. in conc. HNO_3. Decomp. by acetic acid. (Rose, Pogg. **10.** 323.)

Magnesium ferrite, MgO, Fe_2O_3.

Insol. in H_2O. Not attacked by boiling conc. HNO_3. (Deville. C. R. **52.** 1264.)

Min. *Magnesioferrite.* Difficultly sol. in HCl+Aq. (Rammelsberg, Pogg. **107.** 451.)

$+4H_2O$. Ppt. (List, B. **11.** 1512.)

$6MgO, Fe_2O_3+9H_2O$. Ppt.

$+15H_2O$. Min. *Pyroaurite.*

Manganous ferrite, MnO, Fe_2O_3.

Ppt. (List.)

Nickel ferrite, NiO, Fe_2O_3.

Ppt. (List.)

Potassium ferrite, $3K_2O, 4Fe_2O_3$.

Decomp. by H_2O, KOH+Aq, NaOH+Aq, etc., but only slowly by NH_4Cl+Aq. (Salm-Horstmar, J. pr. **55.** 349.)

$K_2Fe_2O_4$. Decomp. by H_2O. (Rousseau and Bernheim, C. R. **107.** 240.)

Silver (argentous) ferrite, Ag_4O, Fe_2O_3 (?).

Decomp. by dil. HNO_3+Aq. (Rose, Pogg. **10.** 323.)

Sodium ferrite, Na_2O, Fe_2O_3.

Na_2O is dissolved out by H_2O. Easily sol. in dil. HCl+Aq. Not easily decomp. by NH_4Cl+Aq. (Salm-Horstmar.)

Zinc ferrite, ZnO, Fe_2O_3.

Sol. in boiling conc. HCl+Aq. (Ebelmen, A. ch. (3) **33.** 47.)

Min. *Franklinite.*

Flavocobaltic compounds.

See also **Xanthocobaltic compounds.**

Flavocobaltic chloraurate, $(NO_2)_2Co(NH_3)_4AuCl_4$.

More easily sol. than the chloroplatinate. Not wholly insol. in absolute alcohol. (Jörgensen, Z. anorg. **5.** 159.)

—— **chloroplatinate,** $[(NO_2)_2Co(NH_3)_4]_2PtCl_6$

As the chloroplatinite. (Jörgensen.)

—— **chloroplatinite,** $[(NO_2)_2Co(NH_3)_4]_2PtCl_4$.

Somewhat sol. in H_2O, and not insol. in 50% alcohol. (Jörgensen.)

—— **chromate,** $[(NO_2)_2Co(NH_3)_4]_2Cr_2O_7$.

Ppt. (Jörgensen.)

—— **nitrate,** $Co(NO_2)_2(NH_3)_4NO_3$.

Sol. in about 33 pts. cold H_2O; insol. in HNO_3. (Jörgensen.)

$Co(NO_2)_2(NH_3)_4NO_3, HNO_3$. Decomp. by H_2O or alcohol. (Jörgensen.)

—— **cobaltic nitrite,** $3(NO_2)_2Co(NH_3)_4, Co_2(NO_2)_6+2H_2O$.

Sl. sol. in H_2O. (Jörgensen, Z. anorg. **5.** 179.)

—— **diamine cobaltic nitrite,** $(NO_2)_2Co(NH_3)_4, (NO_2)_2(NH_3)_2Co(NO_2)_2$.

Very sl. sol. in H_2O. (Jörgensen.)

—— **sulphate,** $[(NO_2)_2Co(NH_3)_4]_2SO_4$.

Sl. sol. in H_2O, more easily in $HC_2H_3O_2$+Aq. (Jörgensen.)

Fluoborhydric acid, HBF_4.

Decomp. by H_2O very rapidly. (Landolph, C. R. **86.** 603.)

Aluminum fluoboride, $2AlF_3, 3BF_3$.

Sol. in H_2O only when acidulated; sol. in acids. (Berzelius.)

Ammonium fluoboride, NH_4BF_4.

Easily sol. in H_2O. Sol. in 4 pts. H_2O at 16°, and 1.02–1.05 pts. boiling H_2O. (Stolba, Chem. techn. Cent. Anz. **7.** 459.) Sl. sol. in alcohol.

Barium fluoboride, $Ba(BF_4)_2+2H_2O$.

Deliquescent; easily sol. in H_2O; decomp. by alcohol. (Berzelius.)

Cæsium fluoboride, $CsBF_4$.

100 pts. H_2O dissolve 0.92 pt. $CsBF_4$ at 20°, and 0.04 pt. at 100°. (Godeffroy, B. **9.** 1367.)

0.02 pts. are sol. in 100 pts. H_2O at 20°. (Erdmann, Arch. Pharm. 1894, **232.** 21.)

Calcium fluoboride, $Ca(BF_4)_2$.

Decomp. by H_2O, with formation of a sol. acid salt and an insol. basic salt. (Berzelius.)

Cupric fluoboride, $Cu(BF_4)_2$.

Deliquescent, and very sol. in H_2O. (Berzelius.)

Lead fluoboride, $Pb(BF_4)_2$.

Sol. in H_2O. Decomp. by boiling with H_2O or alcohol into an acid soluble, and a basic insoluble salt. (Berzelius.)

Lithium fluoboride, $LiBF_4$.

Hygroscopic. Easily sol. in H_2O. (Berzelius.)

Magnesium fluoboride.

Easily sol. in H_2O. (Berzelius.)

Potassium fluoboride, KBF_4.

Sol. in 223 pts. H_2O at 20°. (Stolba.)
Sol. in 70.4 pts. cold H_2O. (Berzelius.)
Sol. in 15.94 pts. H_2O at 100°. (Stolba.)
1.43 pts. are sol. in 100 pts. H_2O at 20°. (Erdmann, Arch. Pharm. 1894, **232.** 21.)
Not more sol. in NH_4OH+Aq than in H_2O; sol. in hot KOH, NaOH, or M_2CO_3+Aq. (Berzelius.) More sol. in NH_4Cl+Aq. (Rose, Pogg. **80.** 276.) Insol. in 20% $KC_2H_3O_2$+Aq. (Stromeyer.) Insol. in cold, sl. sol. in boiling alcohol.

Rubidium fluoboride, $RbBF_4$.

100 pts. H_2O dissolve 0.55 pt. at 20°, and 1.0 pt. at 100.° (Godeffroy, B. **9.** 1337.)
0.55 pts. are sol. in 100 pts. H_2O at 20°. (Erdmann, Arch. Pharm. 1894, **232.** 21.)

Sodium fluoboride, $NaBF_4$.

Easily sol. in H_2O. Very sl. sol. in alcohol. (Berzelius.)

Yttrium fluoboride.

Sol. in H_2O with excess of acid. (Berzelius.)

Zinc fluoboride, $Zn(BF_4)_2$.

Deliquescent. Sol. in H_2O. (Berzelius.)

Fluoboric acid, HBF_4.

See **Fluoborhydric acid.**
$H_4B_2O_7$, 3HF and $H_4B_2O_9$, 2HF (?). Fume on air, and are decomp. with H_2O. (Landolph, B. **12.** 1583.)
HBO_2, 3HF. Decomp. by H_2O. (Berzelius, Pogg. **59.** 644.)
Is either a mixture, or a solution of HBO_2 in HF, and is decomp. by distillation, and the salts are decomp. by recrystallisation. (Basarow, C. R. **78.** 1698.)

Potassium fluoborate, $K_2B_2O_3F_2$ (?).

Sl. deliquescent. Scarcely sol. in boiling alcohol. (Schiff, A. Suppl. **5.** 175.)
See **Boron *tri*oxide potassium fluoride,** B_2O_3, 2KF.

Fluochromic acid.

Ammonium fluochromate, NH_4CrO_3F.

Sol. in H_2O. (Varenne, C. R. **91.** 989.)

Potassium fluochromate, $KCrO_3F$.

Efflorescent. Sol. in H_2O, with gradual decomp. (Streng, A. **129.** 225.)

Fluocolumbic acid.

See also **Fluoxycolumbic acid.**

Ammonium fluocolumbate fluoxycolumbate, $(NH_4)_2CbF_3$, $2CbOF_3$, NH_4F.

Cadmium fluocolumbate, $Cd_5H_5Cb_3F_{30}+28H_2O$.

Insol. in, and decomp. by H_2O. (Streng.)

Cobalt fluocolumbate, $Co_5H_5Cb_3F_{30}+28H_2O$.

Insol. in, and decomp. by H_2O. (Streng.)

Copper fluocolumbate, $Cu_2HCbF_{10}+9H_2O$.

Insol. in, and decomp. by H_2O.

Ferrous fluocolumbate, $Fe_3H_4Cb_2F_{20}+19H_2O$.

As above.

Manganous fluocolumbate, $Mn_5H_5Cb_3F_{30}+28H_2O$.

Mercuric fluocolumbate, $Hg_3CbF_{11}+8H_2O$.

As above.

Nickel fluocolumbate, $Ni_3H_4Cb_2F_{20}+19H_2O$.

As above.

Potassium fluocolumbate, K_2CbF_7.

Decomp. by solution in H_2O. (Marignac A. ch. (4) **8.** 34.)

Rubidium fluocolumbate, Rb_2CbF_7.

Sol. in H_2O and HF+Aq. Insol. in alcohol. (Pennington, J. Am. Chem. Soc. 1896, **18.** 58.)

Zinc fluocolumbate, $Zn_5H_5Cb_3F_{30}+28H_2O$.

Insol. in cold H_2O; decomp. by hot H_2O. (Santesson, Bull. Soc. (2) **24.** 52.)

Fluodithionic acid.

Cæsium *mono*fluodithionate, $S_2O_5(OH)FCs_2+H_2O$.

Easily sol. in H_2O with decomp.
Sol. in HF; very unstable. (Weinland, Z. anorg. 1899, **21.** 66.)

Potassium *di*fluodithionate, $S_2O_5F_2K_2+3H_2O$.

Easily sol. in H_2O with decomp.
Sol. in HF; very unstable. (Weinland.)

Rubidium ***di*****fluodithionate,** $S_2O_6F_2Rb_2+3H_2O$.

Easily sol. in H_2O with decomp

Sol. in HF; very unstable. (Weinland.)

Fluogermanic acid, H_2GeF_6.

Known only in solution. (Winkler, J. pr. (2) **36.** 177.)

Potassium fluogermanate, K_2GeF_6.

Sol. in 173.98 pts. H_2O at 18°. (Winkler.)

Sol. in 184.61 pts. H_2O at 18°. (Krüss and Nilson, B. **20.** 1696.)

Sol. in 34.07 pts. H_2O at 100.° (Winkler.)

Sol. in 38.76 pts. H_2O at 100.° (Krüss and Nilson.)

Insol. in alcohol.

*Di*fluoiodic acid.

Ammonium ***di*****fluoiodate,** $NH_4IO_2F_2$.

Like K salt.

Sol. in 40% HF+Aq. (Weinland, Z. anorg. 1899, **20.** 30.)

Sol. in H_2O. Easily decomp. (Weinland, B. 1897, **30.** 868.)

Cæsium ***di*****fluoiodate,** $CsIO_2F_2$.

(Weinland, Z. anorg. 1899, **20.** 36.)

Cæsium hydrogen ***di*****fluoiodate,** $CsIO_2F_2$, $HIO_2F_2+2H_2O$.

Efflorescent. Sol. in H_2O with decomp. (Weinland, Z. anorg. 1899, **22.** 257.)

Potassium ***di*****fluoiodate,** KIO_2F_2.

Sol. in H_2O. Decomp. in moist air. (Weinland, B. 1897, **30.** 867.

Decomp. in air. Sol. in H_2O with decomp. Sol. without decomp. in 40% HF+Aq. (Weinland, Z. anorg. 1899, **20.** 31.

Rubidium ***di*****fluoiodate,** $RbIO_2F_2$.

Resembles K salt. Sol. in HF+Aq. (Weinland, Z. anorg. 1899, **20.** 35.)

Rubidium hydrogen ***di*****fluoiodate,** $RbIO_2F_2,HIO_2F_2+2H_2O$.

Sol. in 40–60% HF+Aq. (Weinland, Z. anorg. 1899, **22.** 260.)

Sodium ***di*****fluoiodate,** $NaIO_2F_2$.

Decomp. by H_2O. (Weinland, B. 1897, **30.** 868.)

Sol. in HF. (Weinland, Z. anorg. 1899, **20.** 37.)

Fluomanganic acid, H_2MnF_6.

Decomp. by H_2O. Sol. in alcohol and ether in absence of H_2O. (Nicklès, C. R. **65.** 107.)

Ammonium fluomanganate, $(NH_4)_2MnF_6$.

More sol. than the K salt. (Nicklès, C. R. **65.** 107.)

True composition is $(NH_4)_4Mn_2F_{10}=4NH_4F$, Mn_2F_6. (Christensen, J. pr. (2) **34.** 41.)

Cobalt fluomanganate, $2CoF_2$, $Mn_2F_6+3H_2O$.

Sol. in H_2O. (Christensen.)

Nickel fluomanganate, $2NiF_2$, $Mn_2F_6+8H_2O$.

Sol. in H_2O. (Christensen.)

Potassium fluomanganate, K_2MnF_6.

Difficultly sol. in H_2O. Decomp. by much H_2O. (Nicklès, C. R. **65.** 107.)

Composition is $K_4Mn_2F_{10}=4KF$, Mn_2F_6. Also with $2H_2O$. (Christensen, J. pr. (2) **34.** 41.)

Decomp. by H_2O. Sol. in HCl, H_2SO_4 and HNO_3 with decomp. Can be recryst. from 40% HF+Aq. Insol. in acetic acid. (Weinland and Lauenstein, Z. anorg. 1899, **20.** 41.)

Rubidium fluomanganate, $Rb_2MnF_6+2H_2O$.

As the K salt. (Weinland and Lauenstein, Z. anorg. 1899, **20.** 44.)

Silver fluomanganate, $Ag_2Mn_2F_8+14H_2O$.

(Christensen, J. pr. (2) **34.** 41.)

Sodium fluomanganate, $4NaF$, Mn_2F_6.

Decomp. by much H_2O. (Christensen.)

Zinc fluomanganate, $2ZnF_2$, $Mn_2F_6+8H_2O$.

Sol. in H_2O. (Christensen.)

Fluomolybdic acid.

See **Fluoxyhypomolybdic,** *and* **Fluoxymolybdic acids.**

Fluopalladous acid.

Potassium fluopalladite,

Sl. sol. in H_2O.

Sodium fluopalladite.

Sl. sol. in H_2O. (Berzelius.)

Fluoperboric acid.

Ammonium fluoperborate, $NH_4OOB(F)OOB(F)OONH_4$.

Ppt. Insol in ether. (Petrenko, C. C. **1902,** I. 1191.)

Potassium fluoperborate, $K_4B_4F_4O_{11}+H_2O$.

Dry salt is rather stable.

Easily sol. in H_2O. Aqueous solution decomp. rapidly when warmed; at ordinary

temp. the decomp. proceeds slowly. Insol. in alcohol. (Melikoff, B. 1899, **32.** 3350.
$KOOB(F)OOB(F)OK+1\frac{1}{2}H_2O$. Ppt. Insol. in ether. (Petrenko, C. C. **1902,** I. 1191; J. Russ, phys. chem. Soc. **34.** 37.)

Fluopernranic acid.

Potassium fluoperuranate, $K_4U_4F_6O_{15}+4H_2O=3UO_4KF, UO_3F_2, KF+4H_2O$.
Ppt. (Lordkipanidse, C. C. **1900,** II. 525.

Sodium fluoperuranate, $UO_4NaF+5H_2O$.
Ppt. (Lordkipanidse, C. C. **1900,** II. 525.)

Fluophosphamide, $PF_3(NH_2)_2$.
Sol. in H_2O. (Poulenc, A. ch. (6) **24.** 566.)

Fluophosphoric acid.

*Mono***cæsium** *mono***fluophosphate,** $P(OH)_3(OCs)F$.
Like the K salt. (Weinland, Z. anorg. 1899, **21.** 48.)

*Mono***potassium** *mono***fluophosphate,** $P(OH)_3(OK)F$.
Sol. in 40% HF+Aq; decomp. in the air. (Weinland, Z. anorg. 1899, **21.** 44.)

Potassium *mono***fluophosphate,** $KHF.PO_3+H_2O$.
Decomp. by H_2O; unstable. (Weinland, B. 1898, **31.** 124–125.)

*Mono***rubidium** *mono***fluophosphate,** $P(OH)_3(ORb)F$.
Sol. in 40% HF+Aq. (Weinland, Z. anorg. 1899, **21.** 47.)

Rubidium *mono***fluophosphate,** $RbHFPO_3+H_2O$.
Decomp. by H_2O. (Weinland, B. 1898, **31.** 124.)

Fluoplatinic acid.

Ammonium fluoplatinate.
Secomp. by H_2O to a sol. acid, and an insol. basic salt. Insol. in alcohol. (Berzelius.)

Potassium fluoplatinate.
Deliquescent. Insol. in alcohol. Decomp. by H_2O. (Berzelius.)

Sodium fluoplatinate.
Decomp. by H_2O. (Beizelius.)

Fluor- *and* **Fluoro-.**
See **Fluo-.**

Fluorhydric (Hydrofluoric) acid, HF or H_2F_2.

Attracts H_2O from air with great avidity. Very sol. in H_2O with evolution of much heat.
Sat. solution has sp. gr. 1.25. (H. Davy.)
On boiling the aqueous solution an acid of constant composition is obtained, which boils at 120°, has sp. gr. 1.15, and contains 35.37% HF (Bineau, A. ch. (3) **7.** 257.) The residual acid after boiling contains 36 to 38% HF, and by standing over CaO gives off HF until an acid containing 32.5 to 32.7% HF is formed. Weaker acids increase their strength to 32.2 to 32.4% HF, while an acid containing 32.5% HF remains unchanged. (Roscoe, A. **116.** 218.)
Does not attack gutta-percha. Sol. in H_2SO_4.

Sp. gr. of HF+Aq at 15°.

Sp. gr.	% HF	Sp. gr.	% HF	Sp. gr.	% HF
1.01	2.90	1.10	29.00	1.19	55.10
1.02	5.80	1.11	31.90	1.20	58.00
1.03	8.70	1.12	34.80	1.21	60.90
1.04	11.60	1.13	37.70	1.22	63.80
1.05	14.50	1.14	40.60	1.23	66.70
1.06	17.40	1.15	43.50	1.24	69.60
1.07	20.30	1.16	46.40	1.25	72.50
1.08	23.20	1.17	49.30	....	...
1.09	26.10	1.18	52.20	....	...

(Hart, J. Anal. Ch. **3.** 372.)

Sp. gr. of HF+Aq at ord. temp.

Deg. Baumé	Sp. gr.	% HF
1	1.0069	2.32
2	1.0139	4.04
3	1.0211	5.76
4	1.0283	7.48
5	1.0356	9.20
6	1.0431	10.92
7	1.0506	12.48
8	1.0583	14.04
9	1.0661	15.59
10	1.074	17.15
11	1.082	18.86
12	1.0901	21.64
13	1.0983	24.42
14	1.1067	27.20
15	1.1152	29.98
16	1.1239	32.78
17	1.1326	35.15
18	1.1415	37.53
19	1.1506	39.91
20	1.1598	42.29
21	1.1691	44.67
22	1.1786	47.04
23	1.1883	49.42
24	1.1981	51.57
25	1.2080	53.72
26	1.2182	55.87
27	1.2285	58.02

Sp. gr. of HF+Aq at ord. temp.—*Continued.*

Deg. Baumé	Sp. gr.	% HF
28	1.2390	60.17
29	1.2497	62.32
30	1.2605	64.17
31	1.2716	66.61
32	1.2828	68.76
33	1.2943	70.91
34	1.3059	73.06
35	1.3177	75.21
36	1.3298	77.36
37	1.3421	79.51
38	1.3546	81.66
39	1.3674	83.81
40	1.3804	85.96
41	1.3937	88.10
42	1.4072	90.24
43	1.4211	92.39
44	1.4350	94.54
45	1.4493	96.69

(Eckelt, Ch. Z. 1898, **22.** 225.)

Sp. gr. of HF+Aq at 0°.

% HF	Sp. gr.	% HF	Sp. gr.
0.484	1.005	71.73	1.262
1.504	1.009	72.21	1.260
2.48	1.012	78.05	1.260
4.80	1.017	84.27	1.235
7.75	1.035	87.72	1.212
15.85	1.065	88.11	1.210
24.47	1.097	88.82	1.207
28.48	1.110	89.02	1.202
29.83	1.120	89.15	1.200
34.23	1.130	89.82	1.190
38.50	1.145	90.20	1.185
41.00	1.155	90.64	1.175
41.15	1.155	91.04	1.165
41.92	1.157	92.09	1.152
47.52	1.182	92.81	1.135
48.49	1.187	92.91	1.130
50.97	1.200	94.26	1.095
55.09	1.217	95.84	1.065
55.39	1.220	97.50	1.035
57.66	1.230	98.22	1.022
61.66	1.245	100.05	1.0005
65.19	1.255	....	...

(Hill, Roy. Soc. Proc. 1909, **83.** A. 144.)

Sp. gr. of HF+Aq at 18°.

% HF	Sp. gr.
0.484	1.003
1.504	1.005
2.48	1.009
4.80	1.017
7.75	1.028
15.85	1.058
24.47	1.087
29.83	1.103

(Hill.)

Aq. solution of sp. gr. 1.138 at 18° contains 43.2% HF and has a constant bpt. of 111° at 750 mm. (Deussen, Z. anorg. 1906, **49.** 297.)

The strongest acid that can be obtained by distillation contains 48.17% HF and boils at 125–125.5°. (Gore.)

Fluorides.

The alkali fluorides, also AgF and SnF_2, are sol. in H_2O; the fluorides of Fe, Sr, and Cd are sl. sol.; the others are insol. in H_2O. Most fluorides are sol. in acids, especially HF +Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 822.)

See under each element.

Fluorine, F_2.

Decomposes H_2O and all organic solvent with great violence. (Moissan, C. R. **103.** 202 and 256.)

Liquified at —185° to a yellowish liquid which does not dissolve glass nor ignite cooled Si, B, C, S, P, or Fe. (Moissan, C. R. 1897, **124.** 1202–1204.)

Fluomolybdic acid.

Ammonium fluomolybdate, $(NH_4)MoF_4$+H_2O.

Somewhat more sol. in H_2O than the K salt. Hydrolysed by H_2O. (Rosenheim, Z. anorg. 1905, **46.** 321.)

$(NH_4)_3Mo_2F_9$+$2H_2O$. (Rosenheim.)

Potassium fluomolybdate, $KMoF_4$+H_2O.

Nearly insol. in H_2O. (Rosenheim.)

Fluoselenic acid.

Ammonium *mono*fluoselenate, $SeO_3(OH)F(NH_4)_2$.

Not hygroscopic.

Easily sol. H_2O with decomp.

Sol. in HF. (Weinland, Z. anorg. 1899, **21.** 58.)

***Tri*potassium *di*fluo*di*selenate,** $Se_2O_7F_2K_3H$+H_2O.

Decomp. in the air; sol. in H_2O with decomp.; sol. in HF. (Weinland.)

***Tri*rubidium *di*fluo*di*selenate,** $Se_2O_7F_2Rb_3H$ +H_2O.

Decomp. in the air; sol. in H_2O with decomp.; sol. in HF. (Weinland, Z. anorg. 1899, **21.** 57.)

Fluosilicic acid, H_2SiF_6.

Sp. gr. of H_2SiF_6+Aq at 17.5° (H_2O at 17.5° = 1.000).

% H_2SiF_6	Sp. gr.	% H_2SiF_6	Sp. gr
2	1.0161	20	1.1748
4	1.0324	22	1.1941
6	1.0491	24	1.2136
8	1.0661	26	1.2335
10	1.0834	28	1.2537
12	1.1011	30	1.2742
14	1.1190	32	1.2951
16	1.1373	34	1.3162
18	1.1559	..	....

(Stolba, J. pr. **90.** 193.)

+2H_2O. Very deliquescent, and sol. in H_2O. (Kessler, C. R. **90.** 1285.) Solution decomp. into HF and SiF_4 on evaporation, when it becomes concentrated.

Fluosilicates.

Most of the fluosilicates are sol. in H_2O, but the alkali salts (especially K) and the Ba salt are only sl. sol. in H_2O.

Aluminum fluosilicate, $Al_2(SiF_6)_3$.

Easily sol. in H_2O. After evaporating to dryness, the residue is slowly but completely sol. in H_2O. (Deville, A. ch. (3) **61.** 327.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Aluminum fluosilicate silicate, Al_2SiF_{10}, $5Al_2SiO_5$.

Min. *Topaz.* Insol. in acids.

Ammonium fluosilicate, $(NH_4)_2SiF_6$.

Sol. in 5.38 pts. H_2O at 17.5° to form a solution of 1.0961 sp. gr.; sol. in 1.8 pts. hot H_2O; sol. in 45.5 pts. alcohol of 31%. (Stolba, C. C. **1877.** 418.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

$3NH_4F$, SiF_4 = $(NH_4)_2SiF_6$, NH_4F. Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 221.)

Barium fluosilicate, $BaSiF_6$.

Sol. in 3802 pts. cold H_2O. (Fresenius, A. **59.** 120.)

Sol. in 3731 pts. H_2O at 17.5°; in 3315 pts. at 21°; in 1175 pts. at 100°. (Stolba, J. pr. **96.** 22.)

Sol. in 640–733 pts. H_2O containing a little HCl. (Fresenius.)

488 pts. HCl+Aq containing 4.25% HCl dissolve 1 pt. at 22°. (Stolba.)

More sol. in HNO_3+Aq than in H_2O. (Fresenius.)

272 pts. HNO_3+Aq, containing 8% N_2O_5, dissolve 1 pt. at 22°. (Stolba.)

1 pt. $BaSiF_6$ dissolves in 428 pts. sat. NH_4Cl+Aq; in 589 pts. sat. NH_4Cl+Aq+2 vols. H_2O. (Mallet, Sill. Am. J. (2) **28.** 48.)

1 pt. $BaSiF_6$ dissolves in 306 pts. sat. NH_4Cl+Aq at 22°; in 361 pts. 15% solution of NH_4Cl; in 563 pts. sat. boiling NaCl+Aq; in 349 pts. 10% solution of NaCl at boiling temp.; in 2185 pts. 10% solution of NaCl at 20°; in 1140 pts. 5% solution of NaCl at 20°. (Stolba.)

Nearly absolutely insol. in alcohol. (Fresenius.)

Solubility in a mixture of H_2O, alcohol (96%), HCl+Aq (20%), H_2SiF_6+Aq (3.7%).

1 pt. $BaSiF_6$ is sol. in pts. of solutions of given composition.

H_2O	Alcohol	HCl+Aq	H_2SiF_6 +Aq	$BaSiF_6$
50	50	0	0	37,219
74.1	25	0.9	0	5,263
70.8	25	4.2	0	2,860
77.95	20	0.9	1.15	39,061
73.0	25	0.9	1.1	70,679
97.09	0	1.25	1.66	3,247
75.0	25	0	0	16,914

(Fresenius, Z. anal. **29.** 143.)

Cadmium fluosilicate, $CdSiF_6$+6H_2O.

Extremely sol. in H_2O. Easily sol. in 50% alcohol. (Engelskirchen, Dissert. **1903.**)

Cæsium fluosilicate, Cs_2SiF_6.

Sol. in 166 pts. H_2O at 17°, and much less h2t H_2O. Insol. in alcohol. (Preis, J. pr. **103.** 410.)

Calcium fluosilicate, $CaSiF_6$+2H_2O.

Sl. sol. in, and partly decomp. by H_2O. Sol. in HF and HCl+Aq. Sol. in fluosilicic acid without decomp. Easily sol. in 60% alcohol. (Fleischer.)

Cerium fluosilicate.

Very difficulty sol. in H_2O, acetic, or fluosilicic acids. Insol. in alcohol. (Stolba, C. C. **1874.** 130.)

Chromium fluosilicate.

Deliquescent. (Berzelius.)

Efflorescent. Sol. in H_2O. (Berlin.)

Cobaltous fluosilicate, $CoSiF_6$+6H_2O.

Easily sol. in H_2O. (Berzelius.)

Cuprous fluosilicate, Cu_2SiF_6.

Insol. in H_2O. (Berzelius, Pogg. **1.** 199.)

Cupric fluosilicate, $CuSiF_6$+6H_2O.

Deliquescent in moist, efflorescent in dry air.

Sol. in 0.428 pt. H_2O at 17°. Sp. gr. of solution sat. at 17° = 1.6241.

Sol. in 17.5 pts. alcohol of 62 vol. % at 20°; in 150 pts. of 85% at 20°; in 617 pts. of 92% at 20°. (Stolba, J. pr. **102.** 7.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Contains 6½ H_2O. (Stolba.)
$+5½H_2O$. (Knop and Wolf.)

Cupric fluosilicate phosphate, $CuSiF_6$, $Cu_3(PO_4)_2$.

Insol. in H_2O, but easily sol. in dil. HCl+Aq. (Thorpe and Rodger, Chem. Soc. **55.** 320.)

Glucinum fluosilicate.

Known only in solution.

Iron (ferrous) fluosilicate, $FeSiF_6+6H_2O$.

Easily sol. in H_2O. (Berzelius.)

Iron (ferric) fluosilicate, $Fe_2(SiF_6)_3$.

Sol. in H_2O. (Berzelius.)

Lead fluosilicate, $PbSiF_6+2H_2O$.

Deliquescent. Easily sol. in H_2O.
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
$+4H_2O$. (Marignac.)

Lithium fluosilicate, $Li_2SiF_6+2H_2O$.

100 pts. H_2O at 17° dissolve 73 pts. crystalline salt. (Marignac.)
100 pts. cold H_2O dissolve 52.6 pts. crystals. Sol. in dil. alcohol. (Stolba, J. pr. **91.** 456.)
100 pts. alcohol of 46 vol. % dissolve about 4 pts., and 100 pts. alcohol of 79 vol. % dissolve about 0.4 pt. crystals. (Stolba, Z. anal **3.** 311.)
Insol. in ether or benzene.
Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Magnesium fluosilicate, $MgSiF_6+6H_2O$.

Efflorescent. Sol. in 1534 pts. cold H_2O, forming a solution of 1.235 sp. gr. at 17.5°. Separates out SiO_2 on warming, which nearly all redissolves on cooling. (Stolba, C. C. **1877.** 578.)

Magnesium fluosilicate silicate, $Mg_5Si_2F_{18}$, $xMg_5Si_2O_9$.

Min. *Humite; Chondrodite.* Gelatinises with HCl, or H_2SO_4+Aq.

Manganous fluosilicate, $MnSiF_6+6H_2O$.
Sol. in H_2O. (Marignac, J. pr. **83.** 202.)
100 pts. dissolve in 71.4 pts. H_2O at 17.5°, and sp. gr. of solution=1.44825. Much more sol. in hot H_2O, and less sol. in alcohol, the stronger the alcohol. (Stolba, C. C. **1883.** 292.)

Mercurous fluosilicate, Hg_2SiF_6.

Sl. sol. in H_2O without decomp. (Lemaire, C. C. **1897,** I. 1046.)
$+2H_2O$. Sl. sol. in H_2O. More easily sol. in acidified H_2O, but precipitated by HCl+Aq. (Berzelius.)

Mercuric fluosilicate, basic, $HgSiF_6$, $HgO+3H_2O$.

Decomp. by H_2O, but sol. in weakest acids. (Berzelius, Pogg. **1.** 200.)

Mercuric fluosilicate, $HgSiF_6+6H_2O$.

Deliquescent, and easily sol. in H_2O. (Finkener, Pogg. **111.** 246.)

Nickel fluosilicate, $NiSiF_6+6H_2O$.

Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 262.)

Potassium fluosilicate, K_2SiF_6.

Sol. in 833.1 pts. H_2O at 17.5°, and 104.8 pts. at 100°. (Stolba, J. pr. **103.** 396.) Sol. in 3800 pts. cold, and more easily sol. in hot H_2O. (Fresenius.)
More sol. in HCl+Aq than in H_2O.
Sol. in 337 pts. HCl+Aq of 26.5% at 14°; in 307 pts. of 25.7% at 15°; in 340 pts. of 14.1 % at 14°; in 303 pts. of 13.6% at 15°; in 327 pts. of 9.6% at 14°; in 313 pts. of 9.2% at 15°; in 376 pts. of 2.7% at 14°; in 319 pts. of 2.4% at 15°; in 409 pts. of 1.8% at 14°. (Stolba, l. c.)
Sol. in 428 pts. sat., and 589 pts. dil. NH_4Cl+Aq. (Mallet.)
Much less sol. in K_2SO_4, KNO_3, or KCl+Aq, but more sol. in NH_4Cl+Aq than in H_2O. (Stolba.)
Sol. in 24,066 pts. K_2SO_4+Aq containing 9.92% K_2SO_4 at 17°; in 17,858 pts. containing 6% at 18°; in 19,530 pts. containing 5% at 17°; in 10,721 pts. containing 1% at 17°.
Sol. in 125,000 pts. KNO_3+Aq containing 18.4% KNO_3 at 15°; in 43,478 pts. containing 8.7% at 15°; in 1735 pts. containing 8.8% at 100°; in 35,814 pts. containing 4.3% at 15°; in 10,203 pts. containing 1.00% at 15°.
Sol. in 40,070 pts. KCl+Aq containing 25% KCl at 17°; in 38,352 pts. containing 18.4% at 17°; in 41,254 pts. containing 13.4% at 14°; in 24,032 pts. containing 6.7% at 12°; in 1200 pts. containing 0.65% at 17°; in 1095 pts. containing 0.45% at 18°.
Sol. in 358 pts. NH_4Cl+Aq containing 26.3 %NH_4Cl at 17°; in 306 pts. containing 15% at 15°; in 339 pts. containing 10% at 15°; in 436 pts. containing 5% at 15°. (Stolba, J. pr. **103.** 306.)
Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)
Insol. in liquid NH_3. (Gore, Am. ch. J. 1898, **20.** 829.)
Completely pptd. from aqueous solution by an equal vol. of alcohol.

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Rubidium fluosilicate, Rb_2SiF_6.

Sol. in 625 pts. H_2O at 20°, and 73.05–74.5 pts. at 100°. More sol. in acidified water. Insol. in alcohol. (Stolba, J. pr. **101.** 1.)

Insol. in H_2O. (Eggeling, Z. anorg. 1905, **46.** 175.)

Less sol. in H_2O than K_2SiF_6. (Gossner, Zeit. Kryst. 1904, **38.** 149.)

Silver fluosilicate, $Ag_2SiF_6+4H_2O$.

Deliquescent. Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 221.)

Sodium fluosilicate, Na_2SiF_6.

Much more sol. in H_2O than K_2SiF_6, especially in hot H_2O. Addition of acid does not increase solubility. (Berzelius.)

Sol. in 153.3 pts. H_2O at 17.5°, and 40.66 pts. at 100°. Easily forms supersaturated solutions. (Stolba, Z. anal. **11.** 199.)

Much less sol. in NaCl+Aq than in H_2O. (Stolba, J. pr. 1865 (1) **96.** 26.)

Precipitated completely from aqueous solution by alcohol. (Rose.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Strontium fluosilicate, $SrSiF_6+2H_2O$.

Sol. in cold H_2O, but decomp. somewhat on heating. Sol. in 31.06 pts. H_2O. (Fresenius.)

Easily sol. in acidified H_2O without decomp. Sol. in alcohol.

Solubility in a mixture of H_2O, alcohol (96%), HCl+Aq (20%), H_2SiF_6+Aq (3.7%). 1 pt. $SrSiF_6$ is sol. in pts. of solutions of given composition.

H_2O	Alcohol	HCl+Aq	H_2SiF_6 +Aq	$SrSiF_6$
50	50	0	0	15.29
74.1	25	0	0	82.93
70.8	25	4.2	0	50.9
77.95	20	0.9	1.15	55.0
73	25	0.9	1.1	82.97
75	25	0	0	147.4
95.24	0	2.04	2.72	7.3

(Fresenius, Z. anal. **29.** 143.)

Thallous fluosilicate, $Tl_2SiF_6+2H_2O$.

Very easily sol. in H_2O. (Kuhlmann.)

Thorium fluosilicate, $Th(OH)_2SiF_6$ (?). (Cleve.)

Tin (stannic) fluosilicate, SnF_4, SiF_4.

Very easily sol. in H_2O. (Berzelius.)

Uranyl fluosilicate.

Very sl. sol. in acids. (Berzelius.)

Sol. in alcohol. (Stolba, Z. anal. **3.** 71.)

Vanadium fluosilicate.

Deliquescent. Sol. in H_2O. (Guyard, Bull. Soc. (2) **25.** 352.)

Yttrium fluosilicate.

Insol. in pure, sol. in acidified H_2O. (Berzelius.)

Zinc fluosilicate, $ZnSiF_6+6H_2O$.

Very easily sol. in H_2O. (Berzelius.)

Zirconium fluosilicate.

Sol. in H_2O. Solution clouds up on boiling. (Berzelius.)

Fluostannic acid.

Ammonium fluostannate, $(NH_4)_2SnF_6$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 224.)

$4NH_4F, SnF_4$. Sol. in H_2O. (Marignac.)

Barium fluostannate, $BaSnF_6$.

Slowly sol. in H_2O.

$+3H_2O$. Sol. in 18 pts. H_2O at 18°. (Marignac, Ann. Min. (5) **15.** 246.)

Decomp. by warming with H_2SO_4 with evolution of HF. (Emich, M. 1904, **25.** 1912.)

Calcium fluostannate, $CaSnF_6+2H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 250.)

Cadmium fluostannate, $CdSnF_6+6H_2O$.

Sol. in H_2O. (Marignac.)

Cobaltous fluostannate, $CoSnF_6+6H_2O$. (Gossner, Zeit. Kryst. 1907, **42.** 482.)

Cupric fluostannate, $CuSnF_6+4H_2O$.

Not deliquescent. (Marignac, Ann. Min. (5) **15.** 291.)

Lithium fluostannate, $Li_2SnF_6+2H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 242.)

Magnesium fluostannate, $MgSnF_6+6H_2O$.

Not deliquescent. Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 256.)

Manganous fluostannate, $MnSnF_6+6H_2O$.

Slowly efflorescent. (Marignac.)

Nickel fluostannate, $NiSnF_6+6H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 262.)

Potassium fluostannate, $K_2SnF_6+H_2O$.

Two modifications—(a) *Thin plates.* Sol. in 2.3 pts. H_2O at 100°, and in 15–16 pts. at 18°. (Marignac.)

(b) *Octahedra.* Sol. in 3 pts. H_2O at 100°, and 27 pts. at 18°. (Marignac.)

Sol. in hot H_2O. Can be cryst. from hot H_2O. With conc. H_2SO_4, HF is evolved. (Emich, M. 1904, **25.** 911.)

Potassium hydrogen fluostannate, 3KF, HF, SnF_4.

Sol. in H_2O. (Marignac.)

Silver fluostannate, $Ag_2SnF_6+4H_2O$.

Sl. deliquescent. Easily sol. in H_2O. (Marignac.)

Sodium fluostannate, Na_4SnF_6.

Sol. in 18–19 pts. H_2O at 20°. (Marignac.)

Strontium fluostannate, $SrSnF_6+2H_2O$.

Sol. in 5.5 pts. H_2O at 18°. (Marignac.)

Zinc fluostannate, $ZnSnF_6+6H_2O$.

Sol. in H_2O. (Marignac.)

Fluosulphonic acid, HSO_3F.

See **Sulphuryl hydroxyl fluoride.**

Ammonium fluosulphonate, FSO_3NH_4.

Easily sol. in H_2O from which it can be cryst.

Sol. in ethyl alcohol, more sol. in methyl alcohol. Can be cryst. from abs. alcohol. (Traube, B. 1913, **46.** 2528.)

Sodium fluosulphonate, FSO_3Na.

Hydroscopic.

Sol. in alcohol and acetone. (Traube.)

Fluosulphuric acid.

*Tri*cæsium *di*fluo*di*sulphate, $S_2O_7F_2Cs_3H+H_2O$.

As the K salt. (Weinland, Z. anorg. 1899, **21.** 53.)

*Tri*potassium *di*fluo*di*sulphate, $S_2O_7F_2K_3H+H_2O$.

Sol. in HF; quite stable in air; sol. in H_2O with decomp. (Weinland, Z. anorg. 1899, **21.** 51.)

*Tri*rubidium *di*fluo*di*sulphate, $S_2O_7R_2Tb_3H+H_2O$.

Sol. in HF. (Weinland, Z. anorg. 1899, **21.** 53.)

Fluotantalic acid.

Ammonium fluotantalate, $(NH_4)_2TaF_7$.

Very sol. in H_2O. (Marignac, A. ch. (4) **9.** 272.)

$(NH_4)_3TaF_8$. (Balke, J. Am. Chem. Soc. 1905, **27.** 1151.)

Cæsium fluotantalate, $CsTaF_6$.

Can be recryst. from HF+Aq. (Balke.)

Cs_2TaF_7. Can not be recryst. from H_2O as it tends to go into CsF, TaF_5. (Balke, J. Am. Chem. Soc. 1905, **27.** 1151.)

15CsF, TaF_5. Sl. sol. in H_2O. (Pennington, J. Am. Chem. Soc. 1896, **18.** 59.)

Calcium fluotantalate.

Difficulty sol. in H_2O (Berzelius.)

Cupric fluotantalate, $CuTaF_7+4H_2O$.

Deliquescent. Easily sol. in H_2O. (Marignac, A. ch. (4) **9.** 294.

Lead fluotantalate.

Difficulty sol in H_2O. (Berzelius.)

Lithium fluotantalate, LiF, TaF_5+2H_2O.

Can be recryst. from conc. HF. (Balke, J. Am. Chem. Soc. 1905, **27.** 1143.)

Potassium fluotantalate, K_2TaF_7.

Sl. sol. in cold, much more easily in hot H_2O. Decomposes, with formation of a white precipitate on boiling. (Berzelius.)

Much more sol. in HF+Aq. 1 pt. of the salt is sol. in 200 pts. H_2O containing a trace of HF, and in 150–160 pts. of H_2O containing a little more HF. (Marignac, A. ch. (4) **9.** 267.)

Potassium hydrogen fluotantalate, KF, HF, TaF_5 (?).

Sol. in H_2O. (Berzelius.)

Rubidium fluotantalate, Rb_2TaF_7.

Sol. in HF+Aq. (Pennington, J. Am. Ch. Soc. 1896, **18.** 58.)

3RbF, $2TaF_5$. (Balke, J. Am. Chem. Soc. 1905, **27.** 1151.)

Sodium fluotantalate, 3NaF, TaF_5.

Easily sol. in H_2O.

$Na_2TaF_7+H_2O$. Sol. in H_2O. (Marignac.)

Thallous fluotantalate, Tl_2TaF_7.

Sol. in H_2O. On boiling the aqueous solution tantalic acid separates.

Decomp. by conc. H_2SO_4. Difficultly sol. in cold, easily sol. in hot HF. (Ephraim. B. 1909, **42.** 4461.)

Zinc fluotantalate, $ZnTaF_7+7H_2O$.

Very deliquescent. Sol. in H_2O. (Marignac, A. ch. (4) **9.** 249.)

Fluotelluric acid.

Ammonium fluotellurate, $NH_4TeF_5+H_2O$.

Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Barium fluotellurate, $Ba(TeF_5)_2+H_2O$.
As above.

Potassium fluotellurate, $KTeF_5$.
As above.
$TeO_3F_2K_2+3H_2O$. Stable in dry air; only sl. sol. in H_2O with decomp.; sol. in HF. (Weinland, Z. anorg. 1899, **21.** 61.)

Rubidium *di*fluotellurate, $TeO_3F_2Rb_2+3H_2O$.
Sl. sol. in H_2O with decomp. Sol. in HF. (Weinland, Z. anorg. 1899, **21.** 62.)

Fluotitanic acid.

Known only in solution as titanium hydrogen fluoride.

Ammonium fluotitanate, $(NH_4)_2TiF_6$.
Sol. in H_2O. (Marignac.)
$3NH_4F$, TiF_4. Sol. in H_2O. (Marignac.)

Ammonium fluo*sequi*titanate, $6NH_4F$, Ti_2F_6.
Easily sol. in H_2O. Sl. sol. in NH_4F+Aq. (Petersen, J. pr. (2) **40.** 54.)
Insol. in NH_4F+Aq. (Piccini, C. R. **97.** 1064.)
$4NH_4F$, Ti_2F_6. Properties as the corresponding K salt. (Piccini, B. **18.** 257 R.)

Barium fluotitanate, $BaTiF_6$.
Very sl. sol. in H_2O. More easily sol. in dil. HNO_3 or HCl. (Engelskirchen, Dissert. **1903.**)
$+\frac{1}{2}H_2O$. (Emich, M. 1904, **25.** 907.)

Cadmium fluotitanate, $CdTiF_6+6H_2O$.
Extremely sol. in H_2O. Easily sol. in 50% alcohol. (Engelskirchen, Dissert. **1903.**)

Cæsium fluotitanate, Cs_2TiF_6.
More sol. in hot than cold H_2O and much more sol. than the Rb comp. (Engelskirchen, Dissert. **1903.**)
$4CsF$, TiF_4. More sol. in H_2O than $Cs_{15}TaF_{20}$ and is not decomp. by pure H_2O. (Pennington, J. Am. Chem. Soc. 1896, **18.** 60.)

Calcium fluotitanate, $CaTiF_6+3H_2O$.
Decomp. by pure H_2O. Sol. without decomp. in acidified H_2O. (Berzelius.)
Separates a precipitate with cold H_2O, which dissolves on heating. (Marignac, Ann. Min. (5) **15.** 250.)

Cupric fluotitanate, $CuTiF_6+4H_2O$.
Sol. in pure H_2O with partial decomp.; easily and completely sol. in acidified H_2O. (Berzelius.)

Cupric fluotitanate ammonium fluoride, $CuTiF_6$, NH_4F+4H_2O.
Efflorescent. Easily sol. in H_2O. (Marignac, Ann. Min. (5) **15.** 267.)

Cupric fluotitanate potassium fluoride, $CuTiF_6$, $KF+4H_2O$.
As the above salt. (Marignac.)

Ferrous fluotitanate, $FeTiF_6+6H_2O$.
Sol. in H_2O. (Weber, Pogg. **120.** 287.)

Ferric fluotitanate.
Decomp. by H_2O. (Berzelius.)

Lead fluotitanate.
Easily sol. in H_2O. (Berzelius.)

Lithium fluotitanate, $Li_2TiF_6+2H_2O$.
Very sol. in H_2O. (Engelskirchen, Dissert, **1903.**)

Magnesium fluotitanate, $MgTiF_6+6H_2O$.
Easily sol. in cold H_2O. (Marignac, Ann. Min. (5) **15.** 257.)

Nickel fluotitanate, $NiTiF_6+6H_2O$.
Easily sol. in H_2O. (Weber, Pogg. **120.** 282.)

Potassium fluotitanate, K_2TiF_6.
Difficultly sol. in cold, much more easily in hot H_2O.
100 pts. H_2O dissolve at:

0°	3°	6°	10°	14°	20°	
0.556	0.667	0.775	0.909	1.042	1.28	pts. K_2TiF_6.

(Marignac, A. ch. (4) **8.** 65.)

Sol. in 78.6 pts. H_2O at 21°. Sol. in acids. (Piccini, Gazz. ch. it. 1886, **16.** 104.)
Sol. in 78 pts. H_2O at 20°; 9.4 pts. at **100°.** By addition of small amount of HF, the solubility is increased. (Weiss and Kaiser, Z. anorg. 1910, **65.** 354.)
Sol. in HF. (Marchetti, Z. anorg. 1895, **10.** 66.)
$+H_2O$. Much less sol. in H_2O in presence of KBr or KI. (Hall, J. Am. Chem. Soc. 1904, **26.** 1246.)
Sol. in H_2O or HF with decomp. (Marchetti, Z. anorg. 1895, **10.** 66.)

Potassium fluo*sesqui*titanate, $4KF$, Ti_2F_6.
Scarcely sol. in H_2O; sol. in dil. acids. (Piccini, B. **18.** 257 R.)

Rubidium fluotitanate, Rb_2TiF_6.
Very sl. sol. in cold, somewhat more sol. in hot H_2O. (Engelskirchen, Dissert. **1903.**)

Silver fluotitanate.
Very deliquescent. (Marignac.)

Sodium fluotitanate, Na_2TiF_6.
Much more sol. in H_2O than the corresponding potassium salt. (Marignac, Ann. Min. (5) **15.** 238.)

Sodium hydrogen fluotitanate, Na_2TiF_6, $NaHF_2$.
Sol. in H_2O. (Marignac.)

Strontium fluotitanate, $SrTiF_6+2H_2O$.
Sol. in cold H_2O. Solution clouds up on heating. (Marignac.)

Zinc fluotitanate, $ZnTiF_6+6H_2O$.
Sol. in H_2O. (Marignac, A. ch. (3) **60.** 304.)

Fluovanadic acid.

Ammonium fluovanadate, $3NH_4F$, VF_3.
Moderately sol. in H_2O. More easily sol. in dil. acids. Nearly insol. in alcohol or MF +Aq. (Petersen, J. pr. (2) **40.** 52.)
$2NH_4F$, VF_3+H_2O. Easily sol. in H_2O. Sl. sol. in alcohol. (Petersen.)
NH_4F, VF_3+2H_2O. As above. (Petersen.)

Cadmium fluovanadate, CdF_2, VF_3+7H_2O.
Very sl. sol. in H_2O. (Piccini and Giorgis, Gazz. ch. it. **22, 1.** 89.)

Cobalt fluovanadate, CoF_2, VF_3+2H_2O.
Sol. in H_2O without decomp. (Petersen, *l. c.*)

Nickel fluovanadate, NiF_2, VF_3+2H_2O.
As the Co salt. (Petersen.)

Potassium fluovanadate, $2KF$, VF_3+H_2O.
Sl. sol. in H_2O; easily sol. in acids. Insol. in KF+Aq. (Petersen, J. pr. (2) **40.** 51.)

Potassium fluovanadate fluoxyvanadate, $4KF$, VF_3, VOF_3.
Easily sol. in H_2O, and still more easily in HF+Aq. Sl. sol. in KF+Aq. (Petersen, J. pr. (2) **40.** 274.)

Sodium fluovanadate, $5NaF$, $2VF_3+H_2O$.
As the potassium salt. (Petersen.)

Thallous fluovanadate, TlF, VF_3+2H_2O.
Easily sol. in H_2O.
Sol. with decomp. in conc. H_2SO_4, dil. HNO_3 or cold dil. HCl.
Insol. in NaOH+Aq. (Ephraim, B. 1909, **42.** 4460.)
$2TlF$, VF_3+H_2O. Easily sol. in H_2O.
Sol. in conc. H_2SO_4, dil. HNO_3, or cold dil. HCl with decomp.
Insol. in cold or hot NaOH+Aq. (Ephraim, B. 1909, **42.** 4461.)

Zinc fluovanadate, ZnF_2, VF_3+7H_2O.
Sl. sol. in cold H_2O. Decomp. on heating. (Piccini and Giorgis.)

Fluoxycolumbic acid.

Ammonium fluoxycolumbate, $3NH_4F$, $CbOF_3$.
Cubic salt. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 38.)
$2NH_4F$, $CbOF_3$. *Lamellar salt.* Much more sol. in H_2O than $2KF$, $CbOF_3$. (M.)
$5NH_4F$, $3CbOF_3+H_2O$. *Hexagonal salt.* (M.)
NH_4F, $CbOF_3$. *Rectangular salt.* (M.)

Ammonium fluoxycolumbate columbium fluoride, $3NH_4F$, $CbOF_3$, CbF_5.
(Marignac.)

Cupric fluoxycolumbate, CuF_2, $CbOF_3+4H_2O$.
Sl. deliquescent. Sol. in H_2O. (Marignac, A. ch. (4) **8.** 42.)

Potassium fluoxycolumbate, $2KF$, $CbOF_3+H_2O$.
Sol. in 12.5-13 pts. H_2O at 17-21°. Much more sol. in hot H_2O, or H_2O containing HF. (Marignac.)
$3KF$, $CbOF_3$. Decomp. by H_2O into above salt. (M.)
$5KF$, $3CbOF_3+H_2O$. Sol. in H_2O. (M.)
$4KF$, $3CbOF_3+H_2O$. Sol. in H_2O. (M.)
$3KF$, $2Cb_2O_5+5H_2O$. Sl. sol. in H_2O. (Petersen, J. pr. (2) **40.** 287.)
KF, $Cb_2O_5+3H_2O$. Sl. sol. in H_2O. (Petersen.)
$2KF$, $3CbO_2F$. Insol. in H_2O. Sol. in HF. (Krüss and Nilson, B. **20.** 1689.)
See also **Fluoxypercolumbate, potassium.**

Potassium hydrogen fluoxycolumbate, $3KF$, HF, $CbOF_3$.
Sol. in H_2O. (Marignac.)

Sodium fluoxycolumbate, $2NaF$, $CbOF_3+2H_2O$.
Sol. in H_2O.
NaF, $CbOF_3+H_2O$. (Marignac.)

Zinc fluoxycolumbate, ZnF_2, $CbOF_3+6H_2O$.
Sol. in H_2O. (Marignac, A. ch. (4) **8.** 41.)

Fluoxyhypomolybdic acid.

Ammonium fluoxyhypomolybdate, $MoOF_3$, $2NH_4F$.
Decomp. by H_2O. (Mauro, Gazz. ch. it. **19.** 179.)
$3MoOF_3$, $5NH_4F+H_2O$. Decomp. by H_2O. (Mauro.)

Cupric fluoxyhypomolybdate, CuF_2, $MoOF_3+4H_2O$.
Deliquescent. Sol. in H_2O. (Mauro, Real. Ac. Linc. **1893, 1.** 194.)

Potassium fluoxyhypomolybdate, $MoOF_3$, $2KF+H_2O$.

Sol. in H_2O with decomp.
Sol. in HF or HCl+Aq. (Mauro and Panabianco, Gazz. ch. it. **12.** 80.)
$3MoOF_3$, $5KF+H_2O$. Sol. in H_2O with decomp. (Mauro, Gazz. ch. it. **19.** 179.)

Thallous fluoxyhypomolybdate, 2TlF, $MoOF_3$.

(Mauro, B. 1894, **27**R. 109.)

Zinc fluoxyhypomolybdate, ZnF_2, $MoOF_3+6H_2O$.

Rapidly deliquescent. Sol. in H_2O. (Mauro, Real. Ac. Linc. **1892. 1.** 194.)

Fluoxyhypovanadic acid.

See **Fluoxyvanadic acid.**

Fluoxymanganic acid.

Ammonium fluoxymanganate, $(NH_4)_2MnOF_4$.
Precipitate. (Nicklès.)

Potassium fluoxymanganate, K_2MnOF_4.
Precipitate. (Nicklès, C. R. **65.** 107.)

*Sesqui*fluoxymanganic acid.

Potassium *sesqui*fluoxymanganate, $K_4Mn_2OF_8=4KF$, Mn_2OF_4.
Precipitate. (Nicklès.)

Fluoxymolybdic acid.

See also **Fluoxyhypomolybdic,** *and* **fluoxypermolybdic acids.**

Ammonium fluoxymolybdate, NH_4F, MoO_2F_2.

Sol. in H_2O. (Mauro, Gazz. ch. it. **20.** 109.)
$+H_2O$. More sol. in H_2O than $2NH_4F$, MoO_2F_2. (Delafontaine, N. Arch. Sci. ph. nat. **30.** 250.)
Correct formula is $3NH_4F$, MoO_2F_2. (Mauro, Gazz. ch. it. **18.** 120.)
$2NH_4F$, MoO_2F_2. Much more sol. than 2KF, MoO_2F_2. (Delafontaine.)
$3NH_4F$, MoO_2F_2. Sol. in H_2O. (Mauro.)
$5NH_4F$, $3MoO_2F_2+H_2O$. Sol. in H_2O. (Mauro, Gazz. ch. it. **20.** 109.)

Ammonium fluoxymolybdate molybdate, MoO_2F_2, $4NH_4F$, $(NH_4)_2MoO_4$.

Sol. in H_2O, but with decomp. (Mauro, Gazz. ch. it. **18.** 120.)

Cadmium fluoxymolybdate, CdF_2, $MoO_2F_2+6H_2O$.

Sl. efflorescent. (Delafontaine, J. B. **1867.** 236.)

Cobaltous fluoxymolybdate, CoF_2, $MoO_2F_2+6H_2O$.

Sol. in H_2O. (Delafontaine, J. B. **1867.** 236.)

Cupric fluoxymolybdate, CuF_2, $MoO_2F_2+4H_2O$.

Deliquescent. (Mauro, Real. Ac. Linc. **1892, 1.** 194.

Nickel fluoxymolybdate, NiF_2, $MoO_2F_2+6H_2O$.

Sol. in H_2O. (Delafontaine, J. B. **1867.** 236.)

Potassium fluoxymolybdate, 2KF, $MoO_2F_2+H_2O$.

Easily sol. in boiling H_2O.
Sol. in H_2O with decomp. Sol. in HF. (Marchetti, Z. anorg. 1895, **10.** 68.)
KF, $MoO_2F_2+H_2O$. Gradually efflorescent. (Delafontaine.)

Rubidium fluoxymolybdate, 2RbF, $2MoO_2F_2+2H_2O$.

Sol. in cold, more sol. in hot H_2O. (Delafontaine.)

Sodium fluoxymolybdate, NaF, $MoO_2F_2+\frac{1}{2}H_2O$.

Sol. in H_2O. (Delafontaine.)

Thallous fluoxymolybdate, 2TlF, $MoO_2F_2+H_2O$.

Sol. in hot H_2O. (Delafontaine.)

Zinc fluoxymolybdate, ZnF_2, $MoO_2F_2+6H_2O$.
Sol. in H_2O. (Delafontaine.)

Fluoxypercolumbic acid.

Potassium fluoxypercolumbate, 2KF, $CbO_2F_3+H_2O$.

(Piccini, Z. anorg. **2.** 21.)
Sol. in H_2O with decomp.
Sol. in HF. (Marchetti, Z. anorg. 1895, **10.** 67.)

Fluoxypermolybdic acid.

Ammonium fluoxypermolybdate, MoO_3F_2, $3NH_4F$.

Sol. in H_2O. (Piccini, Z. anorg. **1.** 51.)

Cæsium fluoxypermolybdate, MoO_3F_2, $2CsF+H_2O$.

(Piccini.)

Potassium fluoxypermolybdate, MoO_3F_2, $2KF+H_2O$.
Not very sol. in H_2O; more sol. in HF+Aq without decomp. (Piccini.)

Rubidium fluoxypermolybdate, MoO_3F_2, $2RbF + H_2O$.

Somewhat more sol. in H_2O than K salt. Easily sol. in $HF + Aq$. (Piccini.)

Fluoxypertantalic acid.

Potassium fluoxypertantalate, $2KF$, $TaO_2F_3 + H_2O$.

Sol. in H_2O. (Piccini, Z. anorg. **2.** 21.)

Fluoxypertitanic acid, TiO_2F_2, HF.

Known only in solution. (Piccini, B. **18.** 255 R.)

Ammonium fluoxypertitanate, TiO_2F_2, $2NH_4F$.

Very unstable. (Piccini, Gazz. ch. it. **17.** 479.)

TiO_2F_2, $3NH_4F$. Sol. in H_2O.

Sol. in H_2O_2. (Piccini, Z. anorg. 1895, **10** 439.)

$2TiO_2F_2$, $3NH_4F$. Sol. in H_2O. (Piccini, B. **18.** 698 R.)

Barium fluoxypertitanate, TiO_2F_2, BaF_2.

Precipitate. Easily sol. in acids. (Piccini, B. **18.** 698 R.)

$2TiO_2F_2$, $3BaF_2$. Insol. in H_2O; sol. in dil. acids. (Piccini, Gazz. ch. it. **17.** 479.)

Potassium fluoxypertitanate, TiO_2F_2, $2KF$.

Sol. in H_2O. (Piccini, B. **21.** 1391.)

Sol. in H_2O_2. (Piccini, Z. anorg. 1895, **10.** 438.)

Fluoxypertungstic acid.

Potassium fluoxypertungstate, $2KF$, $WO_3F + H_2O$.

(Piccini, Z. anorg. **2.** 11.)

Fluoxytantalic acid.

See also **Fluoxypertantalic acid.**

Ammonium fluoxytantalate, $3NH_4F$, $TaOF_3$.

Easily sol. in H_2O. The solution clouds up by standing or on warming. (Joly, C. R. **81.** 1266.)

Fluoxytitanic acid.

See also **Fluoxypertitanic acid.**

Barium fluoxytitanate, $TiOF_2$, BaF_2.

Insol. in H_2O; sol. in dil. acids. (Piccini, Gazz. ch. it. **17.** 479.)

Fluoxytungstic acid.

Ammonium fluoxytungstate, $2NH_4F$, WO_2F_2.

Very sol. in H_2O. (Marignac, A. ch. (3) **69.** 65.)

NH_4F, $WO_2F_2 + H_2O$. Decomp. by H_2O. Crystallises unchanged from H_2O containing HF. (Marignac.)

Ammonium fluoxytungstate tungstate, $4NH_4F$, WO_2F_2, $(NH_4)_2WO_4$.

Incompletely sol. in H_2O. Residue dissolves in $NH_4OH + Aq$. (Marignac.)

Cadmium fluoxytungstate.

Very sol. in H_2O. (Marignac.)

Cupric fluoxytungstate, CuF_2, $WO_2F_2 + 4H_2O$.

Very sol. in H_2O. (Marignac, C. R. **55.** 888.

Cupric fluoxytungstate ammonium fluoride, CuF_2, WO_2F_2, $NH_4F + 4H_2O$.

Sol. in H_2O. (Marignac.)

Manganese fluoxytungstate.

Very sol. in H_2O. (Marignac.)

Nickel fluoxytungstate, NiF_2, $WO_2F_2 + 10H_2O$.

Deliquescent. Very sol. in H_2O. (Marignac.)

Potassium fluoxytungstate, KF, $WO_2F_2 + H_2O$.

Can be recrystallised without decomp. only from H_2O containing HF. (Marignac, A. ch. (3) **69.** 70.)

$2KF$, $WO_2F_2 + H_2O$. Difficultly sol. in cold, more easily in hot H_2O. (Berzelius.)

Sol. in 17 pts. H_2O at 15°. (Marignac.)

Can be recrystallised without decomp. from H_2O, or H_2O containing HF. (Marignac.)

Sol. in H_2O with decomp. Sol. in HF. (Marchetti, Z. anorg. 1895, **10.** 71.)

See also **Fluoxypertungstate, potassium.**

Silver fluoxytungstate.

Very easily sol. in H_2O. (Marignac.)

Sodium fluoxytungstate, $2NaF$, WO_2F_2.

More sol. in H_2O than the corresponding K compound. (Berzelius.)

Thallous fluoxytungstate, TlF, WO_2F_2.

Insol. in H_2O. Decomp. by H_2O. (Ephraim and Heymann, B. 1909, **42.** 4463.)

$2TlF$, WO_2F_2. Insol. in H_2O but decomp. thereby. (Ephraim and Heymann, B. 1909, **42.** 4462.)

$3TlF$, $2WO_2F_2$. Insol. in H_2O. Decomp. by acids. (Ephraim and Heymann, B. 1909, **42.** 4462.)

Zinc fluoxytungstate, ZnF_2, $WO_2F_2 + 10H_2O$.

Very sol. in H_2O. (Marignac.)

Fluoxyuranic acid.

Ammonium fluoxyuranate, $3NH_4F, UO_2F_2$.

Easily sol. in H_2O, less in HF. Insol. in alcohol. (Bolton.)

100 g. solution sat. at 27° contain 10.11 g. salt.

100 g. solution sat. at 81.3° contain 20.71 g. salt.

(Bürger, Dissert. **1904.**)

Barium fluoxyuranate, $3BaF_2, 2UO_2F_2+2H_2O$.

Traces dissolve in hot H_2O. Easily sol. in dil. acids. (Bolton.)

Potassium fluoxyuranate, $3KF, UO_2F_2$.

Sol. in 8 pts. H_2O at 21°. Insol. in alcohol and ether. (Bolton, J. pr. **99.** 269.)

Does not exist. (Smithells, Chem. Soc. **43.** 125.)

$4KF, UO_2F_2$. Insol. in H_2O. Easily sol. in dil. acids. (Ditte, C. R. **91.** 115.)

$5KF, 2UO_2F_2$. (Baker, Chem. Soc. **35.** 760.)

$3KF, 2UO_2F_2+2H_2O$. (Baker.)

Sodium fluoxyuranate, NaF, UO_2F_2.

$+2H_2O$. Not efflorescent.

$+4H_2O$. Insol. in H_2O and dil. acids. Sl. sol. in conc. HCl+Aq. Sol. in conc. H_2SO_4. (Bolton, J. B. **1866.** 212.)

$4NaF, UO_2F_2$. (Ditte.)

Does not exist. (Smithells, Chem. Soc. **43.** 125.)

Fluoxyvanadic acid.

Ammonium fluoxyvanadate, $12NH_4F, V_2O_5, 2VOF_3$.

Easily sol. in H_2O, and not attacked by cold conc. H_2SO_4. (Baker, Chem. Soc. **33.** 388.)

Formula is $3NH_4F, VO_2F$. (Petersen, J. pr. (2) **40.** 289.)

$3NH_4F, VO_2F$. Sol. in H_2O. (Petersen, *l. c.*)

Much less sol. in H_2O in presence of NH_4F. (Piccini and Giorgis, Gazz. ch. it. **27. 1.** 65.)

$+H_2O$. (Piccini and Giorgis, Gazz. ch. it. 1892, **22.** 55.)

$3NH_4F, VOF_2$. "Hypovanadate." Quite sol. in H_2O. Very sl. sol. in MF+Aq. Less sol. in alcohol than in H_2O. (Petersen, J. pr. (2) **40.** 195.)

$2NH_4F, VOF_2$. Sol. in H_2O. (Petersen.)

$+H_2O$. (Piccini and Giorgis.)

$7NH_4F, 4VOF_2+5H_2O$. Very sol. in H_2O. (Petersen.)

$3NH_4F, 2VO_2F$. Sol. in H_2O without decomp. Sol. in conc. HF+Aq. (Piccini and Giorgis, Gazz. ch. it. **24. 1.** 68.)

$3NH_4F, 2VOF_3+H_2O$. Sol. in H_2O with decomp.

$V_2O_5, 2NH_4F$. (Ditte, C. R. **106.** 270.)

$V_2O_5, 8NH_4F+4H_2O$. As above.

$V_2O_5, 4NH_4F+4H_2O$. As above. Sol. in H_2O.

Ammonium hydrogen flu*di*oxyvanadate, $7NH_4F, HF, 4VO_2F$.

Very sol. in H_2O. (Petersen, J. pr. (2) **40.** 284.)

Ammonium hydrogen *tri*fluoxyvanadate, $3HF, 9NH_4F, 5VOF_3$.

Easily sol. in H_2O. Sl. sol. in MF+Aq. (Petersen, J. pr. (2) **40.** 280.)

$3NH_4F, 3HF, 2VOF_3$. Sol. in H_2O. (Baker, Chem. Soc. **33.** 388.)

Identical with $3HF, 9NH_4F, 5VOF_3$. (Petersen.)

Barium fluoxyvanadate, BaF_2, VO_2F.

Ppt. (Ephraim, Z. anorg. 1903, **35.** 79.)

Cadmium fluoxyvanadate, CdF_2, VOF_2+7H_2O.

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

Cobalt fluoxyvanadate, CoF_2, VOF_2+7H_2O.

"Hypovanadate." Sol. in H_2O. (Piccini and Giorgis.)

Nickel fluoxyvanadate, NiF_2, VOF_2+7H_2O.

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

Potassium fluoxyvanadate, $7KF, 3VOF_2$.

Very sl. sol. in H_2O and MF+Aq. Easily sol. in dil. acids. (Petersen, J. pr. (2) **40.** 199.)

$2KF, VOF_2$. As above. (Petersen.)

$2KF, 2V_2O_5+8H_2O$. Sol. in H_2O and H_2SO_4. (Ditte, C. R. **105.** 1067.)

$2KF, 3V_2O_5+5H_2O$. As above.

$2KF, 4V_2O_5+8H_2O$. As above.

$4KF, V_2O_5$. Less sol. than $4KF, 3V_2O_5$.

$+2H_2O$, and $+3H_2O$. Sol. in H_2O.

$4KF, 3V_2O_5+4H_2O$, and $+6H_2O$. Less sol. than $2KF, 3V_2O_5+5H_2O$.

$8KF, V_2O_5+2H_2O$, and $+3H_2O$. Sol. in H_2O.

Potassium *tri*fluoxyvanadate, $2KF, VOF_3$.

Ppt. (Petersen, J. pr. (2) **40.** 272.)

$6KF, V_2O_5, 2VOF_3+2H_2O$. Sol. in H_2O. Insol. in cold conc. H_2SO_4. (Baker, Chem. Soc. **33.** 300.)

Formula is $3KF, 2VO_2F$. (Piccini and Giorgis.)

See also **Fluovanadate fluoxyvanadate, potassium.**

Potassium flu*di*oxyvanadate, $2KF, VO_2F$.

Easily sol. in H_2O. (Petersen, J. pr. (2) **40.** 278.)

$3KF, VO_2F$. As above. (Petersen.)
$3KF, 2VO_2F$. Sol. in H_2O; scarcely attacked by H_2SO_4. (Piccini and Giorgis.)

Potassium hydrogen fluoxyvanadate, $3KF, HF, 2VOF_3$.
Sol. in H_2O. (Petersen.)

Sodium fluoxyvanadate, $8NaF, 3VOF_2+2H_2O$.
Sol. in H_2O. (Petersen, J. pr. (2) **40.** 200.)
$3NaF, VO_2F, VOF_3$ (?). Very easily decomp. (Piccini and Giorgis.)
$2NaF, 2V_2O_5+10H_2O$. Sol. in H_2O. (Ditte, C. R. **106.** 270.)
$4NaF, V_2O_5$. As above.
$4NaF, 3V_2O_5+18H_2O$. As above.
$6NaF, V_2O_5+5H_2O$. As above.
$8NaF, V_2O_5+3H_2O$. (As above.

Thallous fluoxyvanadate, $2TlF, VOF_2$.
Somewhat sol. in cold H_2O without decomp. Sol. in boiling H_2O with exception of a black residue, which is easily sol. in dil. H_2SO_4. (Ephraim, B. 1909, **42.** 4460.)
$3TlF, 2VO_2F$. Insol. in H_2O. Sol. in H_2O containing H_2SO_4. (Ephraim and Heymann, B. 1909, **42.** 4459.)

Zinc fluoxyvanadate, $ZnF_2, ZnO, 2VOF_3+14H_2O$.
Decomp. on air; sol. in H_2O. (Baker, Chem. Soc. **33.** 388.)
True composition is represented by the formula ZnF_2, VO_2F+7H_2O. (Petersen.)
ZnF_2, VO_2F+7H_2O. Very sol. in H_2O. (Piccini and Giorgis.)
ZnF_2, VOF_2+7H_2O. "Hypovanadate." Sol. in cold H_2O, but decomp. by boiling; sol. in dil. $HF+Aq$. (Piccini and Giorgis.)

Fluozirconic acid.

Ammonium fluozirconate, $(NH_4)_2ZrF_6$.
Sol. in H_2O.
$3NH_4F, ZrF_4$. Sol. in H_2O. (Marignac.)

Cadmium fluozirconate, $2CdF_2, ZrF_4+6H_2O$.
Sol. in H_2O; can be recrystalised therefrom. (Marignac, A. ch. (3) **60.** 257.)
$CdZrF_6+6H_2O$. Sol. in H_2O. (Marignac.)

Cæsium fluozirconate, CsF, ZrF_4+H_2O.
Sol. in H_2O without decomp. (Wells, Z. anorg. 1895, **10.** 434.)
$2CsF, ZrF_4$. Sol. in H_2O without decomp. (Wells, Z. anorg. **1895,** 10, 434.)
$2CsF, 3ZrF_4+2H_2O$. Only sl. sol. in H_2O. (Wells, Z. anorg. 1895, **10.** 434.)

Cupric fluozirconate, $2CuF_2, ZrF_4+12H_2O$.
Easily sol. in cold H_2O. (Marignac, A. ch. (3) **60.** 296.)
$3CuF_2, 2ZrF_4+16H_2O$. Sol. in H_2O. (Marignac.)

Lithium fluozirconate, $2LiF, ZrF_4$.
Ppt. (Wells, Am. J. Sci. 1897, (4) **3.** 468.)
$4LiF, ZrF_4+\frac{1}{2}H_2O$. Sol. in H_2O with decomp. (Wells, Am. J. Sci. 1897, (4) **3.** 469.)

Magnesium fluozirconate, $MgZrF_6+5H_2O$.
Sol. in H_2O. (Marignac.)

Manganous fluozirconate, $MnZrF_6+5H_2O$.
Sol. in H_2O. (Marignac, J. pr. **83.** 202.)

Nickel fluozirconate, $2NiF_2, ZrF_4+12H_2O$.
Sol. in H_2O. (Marignac, A. ch. (3) **60.** 291.)
$NiZrF_6+6H_2O$. Sol. in H_2O. (Marignac.)

Nickel potassium fluozirconate, $K_2ZrF_6, NiZrF_6+8H_2O$.
Sol. in H_2O. (Marignac.)

Potassium fluozirconate, KF, ZrF_4+H_2O.
Much more sol. in hot, than cold H_2O. (Marignac.)
$2KF, ZrF_4=K_2ZrF_6$. 100 pts. H_2O dissolve at 2°, 0.781 pt.; at 15°, 1.41 pts.; at 19.° 1.69 pts.; at 100°, 25.0 pts. K_2ZrF_6. (Marignac.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)
$3KF, ZrF_4$.

Sodium fluozirconate, $5NaF, ZrF_4$.
100 pts. H_2O dissolve 0.387 pt. at 18°, and 1.67 pts. at 100°. (Marignac.)
$2NaF, ZrF_4$. (Wells, Am. J. Sci. 1897, (4) **3.** 469.)
$5NaF, 2ZrF_4$. Sol. in H_2O with decomp. (Wells.)

Tellurium fluozirconate, TeF, ZrF_4.
Sol. in H_2O without decomp. (Wells, Am. J. Sci. 1897, (4) **3.** 470.)
$+H_2O$. Sol. in H_2O without decomp. (Wells.)
$3TeF, ZrF_4$. Sol. in H_2O without decomp. (Wells.)
$5TeF, 3ZrF_4$. Sol. in H_2O without decomp. (Wells.)

Zinc fluozirconate, $ZnZrF_6+6H_2O$.
Sol. in H_2O. (Marignac.)
$2ZnF_2, ZrF_4+12H_2O$. Sol. in H_2O. (Marignac, A. ch. (3) **60.** 257.)

Fulminating gold.
See **Auroamidoimide.**

Fulminating platinum.
See **Fulminoplatinum.**

Fulminating silver.
See **Silver nitride.**

Fulminoplatinum compounds.
See—
***Di*chlorofulminoplatinum.**
***Tri*chlorofulminoplatinum.**
***Tetra*chlorofulminoplatinum.**
Chloroxyfulminoplatinum.

Fuscocobaltic chloride, $Co(NH_3)_4(OH)Cl_2 + H_2O$.
Sol. in H_2O, from which it is precipitated by NH_4Cl+Aq; decomp. by boiling H_2O; pptd. from aqueous solution by alcohol. (Fremy, C. R. **32.** 501.)

—— **nitrate,** $Co(NH_3)_4(OH)(NO_3)_2+H_2O$.
Sol. in H_2O. Properties as the chloride. (Fremy.)

—— **sulphate,** $Co(NH_3)_4(OH)SO_4+1\frac{1}{2}H_2O$.
Sol. in H_2O. Insol. in NH_4OH+Aq. (Fremy, C. R. **32.** 501.)
Insol. in H_2O. Sol. in conc. HCl+Aq, or H_2SO_4, from which it is precipitated by H_2O. (Vortmann, N. **6.** 412.)

Fusible white precipitate.
See **Mercuri*di*ammonium chloride.**

Gadolinium, Gd.
(Marignac, C. R. **102.** 92.)

Gadolinium bromide, $GdBr_3+6H_2O$.
Sol. in HBr. (Benedicks, Z. anorg. 1900, **22.** 403.)

Gadolinium chloride, $GdCl_3+6H_2O$.
Somewhat deliquescent. Sol. in H_2O. (Benedicks.)

Gadolinium platinum chloride.
See **Chloroplatinate, gadolinium.**

Gadolinium fluoride, GdF_3.
Insol. in H_2O; sl. sol. in hot HF. (Popovici, B. 1908, **41.** 635.)

Gadolinium hydroxide, $Gd(OH)_3$.
Ppt. (Benedicks, Z. anorg. 1900, **22.** 402.)

Gadolinium oxide, Gd_2O_3.
Sol. in acids. (de Boisbaudran, C. R. **111.** 394.)
Somewhat hydroscopic; easily sol. in acids. (Benedicks.)

Gallium, Ga.
Not decomp. by H_2O; easily sol. in cold HCl +Aq. Slowly sol. in warm dil. HNO_3+Aq. Not attacked by conc. HNO_3 free from N_2O_3 below 40–50°, and only slowly in presence of N_2O_3. (Dupré, C. R. **86.** 720.)
Easily sol. in cold or warm KOH+Aq. (de Boisbaudran, A. ch. (5) **10.** 100.)

Gallium bromide, $GaBr_3$.
Deliquescent, and sol. in H_2O.

Gallium *di*chloride, $GaCl_2$.
Deliquescent, and decomp. by H_2O. (Nilson and Petersen, C. R. **107.** 527.)

Gallium chloride, $GaCl_3$.
Deliquescent, and very sol. in little H_2O. Decomp. by much H_2O, with formation of basic salt, which is slowly sol. in dil. HCl +Aq.

Gallium hydroxide.
Sol. in acids; sol. in KOH or NaOH+Aq, less easily in NH_4OH+Aq, even in presence of ammonium salts.

Gallium iodide, GaI_3.
Deliquescent, and sol. in H_2O. (de Boisbaudran and Jungfleisch, C. R. **86.** 578.)

Gallium *sub*oxide, GaO (?).
Sol. in HNO_3+Aq. (Dupré.)
Sol. in dil. H_2SO_4+Aq.

Gallium oxide, Ga_2O_3.
Sol. in acids.

Germanium, Ge.
Insol. in HCl+Aq. Easily sol. in aqua regia. Decomp. by HNO_3+Aq to oxide. Conc. H_2SO_4 decomp. to sulphate. Insol. in boiling KOH+Aq. (Winkler, J. pr. (2) **34.** 177; **36.** 177.)

Germanium *tetra*bromide, $GeBr_4$.
Decomp. by H_2O. (Winkler.)

Germanium *di*chloride, $GeCl_2$.
Decompl by H_2O. (Winkler.)

Germanium *tetra*chloride, $GeCl_4$.
Sinks in H_2O, and is gradually decomp. thereby. (Winkler, J. pr. **34.** 177.)
Insol. in and not attacked by hot conc. H_2SO_4. (Friedrich, W. A. B. **102, 2b. 540.**)

Germanium chloroform, $GeHCl_3$.
Decomp. by H_2O. Sol. in HCl+Aq. (Winkler.)

Germanium *tetra*fluoride, GeF_4.
Deliquescent, and sol. in H_2O.
$+3H_2O$. Deliquescent. Melts in its crystal H_2O when warmed. (Winkler.)

Germanium potassium fluoride.
See **Fluogermanate, potassium.**

Germanium hydride, GeH_4.

Sl. sol. in hot HCl. Sol. in NaOCl+Aq. (Voegelen, Z. anorg. 1902, **30.** 327.)

Germanium *tetra***iodide,** GeI_4.

Deliquescent, and sol. in H_2O with decomp. (Winkler.)

Germanium *mon***oxide,** GeO.

Not appreciably sol. in dil H_2SO_4+Aq. Easily sol. in HCl+Aq. Insol. in alkalies. (Winkler, J. pr. (2) **34.** 177.)

Somewhat sol. in H_2O; insol. in H_2SO_4+Aq, even when hot and conc. (van Bemmelen, R. t. c. **6.** 205.)

Germanium *di***oxide,** GeO_2.

Not very difficultly sol. in H_2O.

Sol. in 247.1 pts. H_2O at 20°; in 93.3 pts. at 100°. (Winkler.)

Easily sol. in alkali carbonates or hydrates +Aq; sl. sol. in acids.

Germanium oxychloride, $GeOCl_2$.

Insol. in H_2O; sol. in acids. (Winkler, J. pr. (2) **36.** 177.)

Germanium *mono***sulphide,** GeS.

Sol. in 402.9 pts. H_2O. Sol. in conc. hot HCl+Aq. Sol. in KOH+Aq. Sol. in $(NH_4)_2S$+Aq when precipitated. Insol. in $(NH_4)_2S$+Aq if crystalline. Also exists in a colloidal state. (Winkler.)

Germanium *di***sulphide,** GeS_2.

Sol. in 221.9 pts. H_2O. Easily sol. in KOH+Aq, or NH_4OH+Aq. Insol. in acids. Exists also in a colloidal state. (Winkler.)

Glass.

Numerous and extensive researches have been made on the action of H_2O and various solutions on glass. The older work has a certain historical interest, but only a brief statement of some of the more important results can be given here. For a very thorough résumé of the work before the year 1861, Storer's Dictionary, p. 555, should be consulted.

All glass is more or less attacked by H_2O, the more easily the greater the amount of alkali present, the finer it is powdered, and the higher the temperature.

Glass, as that of a flask, is decomposed to a considerable extent by several days' boiling with H_2O, a portion of the fixed alkali being dissolved, but when powdered glass is rubbed with distilled H_2O in a mortar, the H_2O remains pure and exhibits no alkalinity. (Scheele.)

Glass of alembics is partially dissolved by long boiling with H_2O. (Lavoiser.)

H_2O extracts potash or soda from glass together with a portion of the silica, the decomposition taking place the more easily in proportion as the glass is richer in alkalies, more minutely divided, or the temperature of the water higher. (Bischof, Kastn. Arch. **1.** 443.)

Powdered crown glass and some varieties of window glass render cold H_2O alkaline when in contact therewith. (Dumas.)

100 pts. finely divided flint glass lose 7 pts. potash when boiled one week with H_2O. (Griffiths, Q. J. Sci. 20. 258.)

Retorts of ordinary or flint glass are partially dissolved by H_2O when it is evaporated therein. (Chevreul, 1811.)

Finely powdered plate glass (Faraday, Pogg. 18. 569), and Thuringian potash glass (Ludwig, Arch. Pharm. 91. 47) redden moistened litmus paper.

The alkaline reaction disappears by continued washing, but reappears when the glass is freshly rubbed. (Griffiths.)

Cold H_2O takes up SiO_2 as well as alkali from glass powder. (Fuchs.)

Powdered lead glass gives up appreciable amounts of PbO to weakly acidified H_2O. (Pelouze.)

When powdered white glass, containing 12.4% Na_2O, 15.5% CaO, and 72.1% SiO_2, is treated repeatedly with H_2O, more than 3% of the glass is dissolved, and the undissolved part gives up 1.5% CaO to HCl+Aq with effervescence. A glass containing more alkali, *i. e.* 16.3% Na_2O, 6.4% CaO, 77.3% SiO_2, lost with the same treatment 18.2%, and the residue gave up 2% CaO to HCl+Aq. (Pelouze, C. R. 43. 117.)

In the above case the fineness of the glass has an influence as well as its composition. When the same sample of glass was boiled 1 hour with H_2O, amounts were dissolved in the proportion 1 : 4 : 28, according as the glass was in form of a coarse, fine, or very fine powder. Glass of the composition of the above samples, as given by Pelouze, lost 10 and 32% respectively.

If powdered glass is boiled with H_2O and CO_2 conducted into the solution, it is absorbed; if boiled with K_2SO_4, Na_2SO_4 is dissolved. (Pelouze.)

Glass tubes are converted into a white crystalline mass by heating with H_2O several months to 75–150°; lead glass and Bohemian glass most easily, English crown glass least. A little H_2O attacks glass more than much H_2O.

The action of H_2O is greatly increased by finely pulverising the glass.

H_2O dissolved 10% of a glass containing 12% Na_2O, 15.5% CaO, and 72.5% SiO_2, and 32% of another glass containing 16.3% Na_2O, 6.4% CaO, and 77.3% SiO_2. (Vogel, B. A. Munchen, **1867.** 437.)

Action of H_2O on a glass containing 74% SiO_2, 8.6% CaO, 14% Na_2O, 0.6% K_2O, with traces of Al_2O_3, Fe_2O_3, MnO, and MgO.

By boiling with H_2O a decrease of 3.9 mg. was observed for the first hour, which soon became constant at 2.2 mg. per hour. The action was then proportional to the time, and also to the surface in contact with the liquid, but independent of the amount of liquid evaporating.

The action decreases rapidly with the temperature, so that at 90-100° only ¼ as much glass is dissolved as by boiling H_2O. (Emmerling, A. **150.** 257.)

When steam condenses in tubes of Na glass, they are so strongly attacked that the H_2O has an alkaline reaction, but tubes of hard or Bohemian K glass are not so strongly attacked. (Tollens, B. **9.** 1540.)

The effect of H_2O is so great as to impart a distinctly alkaline reaction to water condensing in a tube of ordinary glass. By condensing water in long tubes of various kinds of glass the following results were obtained.

I. Easily fusible Thuringian glass. Surface exposed = 324 sq. cm.

After 2 hours, 62.0 mg. KOH were dissolved.

After 3 hours more, 36.0 mg. KOH were dissolved.

After 3 hours more, 33.2 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

Or, in 14 hours, 172.8 mg. KOH were dissolved.

II. Less easily fusible Thuringian glass. Surface exposed = 499 sq. cm.

After 3 hours, 19.2 mg. KOH were dissolved.

After 3 hours more, 15.2 mg. KOH were dissolved.

After 3 hours more, 12.4 mg. KOH were dissolved.

After 3 hours more, 11.2 mg. KOH were dissolved.

Or, after 12 hours, 58.0 mg. KOH were dissolved.

III. Combustion tubing of very difficultly fusible Bohemian glass. Surface exposed = 1130 sq. cm.

After 3 hours 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

Or, after 12 hours, 16.64 mg. KOH were dissolved.

IV. Easily fusible Bohemian glass. Surface exposed = 1394 sq. cm.

After 3 hours, 7.88 mg. KOH were dissolved.

After 3 hours more, 8.56 mg. KOH were dissolved.

After 3 hours more, 1.97 mg. KOH were dissolved.

Or, after 9 hours, 24.32 mg. KOH were dissolved. (Kreusler and Henzold, B. **17.** 34.)

From the above the following table has been calculated.

50 ccm. H_2O dissolves from a surface of 1000 sq. m. in 1 hour:—

96.0 mg. from easily fusible Thuringian glass.

12.8 mg. from less fusible Thuringian glass.

1.2 mg. from combustion tube of Bohemian glass.

2.0 mg. from harder tube of Bohemian glass.

(Kreusler and Henzold, B. **17.** 34.)

100 ccm. H_2O dissolves so much glass from a flask every 2 seconds when in contact therewith that 0.1 ccm. ½ normal oxalic acid is neutralised thereby. (Bohlig, Z. anal. **23.** 518.)

Action of H_2O on various kinds of Na glass. 1 g. of finely powdered glass was boiled 10–15 minutes in a silver dish with 100 ccm. H_2O, and the per cent of Na_2O (or K_2O) in the solution was determined.

	%Na_2O (K_2O)
Orthoclase feldspar	0.17
Glass of a Bohemian combustion tube	0.56
" flask (German manuf.)	0.69
" champagne bottle	1.7
Natrolite	1.32
Glass of a wine bottle (Hungarian)	2.22
Glass which was attacked by H_2O under pressure	3.7
Lead glass	3.8
Glass that broke easily	4.8
Glass tubing that became rough when fused	6.1
Glass tubing that became opaque by fusing	14.35
Solid water glass	26.97

(Wartha, Z. anal. **24.** 220.)

The relative ease by which various kinds of glass are attacked by H_2O is shown by the following table. The glass was powdered and heated on a water bath with exclusion of atmospheric CO_2.

Potassium water glass	291
Sodium water glass	196
Yellow glass rich in alkali	34
Thuringian glass	19
Ditto from Tittel and Co.	8
Window glass	8
Lead glass from Jena	6
Bohemian glass from Kavalier	2.4
Lead crystal glass	1.4
Thermometer glass, 16IV, from Jena	1.0
Zinc glass, 362, from Jena	0.8
Lead glass, 434, from Jena	0.6
Lead glass, 483, from Jena	0.2
Heaviest lead silicate, from Jena	0.0

(Mylius, C. C. **1888.** 1313.)

Solubility of various kinds of glass in H_2O.

The amounts dissolved from various kinds of glass by heating 5 hours with H_2O were as follows.

Yellow glass rich in alkali (13% K_2O, 15% Na_2O)	249 mg.
Poor Thuringian glass (6.6% K_2O, 16.5% Na_2O)	91.4 "
Glass from Tittel and Co. (7.1% K_2O, 14.3% Na_2O)	30.4 "
Bottle glass from Schilling (4.2% K_2O, 11.9% Na_2O)	13.0 "
Bohemian glass from Kavalier (13.3% K_2O, 11.4% Na_2O)	10.1 "
Rhenish window glass (13.5% Na_2O)	8.4 "
Lead crystal glass from Ehrenfeld (12.1% K_2O)	8.5 "
Green bottle glass (1.3% K_2O, 9.5 % Na_2O)	6.5 "

Solubility of various kinds of glass in H_2O—*Continued.*

Thermometer glass 16III from Jena (14.0% Na_2O, 7% ZnO)	6.4 mg.
Lead glass, No. 483, from Jena (47% PbO, 7.3% K_2O)	3 3 "
Lead silicate	0.6 "

(Mylius and Forster, B. **22.** 1100.)

By calculation from the electrical conductivity of the solutions formed, various data were obtained by Kohlrausch (B. **24.** 3565), which showed that different varieties of glass were attacked in very different degree by cold H_2O, and, moreover, the amount dissolved was proportionately much greater during the first few minutes of treatment with H_2O than afterwards, and, furthermore, the rate of decrease was much faster for good glass than poor. Increase of temperature increased the rate of solubility to a very great degree, the increase for 1° C. being about 17%. In 7 hours at 80° half as much was dissolved as in 6 months at 18°. Extensive tables are given. (Kohlrausch, B. **24.** 3651.) See also Kohlrausch (W. Ann. **44.** 577).

A very extensive research on the action of H_2O on glass, with a historical review of the work previously done on the subject, has been published by Mylius and Forster. (Z. anal. **31.** 241.) The general results may be summed up as follows:—

1. The solution of glass in H_2O is caused by a decomposition, by which free alkali is formed.
2. The silicic acid of the glass is brought into solution by a secondary reaction of the free alkali in the solution.
3. The constituents of the solution change according to the conditions of the digestion.
4. The amount of alkali going into solution from a given surface under certain conditions is a measure for the resistance of a glass under those conditions.
5. The rate of attack of glass surfaces by cold H_2O decreases rapidly with the length of time of digestion, and finally approaches a constant value.
6. The solubility increases very rapidly with increase of temperature.
7. The ratio of the solubility of several kinds of glass is dependent on the temperature.
8. From glasses which show the same ease of attack unequal amounts of substance may be dissolved.
9. The solubility of a glass is influenced by the condition of the surface from "weathering" by prolonged exposure to the CO_2 and H_2O of the air.
10. The poorer a glass is the less will its solubility decrease by prolonged treatment with H_2O.
11. A good glass is essentially less easily attacked after having been previously treated with H_2O.
12. After treatment with H_2O, glass surfaces have the property of fixing alkali from the solutions formed, and giving it up again by a subsequent treatment with H_2O.
13. Potassium glass is much more sol. than sodium glass (contrary to previous researches), but the difference decreases as the glass becomes richer in CaO.
14. In glass flasks which are to be only slightly attacked by cold or hot H_2O, the CaO, alkalies, and SiO_2 must stand in a fixed relation to each other.
15. Of the more common varieties of glass, lead flint glass is least sol. in H_2O, but its surface is corroded, and it is easily decomp. by acids.

(Mylius and Forster, Z. anal. **31.** 241.)

Bottle glass containing much Al_2O_3 is easily attacked by acids.

From powdered flint glass, boiling HCl+Aq extracts K, but no Pb. (Griffiths.)

Bottles of flint glass with $(NH_4)_2CO_3$+Aq became so fragile that on shaking pieces of glass were detached. (Griffiths.)

All glass is decomp. by HF.

Conc. H_3PO_4 also attacks all glass.

Glass containing small amounts of SiO_2 are attacked by H_2SO_4; poorer glass by boiling HCl, HNO_3, and aqua regia. (Berzelius.)

Conc. HNO_3 does not act on flint glass at 145–150°. (Sorby, C. R. 50. 990.)

Glass of ordinary chemical apparatus gives up traces of metals to HCl and HNO_3+Aq, but hard Bohemian glass consisting of 75% SiO_2, 15% K_2O, 10% CaO, resists the action of warm conc. acids; also an easily fusible Na K glass with 77 % SiO_2, 7.7% K_2O, 5% Na_2O, 10.3% CaO, is not easily attacked. (Stas.)

KOH, and NaOH+Aq dissolve SiO_2 from glass the more easily the hotter and the more conc. the solutions are. (Müller.) NH_4OH, and $(NH_4)_2CO_3$+Aq attack many kinds of glass, especially flint glass. CaO_2H_2 attacks glass appreciably at 45° and lower; still more strongly on boiling. (Lamy, A. ch. (5) **14.** 155.)

The action of various solvents on the glass mentioned on page 359 in Emmerling's experiments is as follows:

The action of HCl+Aq containing 0.2 to 3% HCl is practically null, but is increased either by dilution or concentration. A very small quantity (0.02%) HCl added to H_2O almost wholly prevents its action on glass. With HCl+Aq (11% HCl) a decrease of 4.2 mg. was noticed in the first hour, and only 3–4 mg. afterwards. The same is the case for HNO_3+Aq in still greater degree, 0.008% HNO_3 sufficing to nearly counteract the solvent action of H_2O.

H_2SO_4+Aq has about double the solvent effect possessed by H_2O.

Oxalic and acetic acids both diminish the solvent action of H_2O.

The addition of even traces (0.04%) of

Na_2CO_3 increases the solvent action, and this is further rapidly increased by an increase in the amount of Na_2CO_3. Na_2CO_3+Aq containing 1% Na_2CO_3 dissolves about 10 times as much as pure H_2O, i. e. about 35 mg. per hour.

The above is also the case with KOH+Aq, but in even greater degree. KOH+Aq containing 0.025% KOH dissolved three times as much as pure H_2O.

$(NH_4)_2CO_3$+Aq has about the same action as H_2O.

With NH_4OH+Aq (9% NH_3) 7 mg. decrease for the first hour, and 3 mg. afterwards was noticed. The concentration of the NH_4OH+Aq was apparently without effect.

The addition of NH_4Cl decreases the solvent action of H_2O proportionately to the amount added, but with new flasks large amounts are dissolved.

With NH_4Cl+Aq (7%NH_4Cl) 4.2 mg. were dissolved in the first hour, and the amount dissolved gradually decreased to null after 24 hours on account of the liberation of HCl by the decomp. of NH_4Cl.

NaCl, KCl, KNO_3, and Na_2SO_4 show a similar behaviour to that of NH_4Cl.

Na_2HPO_4+Aq containing 0.4% Na_2HPO_4 has six times the solvent action of pure H_2O. but the action is not increased by further concentration.

In general, those salts the acids of which form insol. Ca salts, as Na_2CO_3, Na_2SO_4, Na_2HPO_4, $(NH_4)_2C_2O_4$, increase the solvent action of H_2O, and this effect is greater the more concentrated the solution. KCl, KNO_3, NH_4Cl, and $CaCl_2$ decrease the effect, and the stronger the solution the less is the action.

All Na glass with approximately the above composition has the same power of resistance against H_2O; Bohemian K glass shows a greater resistance, especially against acids. (Emmerling, A. **150.** 257.)

Action of various reagents on hard Bohemian glass. 100 ccm. substance dissolved mg. glass in 6 days at 100°.

H_2O	10.0
H_2S+Aq	8.7
Dil. $(NH_4)_2S$+Aq.	52.5
Conc. $(NH_4)_2S$+Aq.	47.2
Conc. NH_4OH+Aq	42.5
Dil. NH_4OH+Aq.	7.7
NH_4SH+Aq.	51.2

(Cowper, Chem. Soc. **41.** 254.)

Action of various solutions on glass of different composition. (The figures denote decrease in weight in mg. of a 100 ccm. flask.)

	Time	1	2	3	4	5	6	7	8	9	10
H_2O	5 hrs.	62	31	29	17	13	9	7	7	5	4
H_2SO_4+Aq (25% H_2SO_4)	3 "	..	43	35	8	7	6	5	5	5	3
HCl+Aq (12% HCl)	3 "	85	...	27	4	2	1	1	1	0	0
NH_4OH+Aq (10% NH_3)	3 "	..	...	62	11	8	7	7	6	5	5
Na_2HPO_4+Aq (12% Na_2HPO_4)	3 "	..	...	81	64	40	35	34	30	15	12
Na_2CO_3+Aq (2% Na_2CO_3)	3 "	283	160	130	124	50	45	42	42	26	25

Composition of above varieties of glass.

	1	2	3	4	5	6	7	8	9	10
SiO_2	76.22	74.09	76.39	68.56	74.48	74.69	66.75	74.12	77.07	74.40
Al_2O_3	...	0.40	0.50	1.85	0.50	0.45	1.31	0.50	0.30	0.70
CaO	4.27	5.85	5.50	7.60	7.15	7.85	13.37	8.55	8.10	8.85
K_2O	...	7.32	4.94	2.24	6.64	8.64	05.50	4.86	3.75	4.40
Na_2O	19.51	12.34	12.67	19.75	11.23	8.37	3.07	11.97	10.78	11.65

It is seen that glass which resists the attack of H_2O also resists acids and alkalies, and that the relative resistance of all varieties to any of the solutions is the same. Therefore the action of H_2O may be accepted as a criterion for judging of the resistance of a glass to all solvents. Glass No. 10, in which the molecular ratio of SiO_2:CaO:$K_2O(Na_2O)$ is 8: 1:1.5, is recommended as best suited for chemical uses. (Weber and Sauer, B. **25.** 70.)

Mylius and Förster (B. **25.** 97) recommend a glass in which the molecular ratio of SiO_2: CaO: K_2O (Na_2O) is 7.2: 1: 1.1 as the best suited for chemical apparatus.

In an exhaustive research on the action of aqueous solutions on glass, which cannot be given in full on account of its great length, the following conclusions are reached:—

1. Solutions of caustic alkalies act on glass much more strongly than H_2O, dissolving all the constituents of the glass—that is, the glass as such. Very dilute solutions form an exception.

2. Of the caustic alkalies, NaOH+Aq has the strongest action, then come KOH, NH_4OH, and BaO_2H_2+Aq in the order named.

3. Increase in temperature increases the

strength of the attack of alkalies very considerably.

4. At high temperatures, the ease with which glass is attacked increases at first rapidly with the concentration of the alkali, but afterwards more slowly.

5. At ordinary temperatures very concentrated alkali solutions have less action on glass than dil. solutions.

6. Solutions of pure alkalies, if not too conc., act less on glass than when contaminated with small amounts of SiO_2.

7. Alkali carbonates+Aq attack glass much more than H_2O, even when they are very dilute. The action corresponds less to that of the caustic alkalies than to that of other salts. With equivalent concentration, Na_2CO_3+Aq has a stonger action than K_2CO_3 +Aq.

8. The action of salt solutions on glass is a compound one, depending both on the concentration and the kind of salt dissolved, and is made up of the action of the H_2O and the salt in solution.

9. Each kind of attack is differently influenced by the composition of the glass.

10. Solutions of those salts, the acids of which form insol. Ca salts, have a stronger action than H_2O, and the action increases with the concentration.

11. Solutions of those salts, the acids of which form sol. Ca salts, have less action than H_2O, and the action decreases with the concentration. (Förster, B. **25.** 2494.)

Data on this subject published since the first edition of this work have not been considered.

Glucinic acid.

Potassium glucinate, K_2GlO_2.

Very deliquescent. Sol. in H_2O and acids. (Krüss and Moraht, B. **23.** 733.)

Glucinum (Beryllium), Gl.

Not attacked by hot or cold H_2O. Sol. in cold dil. HNO_3+Aq. (Wöhler, Pogg. **13.** 577.)

Sol. only in boiling conc. HNO_3+Aq. (Debray, A. ch. (3) **44.** 5.)

Sol. in dil. HCl+Aq. dil. and conc. H_2SO_4+Aq, and KOH+Aq, but insol. in NH_4OH+Aq. (Wöhler, Debray.)

Sol. in hot HCl, hot conc. HNO_3, and hot conc. H_2SO_4. (Lebeau, A. ch. 1899, (7), **16.** 474.)

Glucinium azoimide, GlN_3.

Decomp. by hot H_2O. (Curtius, J. pr. 1898, (2), **58.** 292.)

Glucinum borocarbide, $3Gl_2C, B_6C$.

Insol. in H_2O. Easily sol. in mineral acids especially HNO_3. (Lebeau, A. ch. 1899, (7) **16.** 481.)

$C_4B_6Gl_6$. Stable in air.

Easily sol. in mineral acids, conc. and dil. (Lebeau, C. R. 1898, **126.** 1349.)

Glucinum bromide, $GlBr_2$.

Sol. in H_2O with evolution of much heat. (Wöhler.)

Sol. in abs. alcohol (Lebeau, A. ch. 1899, (7) **16.** 484.)

Glucinum carbide, Gl_2C.

Decomp. by H_2O. Slowly attacked by cold or hot conc. HCl and HNO_3. Gradually but completely sol. in dil. acids. (Lebeau, A. ch. 1899, (7) **16.** 476.)

GlC_2. Not easily decomp. by strong acids. Easily sol. with decomp. in dil acids. (Lebeau. C. R. 1895, **121.** 497.)

Glucinum chloride, $GlCl_2$.

Anhydrous. Fumes and deliquesces in air. Sol. in H_2O with hissing and evolution of much heat. Easily sol. in alcohol.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Sol. in alcohol and ether. Sl. sol. in C_6H_6, $CHCl_3$, Cl_4 and CS_2. (Lebeau, A. ch. 1899, (7) **16.** 493.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+4H_2O$. Very hydroscopic.

Easily sol. in H_2O and in alcohol. (Mieleitner, Z. anorg. 1913, **80.** 73.)

Glucinum chloride ammonia, $GlCl_2, 4NH_3$.

(Mieleitner, Z. anorg. 1913, **80.** 73.)

Glucinum chloride iodine *tri*chloride, $2ICl_3, GlCl_2+8H_2O$.

Hygroscopic. (Weinland, Z. anorg. 1902, **30.** 140.)

Glucinum ferric chloride, $GlCl_2, FeCl_3+H_2O$.

Decomp. by H_2O. (Neumann, A. **244.** 329.)

Glucinum mercuric chloride, $GlCl_2, 3HgCl_2+6H_2O$.

Sol. in H_2O. (Atterberg, B. **6.** 1288.)

Glucinum thallic chloride, $3GlCl_2, 2TlCl_3$.

Cryst. from HCl solution. (Neumann, A. **244.** 348.)

Glucinum stannic chloride.

See **Chlorostannate, glucinum.**

Glucinum fluoride, basic, $2GlO, 5GlF_2$.

Sol. in H_2O. (Lebeau, A. ch. 1899, (7) **16.** 484.)

Glucinum fluoride, GlF_2.

Deliquescent. Sol. in H_2O. Insol. in anhydrous HF. Sol. in alcohol. (Lebeau, C. R. 1898, **126.** 1421.)

Sol. in H_2O in all proportions. Somewhat sol. in abs. alcohol. Easily sol. in 90% alcohol, also in a mixture of alcohol and ether. Insol. in anhydrous HF. (Lebeau, A. ch. 1899, (7) **16.** 484.)

Glucinum potassium fluoride, GlF_2, KF.

Sl. sol. in H_2O. (Awdejew.) Much more sol. in hot than cold H_2O. (Berzelius.)

GlF_2, 2KF. Sol. in about 50 pts. H_2O at 20°, and 19 pts. boiling H_2O. (Marignac.)

Glucinum sodium fluoride, GlF_2, 2NaF.

Sol. in 34 pts. H_2O at 100°, and 68 pts. at 18°. (Marignac.)

Glucinum hydroxide, GlO_2H_2.

Easily sol. in acids. Sol. in H_2SO_3+Aq.

Sol. in CO_2+Aq; 100 ccm. sat. CO_2+Aq dissolve 0.0185 g. GlO. (Sestini, Gazz. ch. it. **20.** 313.)

Also sol. in KOH, NaOH, NH_4OH, or $(NH_4)_2CO_3$+Aq, especially when freshly precipitated; also in Na_2CO_3, or K_2CO_3+Aq. (Debray.)

Insol. in NH_4OH+Aq containing NH_4Cl+Aq.

Very sl. sol. in Li_2CO_3+Aq. (Gmelin.)

Sol. in H_2SO_4+Aq. (Berthier.)

Sol. in BaO_2H_2+Aq, from which it is pptd. by NH_4 salts, but not by boiling. Sol. in boiling NH_4Cl+Aq when freshly pptd.

Sol. in NH_4F+Aq. (Helmholt, Z. anorg. **3.** 130.)

Solubility of GlO_2H_2 in NaOH+Aq.

G. Na in 20 ccm.	G. Gl. in 20 ccm.
0.3358	0.0358
0.6717	0.0882
0.8725	0.1175
1.7346	0.2847

(Rubenbauer, Z. anorg. 1902, **30.** 334.)

When glucinum hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less glucinum hydroxide according to the concentration. (Rubenbauer.)

Solubility of freshly pptd. GlO_2H_2 in NaOH+Aq at room temperature.

millimols Na per l.	G. GlO dissolved in 1 l.
649	3.6
540	2.92
540	2.53
483	1.69
383	1.64
388	1.53
386	1.45
390	1.24

In the first two cases the values were obtained by adding to $GlCl_2$+Aq at 0°, ice cold NH_4OH and treating the ppt. with NaOH+Aq. In the remaining cases by dissolving basic $GlCO_3$ in HCl and pouring into NaOH+Aq. (Haber, Z. anorg. 1904, **38.** 386.)

Solubility of GlO_2H_2, which is one week old, in NaOH+Aq at t°.

NaOH	t°	G. GlO in 1 l.
½-N	20–23°	0.060
1-N	20–23°	0.170
2-N	20–23°	0.570
½-N	50–53°	0.080
1-N	50–53°	0.230
2-N	50–53°	0.900
½-N	100°	0.080
1-N	100°	0.290
2-N	100°	1.020

(Haber.)

Solubility of GlO_2H_2 in NaOH+Aq at 25°.

G mols.	
Na	Gl.
0.268	0.0330
0.318	0.0492
0.446	0.0841
0.526	0.089
0.563	0.101
0.801	0.143
0.854	0.202

(Wood, Chem. Soc. 1910, **97.** 884.)

Insol. in NH_4OH+Aq and in alkyl amines. (Renz, B. 1903, **36.** 2753.)

Sol. in $GlSO_4$+Aq. (Parsons, J. phys. Chem. 1907, **11.** 658.)

A form insol. in acids and alkalies can be obtained by sufficiently long heating in boiling H_2O, Na_2CO_3+Aq, NH_4OH+Aq, or solutions of NaOH or KOH so dil. that the GlO_2H_2 is either insol. or very sl. sol. therein. (van Oordt, C. C. **1906,** I. 108.)

100 ccm. of glycerine+Aq containing about 60% by vol. of glycerine dissolve 0.1 g. GlO. (Müller, Z. anorg. 1905, **43.** 322.)

Contains $^1/_3H_2O$ (Schaffgotsch); $^4/_3H_2O$ (Atterberg).

Solubility of GlO_2H_2, which has been boiled with alkali, in various solvents.

Alkali used	Time	Solvent	Solubility
10-N NaOH	2½ hrs.	0.106-N NaOH	1 mol. GlO_2H_2 : 331 mole NaOH
		0.39-N NaOH	1 mol. GlO_2H_2 : 183 mole NaOH
		0.97-N NaOH	1 mol. GlO_2H_2 : 91.8 mole NaOH
		2.0-N NaOH	1 mol. GlO_2H_2 : 49 mole NaOH
		2.0-N NaOH	1 mol. GlO_2H_2 : 49 mole NaOH
NaOH	Long time	10-N K_2CO_3	Insol.
NaOH	2 hrs.	Dil. HCl	Sl. sol.
		Hot conc. HCl	Slowly sol.
		Dil. acetic acid	Almost insol.
KOH	Till flocculent ppt. appeared	1-N KOH	Insol.
		1-N NaOH	"
		Warm dil. HCl	Sol.
½-N Na_2CO_3	3 hrs.	1-N NaOH	Easily sol.
		Dil. HCl	"
½-N Na_2CO_3 for then $^1/_{10}$-N Na_2CO_3 for	3 hrs. and 4 hrs.	1-N NaOH	Sl. sol.
		Dil. HCl	Slowly sol.
½-N K_2CO_3	6 hrs.	10-N K_2CO_3	Insol.
10-N K_2CO_3	Short time	1-N NaOH	Easily sol.
		Cold 10-N K_2CO_3	Very slowly sol.
NH_4OH	5 hrs.	½-N NaOH	Very sl. sol.

(Haber.)

Glucinum iodide, GlI_2.

Sol. in H_2O with evolution of much heat. (Wöhler.)

Decomp. in moist air and by H_2O.

Sol. in abs. alcohol. Insol. in most neutral organic solvents, as benzene, toluene, etc. (Lebeau, C. R. 1898, **126.** 1273.)

Insol. in C_6H_6, C_7H_5 and oil of turpentine. Easily sol. in CS_2. Sol. in anhydrous alcohols without evolution of heat. (Lebeau, A. ch. 1899, (7) **16.** 490.)

Glucinum iodide ammonia, $2GlI_2, 3NH_3$.

Ppt. (Lebeau, A. ch. 1899, (7) **16.** 492.)

Glucinum oxide, GlO.

Crystalline. Insol. in acids except conc. H_2SO_4. (Ebelmen, C. R. **32.** 710.)

Amorphous. Absolutely insol. in H_2O. The higher the temp. to which the substance has been heated the more insol. is it in acids. Insol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq. Insol. in conc. NH_4Cl+Aq, or KOH, and NaOH+Aq. (Rose.)

When obtained by ignition of $GlSO_4$, it is very slowly but completely sol. in HCl, and H_2SO_4+Aq. (Rose.)

Insol. in hydracids. Sol. in conc. H_2SO_4. (Lebeau, C. R. 1896, **123.** 819.)

Insol. in liquid NH_3. (Gore, Am. ch. J. 1898, **20.** 828.)

Glucinum peroxide basic, $2GlO_2, 3GlO$. $+8\frac{1}{2}H_2O$. (Komarovski, Chem. Soc. 1913, **104** (2) 707.)

Glucinum oxybromides.

Sol. in H_2O if three or less equivalents of base are present to one of acid; insol. if more of the base is present. (Ordway, Am. J. Sci. (2) **26.** 207.)

Glucinum oxychloride, $Gl_2OCl_2 = GlO, GlCl_2$.

Insol. in H_2O.

$3GlCl_2, 2GlO+2H_2O$ (?). Sol. in H_2O. (Atterberg.)

$GlCl_2, 3GlO+3H_2O$ (?). Sol. in H_2O, but solution soon becomes cloudy and deposits a fine ppt. By boiling the solution it is decomp. into above salt, and $GlCl_2$, $12GlO_2H_2$+$10H_2O$, which is insol. in H_2O; decomp. into GlO_2H_2 by washing. Sol. in acids. (Atterberg.)

Glucinum oxyfluoride, $5GlF_2, 2GlO$.

Readily sol. in H_2O. (Lebeau, C. R. 1898, **126.** 1419.)

Glucinum phosphide.

Decomp. by H_2O. (Wöhler.)

Glucinum selenide.

Sl. sol. in H_2O. (Berzelius.)

Glucinum sulphide.

Slowly sol. without decomp. in H_2O, but easily decomp. by acids. (Wöhler.)

Gold, Au.

Gold which has been pptd. from $AuCl_3$+Aq by $FeSO_4$ is sl. sol. in HCl. (Awerkiew, Z. anorg. 1909, **61.** 10.)

Not attacked by H_2O. Insol. in HNO_3 or HCl+Aq. Easily sol. in aqua regia or any mixture evolving Cl or Br. Sol. in selenic acid, or antimonic acid+Aq; less easily in arsenic acid+Aq. Sol. in mixtures of HCl and nitrates, or HNO_3 and chlorides; also in $(NaCl+KNO_3+K_2Al_2(SO_4)_4)$+Aq (?). Insol in H_2SO_4, except in presence of $KMnO_4$, HNO_3, or HIO_3. Sol. in a solution of I in ether in direct sunlight.

Sol. in solutions of ferric, and cupric salts.

Sol. in HCl+Aq containing H_2CrO_4, H_2MnO_4, H_2SeO_4, H_3AsO_4, or $FeCl_3$. (Wurtz).

Attacked by fuming HCl (sp. gr. 1.178) at ord. temp. in direct light, especially in the presence of a trace of $MnCl_2$, but not attacked in the dark even in the presence of this salt. (Berthelot, C. R. 1904, **138.** 1298.)

100 ccm. hot conc. HCl dissolve 0.008 g. yellow Au powder in 4 hours. (Hanriot and Raoult, C. R. 1912, **155.** 1086.)

Upon boiling 25 and 50 cc. HCl+Aq (sp. gr. 1.178), dil. to 125 cc. with 250 mg. sheet Au 1/8 in. square, 0.009 in. thick, weighing 250 mg. for several hours, there was no loss of weight of Au. (McCaughey, J. Am. Chem. Soc. 1909, **31.** 1263.)

From 5 g. finely divided ordinary yellow gold; 100 cc. HNO_3 of 22° B. dissolve 0.002 g. in 2 hrs.

100 cc. HNO_3 of 32° B. dissolve 0.0119 g. in 2 hrs.

100 cc. HNO_3 of 36° B. dissolve 0.028 g. in 2 hrs.

100 cc. HNO_3 monohydrate dissolve 0.076 g. in 2 hrs. (Hanriot and Raoult, C. R. 1912, **155.** 1085.)

From 5 g. brown gold:

100 ccm. HNO_3 of 22° Baume dissolve 0.006 g. in 2 hrs.

100 ccm. HNO_3 of 32° Baume dissolve 0.039 g. in 2 hrs.

100 ccm. HNO_3 of 36° Baume dissolve 0.078 g. in 2 hrs.

100 ccm. HNO_3 monohydrate dissolve 1.540 g. in 2 hrs. (Hanriot and Raoult.)

Sl. sol. in boiling HNO_3 (sp. gr. = 1.42). The solution deposits Au by standing several days. (Dewey, J. Am. Chem. Soc. 1910, **32.** 320.)

Best composition of aqua regia for dissolving Au is 200 cc. HCl (sp. gr. 1.1946) 45 cc. HNO_3 (sp. gr. 1.4) and 245 cc. H_2O. 1 pt. Au is sol. in 4.3 pts. of such a mixture. (Priwoznik, C. C. **1910,** II. 1743.)

Sol. in 1 pt. HNO_3+4 pts. HCl as representing the most economical mixture. (Priwoznik, Chem. Soc. 1911, **100.** (2), 484.)

Easily sol. in nitrosulphonic acid from sulphuric acid manufacture, when mixed with equal parts conc. HCl+Aq. (Bornträger, Rep. anal. Ch. **1887.** 741.)

Sol. in hot conc. H_2SO_4 in the presence of MnO_2, Mn_2O_3, Mn_3O_4, PbO_2, Pb_2O_3, Pb_3O_4, CrO_3, CrO_4 and Ni_2O_3. Solution also takes place slowly in the cold. Sol. in hot H_2SO_4+$KMnO_4$. Slowly sol. in cold, more rapidly in hot H_2SO_4+HNO_3. (Lenher, J. Am. Chem. Soc. 1904, **26.** 550.)

Sol. in a hot solution of crystalline telluric acid in H_2SO_4 or H_3PO_4.

Sol. in hot H_3PO_4 in the presence of MnO_2, Mn_2O_3, Mn_3O_4, the higher oxides of lead, CrO_3, chromium tetroxide and nickelic oxide. Solution takes place more slowly in the cold. Sol. in hot H_3PO_4 in the presence of $KMnO_4$. Slowly sol. in a cold, more rapidly sol. in a hot mixture of H_3PO_4 and HNO_3.

Sol. in hot arsenic acid in the presence of MnO_2, Mn_2O_3 and Mn_3O_4. (Lenher, J. Am. Chem. Soc. 1904, **26.** 550.)

Gold leaf is not attacked by cold conc. H_2SeO_4, when completely free from halogens, but is dissolved by conc. H_2SeO_4 at 300°. (Lenher, J. Am. Chem. Soc. 1902, **24.** 354.)

Solubility of thin sheet Au in HCl solution of iron alum.

Time, hours	Mg. Au dissolved			
	1 g. Fe 25 cc. HCl	1 g. Fe 50 cc. HCl	2 g. Fe 25 cc. HCl	2 g. Fe 50 cc. HCl
Temp. 38–43°.				
16	1.00	1.30	1.08	1.47
22	1.12	1.55	1.20	1.81
40	1.52	2.15	1.82	2.75
46	1.71	2.34	2.02	2.95
64	1.96	3.10	2.60	3.79
72	2.12	3.30	2.83	4.05
89	2.32	3.65	3.22	4.65
100	2.40	3.76	3.38	4.81
113	2.45	3.95	3.51	5.12
124	2.60	4.09	3.63	5.39
161	2.78	4.36	3.95	5.96
185	2 90	4.49	4.11	6.22
Temp. 98–100°.				
1	1.13	0.78	1.15	1.27
2	1.99	1.74	2.56	2.86
4	3.46	3.31	4.55	5.06
16	10.09	11.37	13.15	15.56
20	12.20	13.72	15.59	19.41
24	14.37	16.49	17.96	23.29
36	17.38	23.27	22.07	31.73
42	18.79	26.30	24.62	35.29
54	20.94	31.39	29.49	42.11
59½	21.64	33.12	30.64	44.43

The solution contained the given amounts of Fe as iron alum, the sp. gr. of the HCl was 1.178, and the solutions diluted to 125 cc. (McCaughey, J. Am. Chem. Soc. 1909, **31.** 1263.)

The solvent action of ferric salt occurs even in presence of a ferrous salt, but decreases with increase of concentration of ferrous salt. (McCaughey.)

Solubility of thin sheet Au in HCl solution of $CuCl_2$.

Time, hours	Mg. Au dissolved			
	1 g. Cu 25 cc. HCl	1 g. Cu 50 cc. HCl	2 g. Cu 25 cc. HCl	2 g. Cu 50 cc. HCl
	Temp. 38–43°.			
19	0.03	0 26	0.05	0 39
25	0.09	0.36	0.05	0.54
43	0.10	0.54	0.14	0.94
49½	0.12	0.61	0.15	1.07
66½	0.11	0.76	0.17	1.40
78	0.14	0.87	0.22	1.58
91	0.14	0.92	0.24	1.75
102	0.16	1.02	0.27	1.90
139	0.18	1.34	0.32	2.45
163	0.23	1.60	0.39	2.84
	Temp. 98–100°.			
1	0.15	0.34	0.17	0.46
4	0.55	1.23	0.55	1.35
16	1.34	5.00	2.12	8 80
20	1.63	6.53	2.78	11.86
26	2.17	9.13	3.59	15.70
38	3.13	13.98	5.07	23.14
43	3.61	16.54	5.77	26.62
48	4.07	19.26	6.26	30.80
60	4.82	26.37	7.47	39.09

Conditions the same as above for HCl+iron alum. (McCaughey.)

Finely powdered gold is sol. in conc HCl in the presence of alcohol, etc.

0.0302 g. Au. is sol. in 100 cc. HCl+100 cc. CH_3OH.

0.0230 g. Au. is sol. in 100 cc. HCl+100 cc. $CHCl_3$.

0.0066 g. Au. is sol. in 100 cc. HCl+100 cc. C_2H_5OH.

0.0190 g. Au. is sol. in 100 cc. HCl+100 cc. $C_5H_{11}OH$.

0.0125 g. Au. is sol. in 100 cc. HCl+50 cc. $CCl_3CH(OH)_2$.

(Awerkiew, C. C. 1908, II. 1566.)

Solubility of Au which has been pptd. from $AuCl_3$+Aq by various precipitants in HCl+formaldehyde.

HCHO (40%) ccm.	HCl (1.19) ccm.	Au dissolved g.	Au used was pptd. from $AuCl_3$+Aq. by
150	150	0.0007	$FeSO_4$
100	100	0.0006	"
125	25	0.0008	"
100	200	0.0009	sugar
150	150	0.0003	oxalic acid
250	250	0.0002	"
500	500	0.0008	$FeSO_4$
100	500	0	oxalic acid
100	200	0.0004	"
100	200	0	"
150	300	0.0006	sugar
250	125	0.001	"
150	75	0.0013	$FeSO_4$
100	200	0.0008	"
100	200	0.0006	HCHO
100	100	0.0005	"
180	540	0	
360	720	0.001	$FeSO_4$
360	720	0.0019	sugar
209	400	0.0013	$FeSO_4$

In the last four cases the solubility was determined at the ordinary temp.; in the first sixteen the gold was boiled with the mixture of HCl and HCHO.

(Awerkiew, Z. anorg. 1909, **61.** 3.)

Solubility of Au in boiling HCl+paraformaldehyde.

$(CH_2O)_3$ g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
5	25	0.0005	$FeSO_4$
5	25	0.0004	oxalic acid
25	125	0.006	sugar
20	400	0.0024	CHOH
20	400	0.0034	CH_3OH
20	400	0.003	"
20	400	0.0065	sugar
20	400	0.0044	formic acid
20	400	0.0005	"
40	400	0.001	CH_3OH
20	300	0.0024	$FeSO_4$
20	300	0.003	"
10	200	0.0008	CH_3OH
10	200	0.0006	oxalic acid
60	120	0.0015	$FeSO_4$

(Awerkiew.)

Solubility of Au in boiling HCl+methyl alcohol.

CH_3OH (99%) ccm.	HCl (1.19) ccm.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
100	100	0.0302	$FeSO_4$
150	150	0.0043	oxalic acid
150	150	0.028	sugar
25	25	0.001	CH_4OH
50	50	0.0002	oxalic acid
50	50	0.0005	CH_3OH
50	50	0.0002	oxalic acid
50	50	0.0015	$FeSO_4$
50	50	0.002	“
100	100	0.0009	oxalic acid
500	500	0.0128	$FeSO_4$
1000	1000	0.0281	“
50	100	0.0084	“
100	200	0.0006	“
100	300	0	“
75	25	0.005	HCOH
90	30	0.005	“
75	25	0.0014	“
80	20	0.0005	“
100	50	0.0018	$FeSO_4$
100	50	0.0008	CH_3OH
50	200	0.001	“

(Awerkiew.)

Solubility of Au in boiling HCl+ethyl alcohol.

C_2H_5OH (95%) ccm.	HCl (1.19) ccm.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
25	50	0.0006	$FeSO_4$
100	200	0.0111	“
200	400	0.0017	“
150	50	0.0003	sugar
100	300	0.0004	“
100	100	0.0015	“
200	200	0.0055	C_2H_2OH
250	250	0.0021	sugar
300	300	0.0197	$FeSO_4$
1000	1000	0.007	CH_3OH
150	150	0.008	“

(Awerkiew.)

Solubility of Au in boiling HCl+amyl alcohol.

$C_5H_{11}OH$ g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
100	100	0.019	$FeSO_4$
100	200	0.0048	“
150	150	0.0024	sugar
100	100	0.0027	“
150	50	0.0032	“
300	100	0.0023	$FeSO_4$
200	200	0.0067	$C_5H_{11}OH$
500	500	0.028	$FeSO_4$

(Awerkiew.)

Solubility of Au in boiling HCl+phenol.

C_6H_5OH g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
10+25	100	0.001	C_6H_5OH
10	40	0.0004	oxalic acid
20	50	0.0003	“
25	100	0.0005	$FeSO_4$
25	150	0	HCOH
50	200	0.0005	“
25	250	0.0005	$FeSO_4$
25	250	0.0012	“

(Awerkiew.)

Solubility of Au in boiling HCl+chloroform.

$CHCl_3$ g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from $AuCl_3$+Aq. by
50	100	0.0009	$FeSO_4$
100	100	0.023	“
100	100	0.0017	“
150	50	0.0012	“
200	400	0.0024	sugar
250	250	0.002	“
300	300	0.0106	“

(Awerkiew.)

Colloidal gold is sol. in dil. alkalies. (Paal, B. 1902, **35.** 2236.)

Rather quickly sol. in 10–15% solution I in KI+Aq.

Very slowly sol. in 5% solution of I in KI+Aq.

Scarcely sol. in more dil. solution of I in KI+Aq.

Easily sol. in 10% NH_4I+I. Less easily sol. in 5% NH_4I+I. (Döring.)

Sol. in cold Na_2S+Aq when Na_2S is present in proportion of 843 pts. Na_2S to 1 pt. Au. (Becker, Sill, Am. J. (3) **33.** 199.)

In finely divided state Au is sol. in boiling KCN+Aq. Not attacked by boiling $HgCl_2$+Aq. (Vogel, J. pr. **20.** 366.)

Solubility of Au (disks) in KCN+Aq with (A) oxygen passed through solution, and (B) agitated with oxygen.

% KCN	g. Au dissolved in 24 hours	
	A	B
1	0.00845	0.0187
5	0.01355	0.0472
20	0.0115	0.0314
50	0.00505	0.108

(Maclaurin, Chem. Soc. 1893, **63.** 729.)

The solution of Au in KCN+Aq is essentially hastened by sunlight. (Caldecott, Proc. Chem. Soc. 1904, **20.** 199.)

The presence of oxygen is necessary for the solution of Au in $KCN+Aq$. The rate of solution of Au in $KCN+Aq$ varies with the strength of the solution, being small for conc. solutions, increasing as the solution becomes more dilute, reaching a maximum at 0.25% KCN, and then again diminishing. (Maclaurin, Chem. Soc. 1895, **67.** 211.)

Solubility of Au (strips) in dil. $KCN+Aq$.

% KCN	Mg. Au dissolved in 24 hours
0	0.010
0.0005	0.043–0.07
0.001	0.10–0.23
0.0016	0.16
0.002	0.44
0.00325	1.77
0.004	4.29
0.008	48.43
0.016	74.96
0.0325	150.54
0.065	168.12

(Christy, Elektrochem. Z. 1901, **7.** 205.)

Finely divided metallic gold is completely sol. at the ord. temp. in solutions of potassium ferrocyanide. Solution takes place very slowly even when the potassium ferrocyanide solution is boiling. (Beutel, Z. anorg. 1912, **78.** 158.)

Sol. in $RbCl_4I+Aq$. (Erdmann, Arch. Pharm. 1894, **232**, 30.)

Not attacked by $FeCl_3+Aq$ when air is excluded but very energetically attacked in presence of HCl and oxygen. (McIlhiney, Am. J. Sci., 1896, (4), **2.** 293.)

Not attacked by several days heating with $SOCl_2$ at 150°. At 200° there is sl. action in 10 days. (North, J. Am. Chem. Soc. 1912, **34.** 892.)

SO_2Cl_2 in excess dissolves pulverulent Au by several hours heating at 160°. (North, Bull. Soc. (4), **9.** 647.)

Sol. in PCl_3. (Baudrimont, A. ch. (4) **2.** 416.)

Easily sol. in acid solutions of thiocarbamide especially in presence of suitable oxidizing compounds. (Moir, Chem. Soc 1906, **89.** 1345.)

Gold arsenide, AuAs.

H_2O or alcohol slowly extracts As; HNO_3+Aq converts into Au and H_3AsO_4. Sol. in aqua regia. Not attacked by cold, decomp. by hot conc. H_2SO_4. (Tivoli, C. C. **1887.** 778; J. B. **1887.** 610.)

Gold bismuthide, Au_2Bi.

Min. *Maldonite.* Sol. in aqua regia.

Aurous bromide, AuBr.

Insol. in H_2O. (Thomsen, C. C. **1860.** 606.)

Insol. in H_2O, HNO_3, H_2SO_4.

Sol. in NH_4OH+Aq. with decomp.

Decomp. by HBr and $KBr+Aq$. **Sol. in** $KCN+Aq$ without decomp. Slowly decomp. by alcohol, ether, acetone and moist $CHCl_3$. (Lengfeld, Am. Ch. J. 1901, **26.** 325.)

Gold (aurcauric) bromide, Au_2Br_4.

Not deliquescent. H_2O or ether dissolves out $AuBr_3$. (Thomsen, C. C. **1860.** 606.)

Does not exist. (Krüss, B. **20.** 640.)

Existence is maintained by Petersen. (J. pr. (2) **46** 334.)

Auric bromide, $AuBr_3$.

Not deliquescent. Slowly sol. in H_2O, more readily in ether.

Can be recryst. from $AsBr_3$, $SbBr_3$, $TiBr_4$ or $SnBr_2$. (Lindet, Bull. Soc. 1886, (2) **45.** 149.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Aurous phosphorus *tri*bromide, AuBr, PBr_3.

Decomp. by H_2O. (Lindet, J. pr. (2) **32.** 494.)

Auric phosphorus *penta*bromide, $AuBr_3$, PBr_5.

Decomp. by H_2O. (Lindet.)

Aurous bromide phosphorus *tri*chloride, AuBr, PCl_3.

Decomp. by H_2O. (Lindet.)

Auric praseodymium bromide, $PrBr_3$, $AuBr_3+10H_2O$.

Very sol. in H_2O; sol. in conc HBr. (Von Schule, Z. anorg. 1898, **18.** 355.)

Aurous bromide ammonia, AuBr, $2NH_3$.

Decomp. by H_2O and dil. HCl.

Sol. in aqua regia. (Meyer, C. R. 1906, **143.** 281.)

Gold carbide, Au_2C_2.

Ppt. Decomp. by boiling H_2O without evolution of C_2H_2. Decomp. by HCl with evolution of C_2H_2. (Mathews, J. Am. Chem. Soc. 1900, **22.** 110.)

Aurous chloride, AuCl.

Insol. in H_2O, but gradually decomp. thereby into Au and $AuCl_3$. (Thomsen, J. pr. (2) **13.** 341.)

Insol. in H_2O and dil. HNO_3.

Decomp. by conc. HNO_3 to Au and $AuCl_3$.

Sol. in HCl, HBr and in sol. of alkali chloride and bromides, with decomp.

Decomp. by alcohol, ether and acetone. (Lengfeld, Am. Ch. J. 1901, **26.** 324.)

Gold (auric) chloride, $AuCl_3$.

Deliquescent. Very sol. in H_2O. Sol. in 1.47 pts. H_2O. (Abl.) Sol. in conc. HCl, or HNO_3+Aq without decomp.

$AsCl_3$ dissolves about 22% at 160° and 2.5% at 15°. Solubility in $SbCl_3$ is about the same. Much less sol. in $SnCl_4$ or $TiCl_4$, $SnCl_4$ dissolving 4% at 160° and hardly a trace at 0°. Very sl. sol. in hot or cold $SiCl_4$. (Lindet, Bull. Soc. (2) **45.** 149.)

Sl. sol. in liquid NH_3. (Franklin and Kraus, Am. Ch. J. 1898, **20.** 829.)

Sol. in alcohol with gradual decomp. (Gmelin.) Sol. in ether with decomp. in light or on long standing. Ether extracts $AuCl_3$ from $AuCl_3$+Aq (Proust). Sol. in volatile oils with gradual decomp.

Sol. in ether. (Mylius, Z. anorg. 1911, **70.** 207.)

Very sol. in ether. (Willstätter, B. 1903, **36.** 1830.)

Completely sol. in ether. (Frank, C. C.. **1913,** II. 541.)

Insol. in or decomp. by alcohol, ether, CS_2, C_6H_6, oil of turpentine, pentane, hexane, $CHCl_3$, CCl_4, ethyl nitrate, nitrobenzol, ethyl acetate, ethyl propionate and pyridine. (Lenher, J. Am. Chem. Soc. 1903, **25.** 1138.)

$+2H_2O$. (Thomsen.)

Auroauric chloride, Au_2Cl_4.

Decomp. by H_2O into $AuCl_3$ and AuCl. (Thomsen, J. pr. (2) **13.** 357.)

Does not exist. (Krüss and Schmidt, J. pr. (2) **38.** 77.)

Existence is maintained by Christensen. (J. pr. (2) **46.** 328.)

Auric chloride *with* **MCl.**

See **Chloraurate, M.**

Auric nitrosyl chloride, $AuCl_3$, NOCl.

Sol. in H_2O with decomp. (Sudborough, Chem. Soc. **59.** 662.)

Aurous phosphorus *tri***chloride,** AuCl, PCl_3.

Decomp. by H_2O. Sol. in about 100 pts. PCl_3 at 15°, and about 8 pts. at 120°. Sol. in $AsCl_3$. (Lindet, C. R. **101.** 1492.)

Auric phosphorus *penta***chloride,** $AuCl_3$, PCl_5.

Decomp. by H_2O. Nearly insol. in PCl_3. Sol. in $AsCl_3$. (Lindet.)

Aurous potassium chloride, AuCl, KCl.

Decomp. by H_2O or HCl+Aq into KCl, $KAuCl_4$, and Au. (Berzelius.)

Auric potassium chloride.

See **Chloraurate, potassium.**

Auric selenium chloride, $AuCl_3$, $SeCl_4$.

Decomp. by H_2O. Sol. in $AsCl_3$. (Lindet, C. R. **101.** 1492.)

Gold (aurous) sodium chloride, AuCl, NaCl.

Insol. in H_2O. Sol. in alcohol. (Meillet, J. Pharm. **3.** 447.)

Formula is 4NaCl, AuCl, $AuCl_3$. (Jörgensen.)

Auric sodium chloride.

See **Chloraurate, sodium.**

Auric sulphur chloride, $AuCl_3$, SCl_4.

Easily decomp. by H_2O. (Lindet, C. R. **101.** 1492.)

Aurous chloride ammonia, AuCl, NH_3.

Ppt. Unstable. (Diemer, J. Am. Chem. Soc. 1913, **35.** 554.)

AuCl, $3NH_3$. Decomp. by H_2O and dil. acids.

Sol. in aqua regia. Sol. in conc. H_2SO_4 with decomp. (Meyer, C. R. 1906, **143.** 282.)

AuCl, $12NH_3$. (Meyer.)

Auric fluoride, AuF_3.

Very unstable.

Is incapable of existence not only in presence of H_2O but under the ordinary conditions met with in the laboratory and in nature. (Lenher, J. Am. Chem. Soc. 1903, **25.** 1138.)

Auric hydroxide, AuO_3H_3.

Nearly insol. in most acids. Easily sol. in very conc. HNO_3+Aq (Proust), from which all AuO_3H_3 is separated by dilution (Fremy). Extremely sl. sol. in fuming HNO_3. Sol. in dil. HNO_3+Aq when pure (Krüss, A. **237.** 281). Not attacked by H_3PO_4. Insol. in HF. Sol. in HCl, or HBr+Aq (Fremy).

Sol. in H_2SeO_4+Aq. (Mitscherlich.)

Sl. sol. in conc. H_2SO_4; somewhat sol. in $HC_2H_3O_2$+Aq. (Rose.)

Nearly insol. in cold KOH+Aq, but dissolved on boiling. Insol. in NH_4OH+Aq or alkali carbonates + Aq (Rose). Sl. sol. in boiling $CaCl_2$+Aq, NaCl+Aq, $BaCl_2$+Aq (Pelletier). Sol. in NH_4CN, and KCN+Aq (Himly).

Sl. sol. in KCl, or NaCl+Aq. (Pelletier.)

Sol. in $K_4Fe(CN)_6$+Aq at ord. temp. rapidly on boiling. (Beutel, Z. anorg. 1912, **78.** 154.)

AuO, OH $= Au_2O_3$, H_2O. (Krüss.)

Auroauric hydroxide, $Au_3O_2(OH)_2 = 3Au_2O_2 + 2H_2O$.

Insol. in boiling conc. KOH+Aq. Decomp. by conc. HCl or HNO_3+Aq into Au and Au_2O_3, which dissolves. (Schöttlander, A. **217.** 336.)

Aurous iodide, AuI.

Insol. in cold, decomp. by hot H_2O, H_2SO_4, HCl, or HNO_3+Aq, with separation of Au. Decomp. immediately by ether, more slowly by alcohol.

Partially sol. in KI, FeI_3, or HI+Aq (Pelletier). Sl. attacked by NH_4OH, or NaCl+Aq at 35° (Fordos). Instantly decomp. by KOH+Aq.

Gold (auric) iodide, AuI_3.

Insol. in H_2O. Sol. in alkali iodides, and HI+Aq. Decomp. on air or by alkalies. (Johnston, Phil. Mag. J. **9.** 266.)

Aurous iodide ammonia, AuI, NH_3.

Decomp. by H_2O or dil. acids. (Meyer, C. R. 1906, **143.** 281.)

Sol. in aqua regia.

AuI, $6NH_3$. (Meyer.)

Aurous oxide, Au_2O.

Insol. in H_2O or alcohol. Decomp. by boiling with HCl+Aq into Au and $AuCl_3$. H_2SO_4, HNO_3, or $HC_2H_3O_2$+Aq do not attack. Sol. in cold aqua regia. Sol. in HI +Aq. Sol. in KOH, or NaOH+Aq when freshly precipitated. (Berzelius.)

According to Krüss (A. **237.** 281) all hitherto prepared Au_2O is impure. Pure Au_2O is sol. in cold H_2O when freshly precipitated, from which hydroxide is precipitated by boiling. Partly sol. in HCl, or HBr+Aq. Sol. in KOH, or NaOH+Aq when freshly precipitated. Not affected by any other acid or solvent. (Krüss.)

The so-called solution of Au_2O in H_2O is in reality a coloidal suspension. (Vanino, B. 1905, **38.** 462.)

Auric oxide, Au_2O_3.

See **Auric hydroxide.**

Auroauric oxide, Au_2O_2.

Sol. in cold HCl+Aq; forms insol. comp. with HF. (Prat, C. R. **70.** 842.)

Obtained pure by Krüss (A. **237.** 296.)

Gold phosphide, Au_4P_6.

Not attacked by HCl+Aq. HNO_3 forms H_3PO_4 and leaves undissolved Au. (Schrötter, J. B. **1849.** 247.)

AuP. Decomp. on air or with H_2O. (Cavazzi, Gazz. ch. it. **15.** 40.)

Au_3P_4. Readily attacked by aqua regia or Cl_2+Aq. (Granger, C. R. 1897, **124.** 498.)

Gold purple (mixture of Au and SnO_2).

Insol. in H_2O. Easily sol. in aqua regia.

HCl+Aq dissolves all Sn and leaves Au.

Boiling HNO_3+Aq dissolves a little Sn.

Insol. in boiling KOH+Aq (Berzelius). KOH+Aq extracts excess of SnO_2, and the residue becomes sol. in H_2O, from which it is pptd. by NH_4Cl+Aq. (Figuier, A. ch. (3) **11.** 353.)

Sol., when still moist, in NH_4OH+Aq, but insol. if it has been dried.

Obtained in colloidal state in aqueous solution containing 0.58 g. Au. and 5.41 g. SnO_2 in a litre. This solution may be concentrated without coagulation. The solution is coagulated by dil. HNO_3, or HCl+Aq, more easily by dil. H_2SO_4+Aq; also by KCl, $HgCl_2$, $FeSO_4$+Aq, and many other salts. Not coagulated by alcohol, but easily when ether is added to the alcohol. (Schneider, Z. anorg. **5.** 80.)

Gold (auric) selenide, Au_2Se_3.

HNO_3+Aq dissolves out Se. Sol. in aqua regia or alkali sulphides + Aq. (Uelsmann, J. B. **1860.** 90.)

Aurous sulphide, Au_2S.

Easily sol. in H_2O when freshly prepared, but precipitated from aqueous solution by HCl, KCl, or NaCl+Aq. When dried is insol. in H_2O.

Insol. in boiling dil. or conc. HCl, or H_2SO_4 +Aq. Easily sol. in aqua regia, HCl+Aq with $KClO_3$, etc. Slowly sol. in alkali monosulphides+Aq. Easily sol. in polysulphides +Aq.

Insol. in KOH+Aq. Sol. in KCN+Aq. (Krüss, B. **20.** 2369.)

Known also in colloidal state in aqueous solution containing 1.74 g. Au_2S per l. (Schneider, B. **24.** 2241.)

Auric sulphide, Au_2S_3.

Insol. in H_2O and acids except aqua regia; sol. in alkali sulphides, or KOH+Aq. (Berzelius.)

Does not exist (Krüss, B. **22.** 2369), but has since been made by Antony and Luchesi (Gazz. ch. it. **20.** 601). Insol. in HCl, or dil. HNO_3+Aq. Decomp. by conc. HNO_3, KOH, or NaOH +Aq with separation of Au. Sl. decomp. by NH_4OH+Aq. Easily sol. in KCN+Aq; decomp. by $(NH_4)_2S$+Aq. Sol. in cold Na_2S or K_2S+Aq; decomp. on boiling. (Antony and Luchesi, Gazz. ch. it. **21, 2.** 209.)

Insol. in ether. (Hofmann, B. 1904, **37.** 246.)

Auroauric sulphide, Au_2S_2.

Insol. in H_2O or acids except aqua regia. Sl. sol. in cold alkali monosulphides + Aq, but easily sol. on warming. Sol. in cold polysulphides + Aq, but less in ammonium polysulphide than the other alkali polysulphides.

Not attacked by cold, but easily sol. in hot KOH+Aq. Sol. in KCN+Aq. (Hoffmann and Krüss, B. **20.** 2704.)

Obtained also in colloidal state in aqueous solution containing 0.8 g. per l. (Schneider.)

Insol. in Na_2S+Aq. sat. with S. (Ditte, A. ch. 1907, (8) **12.** 273.)

Aurous potassium sulphide, Au_2S, $3K_2S$.

(Antony and Lucchesi, Gazz. ch. it. 1896, **26.** (2) 350.)

Au_2S, $4K_2S+12H_2O$. Very sol. in H_2O. (Ditte, C. R. 1895, **120.** 322.)

Gold silver sulphide, Ag_3AuS_2.

Ppt. (Lucchesi, Gazz. ch. it. 1896, **26.** 350–53.)

Aurous sodium sulphide, $NaAuS+4H_2O$.

Sol. in H_2O and alcohol. (Yorke, Chem. Soc. Q. J. **1.** 236.)

$+5H_2O$. Sol. in H_2O. (Ditte, C. R. 1895, **120.** 321.)

Na_3AuS_2. Sol. in H_2O. (Lucchesi, Gazz. ch. it. 1896, **26.** 350–53.)

Au_2S, $2Na_2S+20H_2O$. Very sol. in H_2O. (Ditte, C. R. 1895, **120.** 321.)

Gold telluride.

Ppt. (Berzelius, Pogg. **8.** 178.)

Gold silver telluride, Au_2Te_2, Ag_2Te.

Min. *Sylvanite.* Sol. in HNO_3+Aq with separation of Au, in aqua regia with separation of AgCl.

$3Ag_2Te$, Au_2Te. Min. *Petzite.*

Hartshorn, salts of.

See **Carbonate carbamate, ammonium hydrogen.**

Helium, He.

Coefficient of absorption for H_2O at $18.2° = 0.0073$. (Ramsay, Z. phys. Ch. 1906, **55.** 347.)

Absorption of helium by H_2O at t° and 760 mm. pressure.

t°	Coefficient of absorption
0	0.01500
0.5	0.01487
5	0.01460
10	0.01442
15	0.01396
20	0.01386
25	0.01371
30	0.01382
35	0.01380
40	0.01387
45	0.01403
50	0.01404

(Estreicher, Z. phys. Ch. 1899, **31.** 184.)

Absorption by H_2O at t°.

t°	Coefficient of absorption
0	0.0134
10	0.0100
20	0.0138
30	0.0161
40	0.0191
50	0.0226

(Antropoff, Roy. Soc. Proc. 1910, **83.** A 480.)

Completely insol. in benzene and in alcohol. (Ramsay, Chem. Soc. 1895, **67.** 684.)

Hexamine chromium compounds.

See **Luteochromium compounds.**

Hexamine cobaltic compounds, $Co_2(NH_3)_6X_6$.

See **Dichrocobaltic compounds.**

$Co(NH_3)_6X_3$.

See **Luteocobaltic compounds.**

Hexamine iridium chloride, $Ir_2(NH_3)_6Cl_6$.

See **Irido*tri*amine chloride.**

Hexathionic acid, $H_2S_6O_6$.

Known only in aqueous solution, which decomposes rapidly, even in presence of free sulphuric acid. (Debus, A. **244.** 76.)

Potassium hexathionate, $K_2S_6O_4$.

Sol. in H_2O, with rapid decomp. Not obtained in pure state. (Debus, A. **244.** 76.)

Holmium, Ho.

Holmium oxide, Ho_2O_3.

(Cleve, C. R. **89.** 478; **91.** 328.)

Consists of at least two elements. (Lecoq de Boisbaudran, C. R. **102.** 1005.)

Consists of seven elements. (Krüss and Nilson.).

*Sesqui***hydraurylamine,** $(AuOH)_3N$, $NH_3 = Au_3N_2+3H_2O$.

Decomp. by boiling with H_2O. (Raschig, A. **235.** 341.)

Hydrazidophosphoric acid.

Barium hydrazidophosphate, $OP(N_2H_3)O_2Ba$.

(Ephraim, B. 1911, **44.** 3420.)

Lead hydrazidophosphate, $OP(N_2H_3)O_2Pb$.

Easily sol. in HNO_3. (Ephraim.)

Potassium hydrazidophosphate, $OP(N_2H_3)(OK)_2$. (Ephraim.)

Sodium hydrazidophosphate, $OP(N_2H_3)(ONa)_2$.

Can be cryst. from dil. alcohol. (Ephraim.)

Hydrazine, $N_2H_4 = NH_2—NH_2$.

Very sol. in H_2O. (Curtius, B. **20.** 1632.)

Very hydroscopic; decomp. by H_2O; solvent for sulphur, KCl, KBr, KNO_3. (de Bruyn, R. t. c. 1894, **13.** 433–40; Chem. Soc. 1895, **68** (2) 347.)

Mixes in all proportions with alcohols; sl. sol. in organic solvents. (Lobry de Bruyn, Chem. Soc. 1897, **72** (2) 22.)

Hydrazine amidosulphonate, N_2H_4, HSO_3, NH_2.

Very sol. in H_2O. (Sabanejeff, Z. anorg. 1899, **20.** 22.)

Hydrazine azoimide, N_2H_4, HN_3.

Deliquescent. Easily sol. in H_2O. Sl. sol. in alcohol, and can be crystallised therefrom. (Curtius, B. **24.** 2344.)

Hydrazine borate, $(N_2H_4)_2(B_2O_3)_6$.

Sol. in H_2O. (Dschawachow, C. C. **1902,** I. 1394.)

$(N_2H_4)_2(H_2B_4O_7)_3$. Sol. in H_2O. (Dschawachow, C. C. **1902,** I. 1394.)

$+5H_2O$. Sol. in H_2O. (Dschawachow, C. C. **1902.** I. 1394.)

$+10H_2O$. Ppt. (Dschawachow, C. C. **1902.** I. 1394.)

Hydrazine cuprous bromide chloride, N_2H_5Cl, N_2H_5 Br, 3CuBr.

(Ranfaldi, Real Ac. Linc. 1906 (5) **15,** II, 95.)

Hydrazine mercuric bromide, $HgBr_2$, 2 (N_2H_4, HBr)$+H_2O$.

Very sol. in H_2O, sol. in alcohol and acetone. Sl. sol. in acetic ether.

Insol. in ethyl ether. (Ferratini, C. A. **1912.** 1612.)

Hydrazine zinc bromide, $2N_2H_4HBr$, $ZnBr_2$ $+H_2O$.

Very sol. in H_2O; sol. in alcohol and acetone. (Ferratini, C. A. **1912.** 1612.)

Hydrazine carbonate.

Very deliquescent, but only sl. sol. in H_2O. Sl. sol. in alcohol. (Curtius and Jay, J. pr. 1889, (2) **39.** 41.)

Hydrazine zinc carbonate hydrazine, $Zn(CO_2, NH, NH_2)_2$, $2N_2H_4$.

Easily sol. in H_2O. (Ebler and Schott, J. pr. 1909, (2) **79,** 72.)

Hydrazine chlorate, N_2H_4, $HClO_3$.

Very sol. in H_2O; sl. sol. in alcohol. Insol. in ether, $CHCl_3$ and benzol. (Salvadori, Gazz. ch. it. 1907, **37,** (2) 32.)

Hydrazine ***di*****chlorate,** N_2H_4, $2HClO_3$.

Ppt. Decomp. in aq. solution. (Turrentine, J. Am. Chem. Soc. 1915, **37.** 1123.)

Hydrazine cupric chloride, N_2H_5Cl, $CuCl_2+\frac{1}{2}H_2O$.

Decomp. by H_2O. (Ranfaldi, Real. Ac. Linc. 1906, (5) **15,** II. 95.)

$+2H_2O$. Decomp. by H_2O. (Ranfaldi.)

Hydrazine mercuric chloride, N_2H_5Cl, $HgCl_2$.

(Hoffmann and Marburg, A. 1899, **305.** 221.)

Hydrazine dithionate, N_2H_4, $H_2S_2O_6$.

Sol. in H_2O; decomp. on standing in aq. solution. (Sabanejeff, Z. anorg. 1899, **20.** 21.)

$2N_2H_4$, $H_2S_2O_6$. Sol. in H_2O. (Sabanejeff.)

Hydrazine fluosilicate, N_2H_4, H_2SiF_6.

Easily sol. in H_2O.

Difficultly sol. in ethyl and methyl alcohol. (Ebler, J. pr. 1910, (2) **81.** 552.)

Hydrazine fluotitanate, $(N_2H_4)_2$, $H_2TiF_6+2H_2O$.

Ppt. Sol. in H_2O. (Ebler, J. pr. 1910, (2) **81.** 555.)

Hydrazine ***mono*****hydrobromide,** N_2H_4, HBr.

Very easily sol. in H_2O or hot alcohol. (Curtius and Schultz, J. pr. (2) **42.** 537.)

Hydrazine ***di*****hydrobromide,** N_2H_4, 2HBr.

Easily sol. in H_2O. Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 535.)

Hydrazine ***mono*****hydrochloride,** N_2H_4, HCl.

Extremely sol. in H_2O. Sl. sol. in boiling absolute alcohol. (Curtius and Jay, J. pr. (2) **39.** 38.)

Hydrazine ***di*****hydrochloride,** N_2H_4, 2HCl.

Easily sol. in cold H_2O; sl. sol. in hot alcohol. (Curtius, *l. c.*)

Sol. in 2.67 pts. H_2O at 23°. Sp. gr. of sat. solution at 20°/4° = 1.4226. (Schiff, Z. phys. Ch. 1896, **21.** 292.)

Sp. gr. of aqueous solution at 20°.

% salt	Sp. gr.
25	1.1183
20	1.0923
15	1.0675
10	1.0436
5	1.0206

(Schiff, Z. phys. Ch. 1896, **21.** 292.)

Nearly insol. in hot absolute alcohol. (Curtius and Jay, J. pr. (2) **39.** 37.)

Hydrazine ***di*****hydrofluoride,** N_2H_4, 2HF.

Easily sol. in H_2O. Nearly insol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 533.)

Hydrazine ***mono*****hydroiodide,** N_2H_4, HI.

Easily sol. in H_2O. (Curtius and Schulz.)

Hydrazine ***di*****hydroiodide,** N_2H_4, 2HI.

Very deliquescent. Easily sol. in H_2O. Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) **42.** 536.)

Trihydrazine dihydroiodide, $3N_2H_4, 2HI$.

Easily sol. in H_2O and alcohol. (Curtius and Schulz, J. pr. (2) **42.** 540.)

Hydrazine hydroxide, N_2H_4, H_2O.

Miscible with H_2O or alcohol, but not with ether, chloroform, or benzene. (Curtius and Schulz, J. pr. (2) **42.** 530.)

Hydrazine hypophosphate, $N_2H_4, H_4P_2O_6$.

Sl. sol. in H_2O. 1.5 pts. dissolve in 100 pts. H_2O. (Sabanejeff, Z. anorg. 1898, **17.** 490.)

Hydrazine hypophosphate ammonia, $N_2H_4, H_4P_2O_6, NH_3$.

Sol. in H_2O. (Sabanejeff, Z. anorg. 1899, **20.** 23.)

Hydrazine mercuric iodide, $2N_2H_5I, HgI_2+H_2O$.

Very sol. in H_2O, alcohol, acetone, acetic ether.

Insol. in ether. Excess of H_2O decomp. (Ferratini, Gazz. ch. it. 1912, **42.** (1), 172.)

Hydrazine zinc iodide, $ZnI_2, 2N_2H_4, HI+\frac{1}{2}H_2O$.

Very sol. in H_2O; sol. in alcohol and acetone. (Ferratini, C. A. **1912.** 1612.)

Hydrazine nitrate, N_2H_4, HNO_3.

Very sol. in H_2O; sl. sol. in abs. alcohol. (Sabanejeff, Z. anorg. 1899, **20.** 24.)

Solubility in H_2O at t°.

t°	g. N_2H_4, HNO_3 per 100 g. Sat. solution	g. N_2H_4, HNO_3 per 100 g. H_2O
10	63.63	174.9
15	68.47	217.2
20	72.70	266.3
25	76.61	327.5
30	80.09	402.2
35	83.06	490.3
40	85.86	607.2
45	88.06	737.6
50	91.18	1034.
55	93.58	1458.
60	95.51	2127.

(Sommer, Z. anorg. 1914, **86.** 85.)

$N_2H_4, 2HNO_3$. Very unstable.

Sol. in H_2O but solution cannot be concentrated beyond 30% without decomp.

Decomp. by abs. alcohol.

Very sol. in hydrazine hydroxide+Aq. (Sabanejeff, Z. anorg. 1898, **20.** 25.)

Hydrazine nitrite, N_2H_4, HNO_2.

Very sol. in H_2O. Pptd. by ether from solution in alcohol; insol. in ether.

Very hydroscopic. (Sommer, Z. anorg. 1913, **83.** 125.)

Hydrazine perchlorate, $N_2H_4, HClO_4+2H_2O$.

Sol. in 1.48 pts. H_2O at 30° and 34 pts. alcohol; crystallizes from boiling absolute alcohol. (Salvadori, Ch. Z. **31.** 680.)

$+3H_2O$.

Solubility in H_2O at t°.

t°	% $N_2H_4, HClO_4$	Sp. gr.
18	41.72	1.264
35	66.9	1.391

(Carlson, Dissert. **1910.**)

Hydrazine *di*perchlorate, $N_2H_4, 2HClO_4+2H_2O$.

Efflorescent.

Deliquescent.

102 pts. salt sol. in 100 pts. H_2O at 29°.

2.8 pts. salt sol. in 100 pts. alcohol.

1.0 pt. " " " 100 " ether.

(Turrentine, J. Am. Chem. Soc. 1915, **37.** 1123.)

Hydrazine phosphate, N_2H_4, H_3PO_4.

Very sol. in H_2O. (Sabanejeff, Z. anorg. 1898, **17.** 488.)

$N_2H_4, 2H_3PO_4$. Sol. in H_2O. (Sabanejeff.)

Hydrazine phosphite, N_2H_4, H_3PO_3.

Sol. in H_2O. (Sabanejeff, Z. anorg. 1898, **17.** 468.)

Hydrazine hydrogen phosphite, $N_2H_4, 2H_3PO_3$.

Less sol. in H_2O than the normal salt. (Sabanejeff.)

Hydrazine selenate, N_2H_4, H_2SeO_4.

Sol. in H_2O with decomp. (Rimini, C. C. **1907,** I. 86.)

Hydrazine zinc selenate, $(N_2H_5)_2SeO_4, ZnSeO_4$.

Sl. sol. in H_2O but more sol. than Cu salt. (Rimini and Malagnini, Gazz. ch. it. **1907, 37.** (1), 265.)

Hydrazine sulphocyanide, $N_2H_4, HSCN$.

Very deliquescent. Sol. in H_2O and alcohol. (Curtius and Herdenreich, J. pr. 1895, [2] **52.** 488.)

Hydrazine sulphate, N_2H_4, H_2SO_4.

Sol. with difficulty in cold, easily in hot H_2O. Insol. in alcohol. (Curtius, *l. c.*)

100 pts. H_2O dissolve 3.055 pts. salt at 22°. (Curtius and Jay, J. pr. (2) **39.** 39.)

$2N_2H_4, H_2SO_4$. Very deliquescent, and

sol. in H_2O. Insol. in alcohol. (Curtius, J. pr. (2) **44.** 101.)

Hydrazine sulphite, $(N_2H_4)_2H_2SO_3$.
(Sabanejeff, Z. anorg. 1899, **20,** 24.)

Hydrazine *pyro***sulphite,** $2N_2H_4$, $H_2S_2O_5$.
Sol. in H_2O with decomp.; insol. in alcohol. (Sabanejeff, Z. anorg. 1899, **20.** 23.)

Hydrazine thiosulphate, $(N_2H_4)_2$ $H_2S_2O_3$.
Ppt. (Not pure.) (Ferratini, Gazz. ch. it. 1912, **42.** (1) 138.)

Hydrazine lead thiosulphate,
PbS_2O_3, $2(N_2H_4)_2H_2S_2O_3+H_2O$.
Insol. in H_2O and alcohol.
Sol. in HCl+Aq and in HNO_3+Aq. (Ferratini, C. A. **1912.** 1612.)

Hydrazine silver thiosulphate,
$Ag_2S_2O_3$, $(N_2H_4)_2H_2S_2O_3$.
Insol. in H_2O; sol. in NH_4OH+Aq and in HNO_3. (Ferratini.)

Hydrazine sulphinic acid.

Barium hydrazine *di***sulphinate,**
$Ba_2N_2(SO_2)_2$.
Insol. in H_2O; sol. in acids. (Ephraim, B. 1911, **44.** 390.)

Hydrazinesulphonic acid, $N_2H_3SO_2OH$.
Sol. in about 24 pts. H_2O at ord. temp. Decomp. by mineral acids; nearly insol. in alcohol and other organic solvents. (Traube, B. 1914, **47.** 941.)

Ammonium hydrazinesulphonate,
$(N_2H_3SO_3)NH_4$.
Deliquescent; decomp. by acids. (Traube.)

Barium hydrazinesulphonate,
$(N_2H_3SO_3)_2Ba+2H_2O$.
Sol. in H_2O; pptd. by alcohol; decomp. by acids. (Traube.)

Calcium hydrazinesulphonate,
$(N_2H_3SO_3)_2Ca+H_2O$.
Sol. in H_2O. Decomp. by acids. Insol. in alcohol. (Traube.)

Potassium hydrazinesulphonate, $N_2H_3SO_3K$.
Decomp. by acids. (Traube.)

Silver hydrazinesulphonate, $N_2H_3SO_3Ag$.
(Traube.)

Sodium hydrazinesulphonate,
$N_2H_3SO_3Na+H_2O$.
Decomp. by acids. (Traube.)

Strontium hydrazinesulphonate,
$(N_2H_3SO_3)_2Sr+2H_2O$.
Sol. in H_2O. Decomp. by acids. Insol. in alcohol. (Traube.)

Hydriodic acid, HI.
See **Iodhydric acid.**

Hydrobromic acid, HBr.
See **Bromhydric acid.**

Hydrochloric acid, HCl.
See **Chlorhydric acid.**

Hydrofluorboric acid, HBF_4.
See **Fluoborhydric acid.**

Hydrofluoric acid, HF.
See **Fluorhydric acid.**

Hydrogen, H_2.

Sl. absorbed by H_2O.

Sol. in 150 pts. H_2O; 1 vol. H_2O absorbs 0.016 vol. H. Recently boiled H_2O absorbs 1.53% H. (Henry, **1803.**)
100 vols. H_2O at 18° absorb 4.6 vols. H. (de Saussure, **1814.**)

1 vol. H_2O absorbs 0.0193 vol. H at 760 mm. and all temperatures between 0° and 23.6°. (Bunsen.)

Later work does not confirm the above statement.

Absorption of H by H_2O at t° and 760 mm. β=coefficient of absorption; β_1="solubility" (see under Oxygen).

t°	β	β_1
0	0.02153	0.02140
1	0.02134	0.02120
2	0.02115	0.02100
3	0.02097	0.02081
4	0.02079	0.02062
5	0.02061	0.02043
6	0.02044	0.02025
7	0.02027	0.02207
8	0.02010	0.01989
9	0.01994	0.01971
10	0.01978	0.01954
11	0.01962	0.01937
12	0.01947	0.01920
13	0.01932	0.01904
14	0.01918	0.01888
15	0.01903	0.01872
16	0.01889	0.01856
17	0.01876	0.01840
18	0.01863	0.01825
19	0.01850	0.01810
20	0.01837	0.01795
21	0.01825	0.01781
22	0.01813	0.01767
23	0.01802	0.01753
24	0.01791	0.01739
25	0.01780	0.01725
26	0.01770	0.01712

(Timofejeff, Z. phys. Ch. **6.** 147.)

Absorption of H by H_2O at t° and 760 mm.
β = coefficient of absorption.

t°	β	t°	β	t°	β
0	0.0203	16	0.0182	32	0.0161
1	0.0202	17	0.0180	33	0.0160
2	0.0200	18	0.0179	34	0.0159
3	0.0199	19	0.0178	35	0.0157
4	0.0198	20	0.0177	36	0.0156
5	0.0196	21	0.0175	37	0.0155
6	0.0195	22	0.0174	38	0.0154
7	0.0194	23	0.0172	39	0.0153
8	0.0192	24	0.0171	40	0.0152
9	0.0191	25	0.0170	45	0.0149
10	0.0190	26	0.0168	50	0.0146
11	0.0189	27	0.0167	60	0.0144
12	0.0187	28	0.0166	70	0.0146
13	0.0186	29	0.0164	80	0.0149
14	0.0184	30	0.0163	90	0.0155
15	0.0183	31	0.0162	100	0.0166

(Bohr and Bock, W. Ann. **44.** 318.)

Absorption of hydrogen by H_2O at t° and 760 mm. pressure. β = coefficient of absorption. β_1 = "solubility" (see under Oxygen).

t°	β	β_1
0	0.02148	0.02135
1	0.02126	0.02112
2	0.02105	0.02090
3	0.02084	0.02068
4	0.02064	0.02047
5	0.02044	0.02026
6	0.02025	0.02006
7	0.02007	0.01987
8	0.01989	0.01968
9	0.01972	0.01950
10	0.01955	0.01932
11	0.01940	0.01915
12	0.01925	0.01899
13	0.01911	0.01883
14	0.01897	0.01867
15	0.01883	0.01851
16	0.01869	0.01836
17	0.01856	0.01821
18	0.01844	0.01706
19	0.01831	0.01792
20	0.01819	0.01777
21	0.01805	0.01761
22	0.01792	0.01746
23	0.01779	0.01730
24	0.01766	0.01715
25	0.01754	0.01700
26	0.01742	0.01685
27	0.01731	0.01670
28	0.01720	0.01656
29	0.01709	0.01642
30	0.01699	0.01630
31	0.01692	0.01618
32	0.01685	0.01606
33	0.01679	0.01596
34	0.01672	0.01585
35	0.01666	0.01574

Absorption of hydrogen by H_2O at t° and 760 mm. pressure.—*Continued.*

t°	β	β_1
36	0.01661	0.01564
37	0.01657	0.01554
38	0.01652	0.01544
39	0.01648	0.01535
40	0.01644	0.01525
41	0.01640	0.01515
42	0.01635	0.01504
43	0.01631	0.01493
44	0.01627	0.01482
45	0.01624	0.01475
46	0.01620	0.01460
47	0.01617	0.01449
48	0.01614	0.01437
49	0.01611	0.01425
50	0.01608	0.01413
52	0.01606	0.01392
54	0.01605	0.01369
56	0.01603	0.01343
58	0.01602	0.01316
60	0.01600	0.01287
62	0.01600	0.01256
64	0.01600	0.01223
66	0.01600	0.01188
68	0.01600	0.01150
70	0.01600	0.01109
72	0.01600	0.01065
74	0.01660	0.01017
76	0.01600	0.00966
78	0.01600	0.00912
80	0.01600	0.00853
82	0.01600	0.00790
84	0.01600	0.00723
86	0.01600	0.00652
88	0.01600	0.00575
90	0.01600	0.00494
92	0.01600	0.00407
94	0.01600	0.00315
96	0.01600	0.00216
98	0.01600	0.00111
100	0.01600	0.0000

(Winkler, B. **24.** 99.)

Critical t,—232°. (Natanson, Z. phys. Ch. 1895, **17.** 43–48.)

Coefficient of absorption for H_2O = 0.01750 at 25°; 0.01905 at 20°; 0.02059 at 15°; 0.02213 at 10°; 0.02366 at 5°. (Braun, Z. phys. Ch. 1900, **33.** 734.)

Solubility in H_2O at 25° = 0.01926. (Geffcken, Z. phys. Ch. 1904, **49.** 267.)

Coefficient of absorption for H_2O = 0.01810 at 20.11.° (Hüfner, Z. phys. Ch. 1907, **57.** 623.)

Solubility in H_2O at 25° = 0.01962. (Drucker and Moles, Z. phys. Ch. 1910, **75.** 417.)

Coefficient of absorption for H_2O at 15° = 0.01892; at 20° = 0.01829. (Müller, Z. phys. Ch. 1912, **81.** 493.)

Solubility of hydrogen in water at 25°.
S = Solubility calculated according to formula, for which see original article.
P = Pressure.

P	S	P	S
756	0.0199	1095	0.0195
757	0.0198	1097	0.0197
850	0.0200	1244	0.0202
877	0.0193	1252	0.0196
986	0.0194	1380	0.0196
992	0.0198	1393	0.0198

(Findlay, Chem. Soc. 1912, **101.** 1465.)

Absorption by H_2O at different pressures.
P = Hg-pressure in metres.
λ = coefficient of solubility.
Table I. Volume of the absorbing liquid = 32.32 ccm. T = 19.5°.

P	λ	P	λ
0.9010	0.01798	3.3926	0.01789
0.9967	0.01796	4.1405	0.01776
1.0809	0.01799	4.6629	0.01761
1.2133	0.01800	5.4705	0.01748
1.3711	0.01794	5.9580	0.01725
1.5448	0.01791	6.6507	0.01706
1.8002	0.01793	7.4548	0.01674
2.5208	0.01793	7.8783	0.01652
2.9971	0.01795	8.2439	0.01632

Table II. Volume of the absorbing liquid = 32.007 ccm. T = 23°.

P	λ	P	λ
1.1154	0.01736	4.6220	0.01716
1.3758	0.01739	5.1130	0.01702
1.7416	0.01733	5.9702	0.01687
2.1712	0.01731	7.1920	0.01649
2.8724	0.01734	7.4493	0.01631
3.4115	0.01732	7.8696	0.01618
4.0229	0.01728	8.1913	0.01603

(Cassuto, Phys. Zeit. 1904, **5.** 235.)

Absorption of H_2 by acids+Aq.
M = content in gram-equivalents per liter.
S = solubility. (See under Oxygen.)
Absorption of H_2 by HNO_3+Aq.

M	S 25°
0.741	0.01851
0.753	0.01868
1.22	0.01812
1.45	0.01782
2.09	0.01739
2.96	0.01690
3.18	0.01667
3.22	0.01633
4.13	0.01611
4.23	0.01589

(Geffcken, Z. phys. Ch. 1904, **49.** 267.)

Absorption of H_2 by HCl+Aq.

M	S 25°
0.426	0.01875
0.432	0.01868
1.063	0.01789
1.302	0.01732
1.802	0.01699
1.928	0.01688
2.338	0.01652
2.438	0.01627
2.836	0.01606

(Geffcken.)

Absorption of H_2 by $\frac{H_2SO_4}{2}$+Aq.

M	S 25°
0.527	0.01869
0.562	0.01838
0.985	0.01780
1.122	0.01768
1.866	0.01642
1.905	0.01632
2.605	0.01575
3.045	0.01496
3.174	0.01456
3.962	0.01422
3.989	0.01402

(Geffcken.)

Solubility of H_2 in H_2SO_4+Aq at 20°.

% H_2SO_4	λ 20°
0	0.0208
35.82	0.00954
61.62	0.00708
95.6	0.01097

(Christoff, Z. phys. Ch. 1906, **55.** 627.)

Solubility of H_2 in colloidal ferric hydroxide solution is practically the same as its solubility in pure H_2O.

Solubility of H_2 in a solution containing 18.11 g. $Fe(OH)_3$ per liter at 25° = 0.3085.

Solubility of H_2 in a solution containing 18.309 g. Fe $(OH)_3$ per liter at 25° = 0.3083.

(Geffcken, Z. phys. Ch. 1904, **49.** 299.)

Absorption of H_2 by bases+Aq.
M = content in gram-equivalents per liter.
S = solubility. (See under Oxygen.)
Absorption of H_2 by KOH+Aq.

M	S 25°
0.536	0.01658
0.715	0.01539
1.059	0.01378
1.056	0.01389
1.480	0.01195

(Geffcken, Z. phys. Ch. 1904, **49.** 267.)

Absorption of H_2 by NaOH+Aq.

M	S 25°
0.543	0.01632
0.571	0.01608
0.692	0.01442
0.974	0.01409
1.059	0.01372
1.137	0.01348
1.850	0.01018
3.400	0.00648
3.430	0.00639
4.687	0.00483

(Geffcken.)

Solubility of H_2 in salts+Aq at 15°.

Salt	% Salt	Coefficient of absorption
H_2O	0.00	0.01883
$CaCl_2$	3.47	0.01619
	6.10	0.01450
	11.33	0.01138
	17.52	0.00839
	26.34	0.00519
$MgSO_4$	4.94	0.01501
	10.19	0.01159
	23.76	0.00499
LiCl	3.48	0.01619
	7.34	0.01370
	14.63	0.0099
K_2CO_3	2.82	0.01628
	8.83	0.01183
	16.47	0.00761
	24.13	0.00462
	41.81	0.00160
KCl	3.83	0.01667
	7.48	0.01489
	12.13	0.01279
	19.21	0.01012
	22.92	0.00892
KNO_3	4.73	0.01683
	8.44	0.01559
	16.59	0.01311
	21.46	0.01180
$NaNO_3$	5.57	0.01603
	11.16	0.01370
	19.77	0.01052
	37.43	0.00578
Na_2CO_3	2.15	0.01639
	8.64	0.01385
	11.53	0.00839
Na_2SO_4	4.58	0.01519
	8.42	0.0154
	16.69	0.00775

(Gordon, Z. phys. Ch. 1895, **18.** 14.)

Absorption by salts+Aq.

Salt	$t_1°$	Sp. gr. salt + Aq. at $t°_1/4°$	% salt	$t°_2$	Absorption-coefficient at $t°_2$	Absorption-coefficient at 15° (Calculated).
KCl	15°	1.1565	22.92	18.62	0.00869	0.00892
		1.1294	19.21	18.82	0.00985	0.01012
		1.0794	12.13	18.71	0.01246	0.01279
		1.0480	7.48	19.00	0.01447	0.01489
		1.0240	3.83	19.23	0.01618	0.01667
KNO_3	15°	1.1460	21.46	17.81	0.01157	0.01180
		1.1101	16.59	17.27	0.01290	0.01311
		1.0936	14.26	16.81	0.01373	0.01391
		1.0539	8.44	17.58	0.01531	0.01559
		1.0295	4.73	17.82	0.01650	0.01683
K_2CO_3	15°	1.4395	41.81	13.17	0.00162	0.00160
		1.3112	30.99	12.77	0.00290	0.00285
		1.2353	24.13	12.62	0.00470	0.00462
		1.1555	16.47	12.51	0.00775	0.00761
		1.0807	8.83	11.32	0.01216	0.01183
		1.0405	4.53	12.29	0.01532	0.01501
		1.0248	2.82	11.23	0.01675	0.01628
NaCl	15°	1.1817	23.84	13.48	0.00602	0.00595
		1.1088	14.78	13.17	0.00938	0.00925
		1.0807	11.09	13.80	0.01140	0..1130
		1.0315	4.47	13.56	0.01565	0.01548
$NaNO_3$	18°	1.2963	37.43	17.27	0.00568	0.00578
		1.2099	27.95	17.36	0.00797	0.00810
		1.1417	19.77	17.40	0.01034	0.01052
		1.0765	11.16	17.65	0.01345	0.01370
		1.0367	5.57	17.80	0.01572	0.01603
Na_2CO_3	15°	1.1213	11.53	13.07	0.00851	0.00839
		1.0835	8.02	12.08	0.01106	0.01082
		1.0457	4.64	11.61	0.01420	0.01385
		1.0217	2.15	11.94	0.01677	0.01639
Na_2SO_4	18°	1.1608	16.69	18.41	0.00757	0.00775
	15°	1.0768	8.42	18.57	0.01223	0.01254
		1.0412	4.58	18.51	0.01482	0.01519
LiCl	15°	1.0843	14.63	12.77	0.01006	0.00990
		1.0416	7.34	12.40	0.01396	0.01370
		1.0192	3.48	10.47	0.01676	0.01619
$MgSO_4$	15°	1.2679	23.76	18.26	0.00487	0.00499
		1.1805	16.64	17.55	0.00783	0.00797
		1.1064	10.19	17.30	0.01140	0.01159
		1.0503	4.97	17.10	0.01479	0.01501
$ZnSO_4$	18°	1.3265	26.51	18.56	0.00590	0.00605
		1.1961	17.23	18.22	0.00940	0.00961
		1.1394	12.73	17.95	0.01151	0.01175
		1.0602	6.03	17.79	0.01495	0.01525
$CaCl_2$	15°	1.2470	26.34	17.68	0.00510	0.00519
		1.2150	23.33	17.84	0.00600	0.00619
		1.1568	17.52	18.09	0.00821	0.00839
		1.0981	11.33	18.40	0.01112	0.01138
		1.0513	6.10	18.04	0.01419	0.01450
		1.0285	3.47	18.52	0.01579	0.01619
$AlCl_3$	15°	1.2647	32.30	17.14	0.00525	0.00533
		1.1589	20.75	17.28	0.00860	0.00874
		1.0914	12.46	17.30	0.01190	0.01210
		1.0488	6.88	17.46	0.01400	0.01486
$C_{12}H_{22}O_{11}$	17.5°	1.2184	47.65	13.80	0.00900	0.00892
		1.1286	30.08	14.19	0.01292	0.01284
		1.0672	16.67	14.16	0.01571	0.01561

(Steiner, W. Ann. 1894 (2), **52.** 291.)

Solubility in salt solutions.

C = concentration of the solution in terms of normal.

α = coefficient of absorption.

Absorption of hydrogen by NH_4NO_3+Aq at 20°.

P	C	α
1.037	0.1308	0.01872
2.167	0.2765	0.01845
3.378	0.4363	0.01823
4.823	0.6333	0.01773
6.773	0.9069	0.01744
11.550	1.6308	0.01647

(Knopp, Z. phys. Ch. 1904, **48.** 103.)

Absorption of hydrogen by KNO_3+Aq at 20°.

P	C	α
1.244	0.1245	0.01835
2.094	0.2114	0.01818
4.010	0.4127	0.01785
5.925	0.6225	0.01743
7.742	0.8293	0.01667
13.510	1.5436	0.01436

(Knopp.)

Absorption of hydrogen by $NaNO_3$+Aq at 20°.

P	C	α
1.041	0.1236	0.01839
2.192	0.2634	0.01774
4.405	0.5416	0.01694
6.702	0.8442	0.01518
12.637	1.7394	0.01300

(Knopp.)

Absorption of hydrogen by KCl+Aq at 20°.

P	C	α
1.089	0.1475	0.01823
2.123	0.2907	0.01757
4.070	0.5687	0.01661
6.375	0.9127	0.01531
7.380	1.0682	0.01472
13.612	2.1222	0.01255

(Knopp.)

Absorption of H_2 by NaCl+Aq.
$\alpha t°$ = coefficient of absorption at t°.

Percent of NaCl in the solution	α25°	α20°	α15°	α10°	α5°
5.999	0 01383	0.01528	0.01640	0.01749	0 01839
5.506	0.01395	0.01532	0.01665	0.01769	0.01861
4.496	0.01429	0.01587	0.01714	0.01817	0.01920
3.798	0.01476	0.01623	0.01760	0.01876	0.01977
1.523	0.01603	0.01754	0.01896	0.02030	0.02155
1.250	0.01621	0.01771	0.01914	0.2052	0.02180

(Braun, Z. phys. Ch. 1900, **33.** 735.)

Absorption of H by $BaCl_2$+Aq.
$\alpha t°$ = coefficient of absorption at t°.

Percent of $BaCl_2$ in the solution	α25°	α20°	α15°	α10°	α5°
7.002	0 01455	0.01591	0.01715	0.01833	0.01937
6 453	0 01474	0.01603	0.01734	0.01857	0.01957
3.600	0 01562	0.01700	0.01839	0.01971	0.02089
3.291	0 01570	0.01719	0.01847	0.01983	0.02110

(Braun.)

1 vol. alcohol at t° and 760 mm absorbs V vols. H gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0.06925	9	0.06799	18	0.06690
1	0.06910	10	0.06787	19	0.06679
2	0.06896	11	0.06774	20	0.06668
3	0.06882	12	0.06761	21	0.06657
4	0.06867	13	0.06749	22	0.06646
5	0.06853	14	0.06737	23	0.06636
6	0.06839	15	0.06725	24	0.06621
7	0.06826	16	0.06713	..	...
8	0.06813	17	0.06701	..	...

(Bunsen's Gasometry, p. 286.)

One vol. alcohol absorbs 0.06925—0.000148t + 0.000001t_2 vols. H at t°. (Bunsen.)

Solubility in alcohol+Aq at 20° and 760 mm.

Wt. % alcohol	Vol. H_2 absorbed	Wt. % alcohol	Vol. H_2 absorbed
0	1.93	28.57	1.04
9.09	1.43	33.33	1.17
16.67	1.29	50	2.02
23.08	1.17	66.67	2.55

(Lubarsch, W. Ann. 1889, (2) **37.** 525.)

Absorption of hydrogen by alcohol.

t°	Coeff. of absorption	t°	Coeff. of absorption
0	0.0676	13.4	0.0705
6.2	0.0693	18.8	0.0740

(Timofejeff.)

Solubility of H_2 in ethyl ether at t°.

t°	Solubility
0	0.1115
5	0.1150
10	0.1195
15	0.1257

(Christoff, Z. phys. Ch. 1912, **79.** 459.)

Coefficient of absorption in petroleum = 0.0582 at 20°, and 0.0652 at 10°. (Griewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Absorption of hydrogen by chloralhydrate+Aq at 20°.

P	C	a
4.911	0.310	0.01839
7.69	0.504	0.01802
14.56	1.030	0.01712
18.77	1.397	0.01653
29.50	2.530	0.01542
32.00	2.845	0.01518
38.42	3.770	0.01440
49.79	6.000	0.01353
60.12	9.120	0.01324
63.90	10.700	0.01307

(Knopp, Z. phys. Ch. 1904, **48.** 103.)

Absorption of H_2 by chloralhydrate+Aq.
t° = temp. of the solution.
P = % chloralhydrate in the solution.
βt° = coefficient of absorption at t°.
β15° = coefficient of absorption at 15°.

t°	P	βt°	β15°
15.0	10.0	0.01740	0.01740
16.4	16.1	0.01719	0.01737
15.8	33.35	0.01475	0.01484
15.0	39.4	0.01470	0.01470
15.6	51.0	0.01300	0.01306
16.2	60.8	0.01281	0.01230
15.5	70.7	0.01282	0.01287
15.0	79.0	0.01320	0.01320
			β20°
19.4	15.5	0.01732	0.01724
17.4	28.3	0.01569	0.01540
18.7	46.56	0.01388	0.01375
16.5	52.0	0.01314	0.01280
17.0	63.0	0.01270	0.01243
17.2	66.0	0.01285	0.01260
17.9	68.0	0.01286	0.01270
18.3	78.4	0.01398	0.01380

(Müller, Z. phys. Ch. 1912, **81.** 499.)

Solubility of H_2 in glycerol+Aq.

t°	% glycerol	Coefficient of absorption
14	0	0.0193
	2.29	0.0189
	5.32	0.0186
	8.57	0.0182
	10.83	0.01815
	15.31	0.01765
21	0	0.0184
	2.29	0.0181
	5.68	0.0177
	6.46	0.0176
	10.40	0.0171
	18.20	0.0160

(Henkel, in Landolt-Börnstein, Tab. 4th Ed. 602.)

Absorption of H_2 by glycerine+Aq.
t° = temp. of the solution.
P = % glycerine in the solution.
βt° = coefficient of absorption at t°.
β15° = coefficient of absorption at 15°.

t°	P	βt°	β15°
14.5	14.9	0.01654	0.01647
13.0	22.8	0.01532	0.01510
13.8	38.0	0.01226	0.01216
14.5	43.5	0.01117	0.01110
13.7	49.15	0.01019	0.01010
14.9	51.5	0.01026	0.01025
12.3	68.0	0.00822	0.00806
18.0	90.7	0.00853	0.00870

(Müller, Z. phys. Ch. 1912, **81.** 496.)

Solubility of H_2 in glycerine+Aq at 25°.
G = % by wt. glycerine in the solvent.
S = Solubility of H_2.
P = corrected pressure at end of experiment in mm. Hg at 0°.

P	G	S
716.3	4.0	0.0186
736.1	10.5	0.0178
684.3	22.0	0.0154
709.9	49.8	0.0099
730.1	50.5	0.0097
672.2	52.6	0.0090
741.1	67.0	0.0067
708.0	80.0	0.0051
665.5	82.0	0.0051
662.3	88.0	0.0044
741.8	95.0	0.0034

(Drucker and Moles, Z. phys. 1910, **75.** 417.)

Absorption of H_2 by glucose+Aq.
t° = temp. of the solution.
P = % glucose in the solution.
βt° = coefficient of absorption at t°.
β20° = coefficient of absorption at 20°.

t°	P	βt°	β20°
20.5	12.2	0.01595	0.01600
20.5	20.7	0.01445	0.01450
21.1	32.56	0.01243	0.01250
21.8	45.8	0.01000	0.01015
21.2	59.0	0.00775	0.00780

(Müller, Z. phys. Ch. 1912, **81.** 494.)

Solubility in sugar+Aq at 15°.

% Sugar	Absorption Coefficient
16.67	0.01561
30.08	0.01284
47.65	0.00892

(Gordon, Z. phys. Ch. 1895, **18.** 14.)

Absorption of H_2 by sucrose+Aq.

t° = temp. of the solution in the absorption vessel.

P = % sucrose in the solution.

βt° = coefficient of absorption at t°.

β_{15}° = coefficient of absorption at 15°.

t°	P	βt°	β15°
12.7		0.01862	0.01892
			β20° =
19.3		0.01840	0.01829
15.2	5.04	0.01723	0.01726
11.6	14.7	0.01547	0.01510
12	20.26	0.01500	0.01462
12.7	29.86	0.01290	0.01257
11.8	31.74	0.01220	0.01185
13.3	39.65	0.01047	0.01033
12.6	42.94	0.00956	0.00939

(Müller.)

Absorption of H_2 by propionic acid+Aq.

αt° = coefficient of absorption at t°.

Percent of propionic acid in the solution	α25°	α20°	α15°	α10°	α5°
9 910	0.01602	0.01782	0 01908	0.02029	0 02129
9.763	0.01638	0.01788	0 01929	0.02042	0.02120
6.500	0.01690	0.01829	0.01925	0 02093	0.02181
5.267	0.01705	0.01842	0.01983	0.02117	0.02239
3.373	0.01706	0 01866	0.01987	0.02120	0.02221
2.634	0.01722	0.01876	0.2003	0 02142	0 02245

(Braun, Z. phys. Ch. 1900, **33.** 735.)

Absorption of H_2 by organic acids+Aq.

M = content in gram-equivalents per liter.

S = solubility.

Absorption of H_2 by CH_3COOH+Aq.

M	S25°
0.517	0.01925
0.528	0.01923
1.160	0.01903
1.20	0.01895
1.963	0.01885
1.980	0.01882
3.178	0.01862
3.220	0.01858
4.157	0.01849

(Geffcken, Z. phys. Ch. 1904. **49.** 267.)

Absorption of H_2 by $CH_2ClCOOH$+Aq.

M	S25°
0.527	0.01905
0.990	0.01852
1.773	0.01783

(Geffcken.)

Absorption of H by organic substances+Aq at t°.

V = absorbed volume reduced to 0° and 760 mm.

α = coefficient of absorption.

Substance	Grams in 1 liter	Vol. of solution used in ccm.	t°	V ccm.	x
Glucose	174	409.94	20.28°	5.48	0.01516
Glucose	80.8	"	20.16°	6.12	0 01649
Glucose	41.45	"	20.00°	6.36	0.01759
Urea	60	"	20.17°	6.26	0.01703
Acetamide	59	"	20.11°	6.51	0 01795
Alanine	39	"	20.08°	5.57	0.01555
Glycocoll	75	"	20.16°	5.67	0.01577

(Hüfner, Z. phys. Ch. 1907, **57.** 623–4.)

Solubility in organic solvents.

Solvent	Solubility at 25° C	Solubility at 20° C	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0.01992	0.02000	—0.000016
Aniline	0 02849	0.03033	—0.000368
Amyl alcohol	0.03708	0 03533	+0.00035
Nitrobenzene	0 03708	0 03533	+0.00035
Carbon bisulphide	0.03753	0.03358	+0.00079
Glacial acetic	0 06330	0.06172	+0.000316
Benzene	0.07560	0.07071	+0.000978
Acetone	0.07641	0 07027	+0.001228
Amyl acetate	0.07738	0.07432	+0.00061
Xylene	0 08185	0.07834	+0.000702
Ethyl acetate	0 08516	0.07877	+0 001278
Toluene	0.08742	0.08384	+0.000716
Ethyl alcohol (99.8%)	0 08935	0.08620	+0.00063
Methyl alcohol	0 09449	0.09016	+0.000866
Isobutyl acetate	0.09758	0.09287	+0.000942
Chloroform	no constant value		
Carbon tetrachloride			

(Just, Z. phys. Ch. 1901, **37.** 359.)

Extended investigations have been made by Findlay and Shen. (Chem. Soc. 1912, **101.** 1465) on the effect of colloids on solubility of H_2 in H_2O. See original article.

Hydrogen arsenide.
See **Arsenic hydride.**

Hydrogen *per*oxide, H_2O_2.

Miscible with H_2O. Not stable in conc. solution. Aqueous solution gives up its H_2O_2 to ether. Ethereal solution is more stable than an aqueous solution of the same strength, and may be distilled without decomp. Miscible with alcohol.

Very stable in aq. solution of various conc. if perfectly free from impurity such as compds. of heavy metals, etc. (Woffenstein, B. 1894, **27.** 3307.)

Cœfficient of distribution between ether and H_2O determined at 3°, 7°, and 17.5° with varying quantities (1.7—5%) of H_2O_2. (Osipoff, C. C. **1903,** II. 1265.)

As sol. in ether as in H_2O. A 50% solution in H_2O still contained about 25% H_2O_2 after

being shaken 6 times with large quantities of fresh ether.

Insol. in petroleum ether. (Brühl, B. 1895, **28.** 2855.)

$+H_2O$, and $+2H_2O$. Does not solidify at -20°. (Wolffenstein, B. 1894, **27.** 3311).

Hydrogen phosphide, gaseous (Phosphine), PH_3.

Very slightly absorbed by H_2O.

Statements as to solubility in H_2O vary considerably.

(a) *Difficultly inflammable gas*—

1 vol. H_2O absorbs 0.1122 vol. PH_3. (Dybkowsky, J. B. **1866.** 735.)

1 vol. H_2O absorbs 0.125 vol. PH_3. (H. Davy.)

(b) *Easily inflammable gas*—

1 vol. H_2O absorbs 0.018 vol. PH_3. (Gengembre, Crell. Ann. **1.** 450.)

1 vol. H_2O absorbs 0.0214 vol. PH_3. (Henry.)

1 vol. H_2O absorbs 0.025 vol. PH_3. (Davy.)

1 vol. H_2O absorbs 0.125 vol. PH_3. (Dalton, Ann. Phil. **11.** 7.)

1 vol. H_2O absorbs 0.255 vol. PH_3. (Raymond, Scher. J. **5.** 389.)

1 vol. H_2O dissolves 0.26 vols. PH_3 at 17°. (Stock, Böttger and Lenger, B. 1909, **42.** 2855.)

Sol. in conc. H_2SO_4 without immediate decomp. (Buff, Pogg. **16.** 363.)

1 vol. 50% H_2SO_4 dissolves 0.05 vol. PH_3. (S. B. and L.)

Absorbed by $CuSO_4$+Aq and by Br. (Berthelot.)

Absorbed rapidly by Cu_2Cl_2+Aq with formation of Cu_2Cl_2, $2PH_3$, and Cu_2Cl_2, $4PH_3$. (Riban, C. R. **88.** 581.)

1 vol. alcohol of 0.85 sp. gr. absorbs 0.5 vol.; 1 vol. ether absorbs 2 vols. (Graham.)

Sol. in volatile oils; 1 vol. oil of turpentine absorbs 3.25 vols. (Graham.)

Several varieties of blood absorb PH_3.

Hydrogen phosphide, liquid, P_2H_4.

Insol. in H_2O. Apparently sol. in alcohol and oil of turpentine, but solution is very quickly decomp. (Thénard, A. ch. (3) **145.**)

Hydrogen phosphide, solid, P_4H_2.

Insol. in H_2O and alcohol. (Leverrier, A. ch. **60.** 174.)

Insol. in all liquids except liquid PH_2. (Thénard, A. ch. (3) **14.** 5.)

Instantly decomp. by HNO_3, or H_2SO_4+Aq. Sol. with decomp. in alcoholic solution of KOH. (Thénard.)

Somewhat sol. in liquid phosphorus. (Buck, Dissert. **1904.**)

P_9H_2. Insol. in all solvents. (Stock, Böttger and Lenger, B. 1909, **42.** 2851.)

$P_{12}H_6$. Sol. in liquid hydrogen phosphide and molten P. There are no other solvents which appreciably dissolve it. Insol. in liquid PH_3. (S. B. and L.)

Hydrogen selenide, H_2Se.

More sol. in H_2O than hydrogen sulphide. (Berzelius.)

Solubility coefficient of H_2Se at t°.

t°	Sol. Coeff.
4	3.77 vols.
9.65	3.43
13.2	3.31
22.5	2.70

(Forcrand and Fonzes-Diacon, C. R. 1902, **134.** 171.)

Sol. in cold $COCl_2$. (Besson, C. R. 1869, **122.** 140.)

Hydrogen silicide.

See **Silicon hydride.**

Hydrogen sulphide, H_2S.

(a) *Liquid.* Dissolves S on warming, which separates on cooling.

(b) *Gas.*

1 vol. H_2O absorbs 1.08 vols. H_2S at 10°. (Henry, 1803.)

1 vol. H_2O absorbs 2.53 vols. H_2S at 15°. (de Saussure, Ann. Phil. 6. 340.)

1 vol. H_2O absorbs 3 vols. H_2S at 11°. (Gay-Lussac and Thénard.)

1 vol. H_2O absorbs 3.66 vols. H_2S at ord. temp. (Thompson.)

1 vol. H_2O absorbs 2.5 vols. H_2S at ord. temp. (Dalton.)

1 vol. H_2O absorbs $4.3706-0.083687t+0.0005213t^2$ vols. H_2S at temperatures between 2 and 43.3°. (Bunsen and Schönfeld, A. **93.** 26.)

At 0° and about 820 mm. pressure, 1 ccm. H_2O absorbs 100 ccm. H_2S, while only about 4 ccm. are absorbed at ord. pressure. (de Forcrand and Villard, C. R. **106.** 1402.)

1 vol. H_2O at 760 mm. pressure and t° absorbs V vols. H_2S, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4.3706	14	3.3012	28	2.4357
1	4.2874	15	3.2326	29	2.3819
2	4.2053	16	3.1651	30	2.3290
3	4.1243	17	3.0986	31	2.2771
4	4.0442	18	3.0331	32	2.2262
5	3.9652	19	2.9687	33	2.1764
6	3.8872	20	2.9053	34	2.1277
7	3.8103	21	2.8430	35	2.0799
8	3.7345	22	1.7817	36	2.0332
9	3.6596	23	2.7215	37	1.9876
10	3.5858	24	2.6623	38	1.9430
11	3.5132	25	2.6091	39	1.8994
12	3.4415	26	2.5470	40	1.8569
13	3.3708	27	2.4909	..	....

(Schönfeld, A. **93.** 26.)

Absorption coefficient of H_2S in H_2O at 0° = 4.6796. (Prytz and Holst, W. Ann. 1895, **54**, 137.)

1 l. H_2O dissolves 0.1004 mol. H_2S at 25° and 760 mm. (Pollitzer, Z. anorg. 1909, **64**. 145.)

Absorption of hydrogen sulphide by H_2O at t°.

t°	Coefficient of absorption
0°	4.686
10°	3.520
20°	2.672

[Calc. fr. data of Fauser. (C. C. 1889, **1**. 754.)]

(Winkler, Z. phys. Ch. 1906, **55**. 350.)

Absorption of hydrogen sulphide by H_2O at t°.

t°	Coefficient of absorption
0	4.621
10	3.362
20	2.554
30	2.014
40	1.642
50	1.376
60	1.176

(Winkler, Z. phys. Ch. 1906, **55**. 350.)

Solubility of H_2S in H_2O.

Layer rich in H_2S	
t°	Mols. H_2S per 100 mols. H_2O
0	0.4
6	0.5
17	0.8
26	1.2
29.5	1.6

Layer rich in H_2O	
t°	Mols. H_2S per 100 mols. H_2O
29.4	96.3
28.5	96.9
26.9	97.3
26.3	97.5
23.8	98.1
23.3	98.1
22.9	98.2
17.2	98.8
13.7	99.1
11.4	99.25
5.3	99.5

(Scheffer, Proc. K. Ak. Amsterdam, 1911, **14** 198.)

Difficultly sol. in conc. H_2SO_4 with decomp. Instantly decomp. by fuming HNO_3.

Solubility of H_2S in HI+Aq at 25° and 760 mm.

HI Mol. per l.	H_2S Mol. per l.
0.00	0.1004
1.01	0.111
1.51	0.113
1.93	0.125
2.65	0.130
2.64	0.138
3.42	0.142
4.38	0.163
5.005	0.165
5.695	0.181
6.935	0.197
* (9.21	0.267)

* Not exact.

(Pollitzer, Z. anorg. 1909, **64**. 145.)

Solubility in acids+Aq.

l = value of H_2S dissolved in acid+Aq as determined by titration.

lo = value of H_2S dissolved in H_2O as determined by titration.

t° = 25°.

Acid	l/lo
½-N.HCl	0.975
½-N.H_2SO_4	0.905

(McLauchlan, Z. phys. Ch. 1903, **44**. 615.)

Less sol. in NaCl, or $CaCl_2$+Aq than in H_2O.

Sol. in $CdCl_2+NH_4OH$+Aq. (Crobaugh, Z. anorg. 1894, **5**. 321.)

Solubility in salts+Aq.

l = value of H_2S dissolved in salt+Aq as determined by titration.

lo = value of H_2S dissolved in H_2O as determined by titration.

t° = 25°.

Salt +Aq.	l/lo	Salt +Aq.	l/lo
½-N.Na_2SO_4	0.73	¼-N.Na_2SO_4	0.855
½-N.K_2SO_4	0.78	¼-N.K_2SO_4	0.890
½-N.$(NH_4)_2SO_4$	0.82	¼-N.$(NH_4)_2SO_4$	0.91
N.NaCl	0.847	½-N.NaCl	0.930
N.KCl	0.853	N.NaBr	0.935
N.NH_4Cl	0.960	N.KBr	0.945
N.$NaNO_3$	0.893	N.NH_4Br	1.00
N.KNO_3	0.913	N.KI	0.98
N.NH_4NO_3	0.990		

(McLauchlan, Z. phys. Ch. 1903, **44**. 615.)

Solubility of H_2S in NaSH+Aq.
(g. mol. H_2S dissolved in 1 l.)

t°	0.05 g. mol. NaSH per l.	0.1 g. mol. NaSH per l.	0.2 g. mol. NaSH per l.
15	...	0.132	0.129
25	...	0.104	0.1035
35	0.082	0.082	...
45	0.064	...	...

(Goldschmidt and Larsen, Z. phys. Ch. 1910, **71.** 449.)

At 18° and ord. pressure, 100 vols. alcohol of 0.84 sp. gr. absorb 606 mols. H_2S. (de Saussure, **1814.**)

1 vol. alcohol absorbs $17.891-0.65598t+0.00661t^2$ vols. H_2S between 0 and 22°. (Carius.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. H_2S reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	17.891	9	12.523	18	8.225
1	17.242	10	11.992	19	7.814
2	16.606	11	11.475	20	7.415
3	15.983	12	10.971	21	7.030
4	15.373	13	10.480	22	6.659
5	14.776	14	10.003	23	6.300
6	14.193	15	9.539	24	5.955
7	13.623	16	9.088	..	...
8	13.066	17	8.650	..	...

(Carius, A. **94.** 140.)

Solubility in alcohol+Aq at 25°.

Molecules of C_2H_5OH in 100 molecules $C_2H_5OH+H_2O$	Molecules H_2O in 100 molecules $C_2H_5OH+H_2O$	l/lo
0.00	100	1.00
1.60	98 (?)	0.96
5.18	94.82	0.933
9.25	90.75	0.91
23.60	76.40	1.28
47.75	52.25	1.95
* (100	0	2.16)

* Carius.

(McLauchlan.)

Sol. in methyl acetate (Marchand), ether (Higgins).
Insol. in caoutchin.
Sol. in glycerine in less amount than in H_2O. If a certain vol. of H_2O dissolves 100 pts. H_2S, the same vol. of glycerine (1 pt. glycerine +1pt. H_2O) dissolves only 60 pts. H_2S, but the solution is very stable. After standing a year there is no appreciable decomp. (Lapage, J. Pharm. (4) **5.** 256.)
According to Lindo (C. N. **57.** 173), the solution in glycerine is no more stable than that in H_2O.
Sol. in CS_2.

Solubility in organic substances+Aq.
l=value of H_2S dissolved in organic substance+Aq as determined by titration.
lo=value of H_2S dissolved in H_2O as determined by titration.
t°=25°.

Solution	l/lo
N-$NH_4C_2H_3O_2$	1.09
N-$C_4H_6O_6$	0.944
3-N-$C_4H_6O_6$	0.858
N-$(NH_2)_2CO$	1.02
pure $C_3H_5(OH)_3$	0.863

(McLauchlan, Z. phys. Ch. 1903, **44.** 615.)

Solubility in acetic acid+Aq at 25°.

Molecules of CH_3COOH in 100 molecules $CH_3COOH+H_2O$	Molecules of H_2O in 100 molecules $CH_3COOH+H_2O$	l/lo
0	100	1.00
8.85	91.15	0.98
16.7	83.30	0.955
21.0	79	1.00
35.5	64.5	1.035
53.5	40.5	1.21
55.7	....	1.29
67.8	32.2	1.40
81.0	19.0	1.83
98.58	1.42	3.81

(McLauchlan.)

Hydrogen *per*sulphide, H_2S_2 or H_2S_5.

Decomp. by contact with H_2O, in which it is apparently insol. Sol.in ether with subsequent decomp. Sol. in CS_2. (Thénard, A. ch. **48.** 79.)
H_2S_2. Quickly decomp. by ether, acetic ether, ethyl, or amyl alcohol. H_2S has no action.
Conc. HCl, or $HC_2H_3O_2$+Aq have no action. Sol. in a solution of S in CS_2, and in liquid hydrocarbons.
Chloroform dissolves without decomp. (Sabatier, C. R. **100.** 1346, 1585.)
Alkalies, and K_2S+Aq decomp. instantly.
Decomp. by H_2O, dil. and conc. HCl, conc. H_2SO_4, alkali and alcohol. Sol. in alcohol containing HCl but soon decomp. in this solution. Miscible in all proportions and without decomp. with benzene, ether and CS_2. (Bloch, B. 1908, **41.** 1977.)
Formula is H_2S_5. (Rebs, A. **246.** 356.)
$+7H_2O$. Easily decomp. by heat. (de Forcrand and Villard, C. R. **106.** 1402.)

Hydrogen *tri*sulphide, H_2S_3.

Decomp. by H_2O, dil. and conc. HCl, conc. H_2SO_4, alkali and alcohol. Somewhat sol. in alcohol containing HCl, but slowly decomp. in this solution. Miscible with ether, benzene and CS_2 and these solutions are relatively stable. (Bloch, B. 1908, **41.** 1974.)

Hydrogen telluride, H_2Te.

Sl. sol. in H_2O. Decomp. in the air. (Ernyei, Z. anorg. 1900, **25.** 313.)

Hydrosulphuric acid, H_2S.

See **Hydrogen sulphide.**

Hydrosulphurous acid, H_2SO_2.

See **Hyposulphurous acid.**

Hydroxylamic acid.

Calcium hydroxylamate, $Ca(ONH_2)_2$.

Very explosive; decomp. by H_2O. (Ebler and Schott, J. pr. 1908, (2) **78.** 323.)

Zinc hydroxylamate $Zn(ONH_2)_2$.

Decomp. by H_2O. (Ebler and Schott.)

Zinc hydroxylamate, hydroxylamine, $Zn(H_2NO)_2$, $3NH_3O$.

Very unstable.

Insol. in abs. alcohol. (Ebler and Schott.)

Hydroxylamine, $NH_3O = NH_2(OH)$.

Known only in solution.

Sol. in alcohol. (Lossen, J. pr. **96.** 462.)

Prepared in free state by de Bruyn.

Very deliquescent, and sol. in H_2O and alcohol. Sl. sol. or insol. in $CHCl_3$, C_6H_6, ether, or ethyl acetate.

Methyl alcohol at 5° dissolves 35%; ethyl alcohol at 15°, 15%; boiling dry ether, 1.2%; boiling ethyl acetate, 1.6%. (de Bruyn, R. t. c. **11.** 18.)

Hydroxylamine arsenate, $AsO_4H_3(NH_3O)_3$.

Sl. sol. in cold H_2O; sol. in hot H_2O from which it can be cryst. (Hofmann, A. 1899, **307.** 331.)

Hydroxylamine azoimide.

See **Azoimide, hydroxylamine.**

Hydroxylamine bromide, NH_2OH, HBr.

Very sol. in H_2O; insol. in ether by which it is pptd. from solution in alcohol. (Adams, Am. Ch. J. 1902, **28.** 205.)

$2NH_2OH$, HBr. Easily sol. in H_2O; insol. in ether and ligroin. Sl. sol. in alcohol. (Adams.)

Hydroxylamine mercuric bromide hydroxylamine, $2NH_2OH$, $2HBr$, $HgBr_2$, $2NH_2OH$.

Decomp. by H_2O and methyl alcohol.

Readily decomp. by alkalies. (Adams.)

Hydroxylamine calcium, $HO.Ca.ONH_2$.

Partially decomp. by H_2O at ordinary temp. (Hofmann, Z. anorg. 1898, **16.** 464.)

Hydroxylamine chloride, basic, $NH_3(OH)Cl$, NH_2OH.

Sol. in H_2O. Alcohol precipitates from aqueous solution. Insol. in ether. (Lossen.)

$2NH_3(OH)Cl$, NH_2OH. Deliquescent; very sol. in H_2O, less in alcohol, and insol. in ether. (Lossen.)

Hydroxylamine chloride, $NH_3(OH)Cl$.

Not deliquescent. Very sol. in H_2O and hot ordinary alcohol. Sl. sol. in absolute alcohol. Insol. in ether. (Lossen.)

Sol. in 1.2 pts. H_2O at 17°. (Schiff, Z. phys. Ch. 1896, **21.** 290.)

Sp. gr. of aqueous solution at 17°.

% salt	sp. gr.
40	1.1852
28	1.1260
20	1.0888
14	1.0616
10	1.0437
7	1.0303
5	1 0214
3.5	1.0147

(Schiff, Z. phys. Ch. 1896, **21.** 290.)

100 pts. absolute methyl alcohol dissolve 16.4 pts. at 19.75°; 100 pts. absolute ethyl alcohol dissolve 4.43 pts. at 19.75°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Somewhat sol. in alcohol. (Adams, Am. Ch. J. 1902, **28.** 204.)

Hydroxylamine mercuric chloride, NH_2OH, HCl, $HgCl_2$.

Very sol. in H_2O and alcohol. Less sol. in ether. (Adams, Am. Ch. J. 1902, **28.** 213.)

$5(NH_2OH)_2$, HCl, $2HgCl_2$. Sol. in cold H_2O, alcohol and ether. More easily sol. in methyl alcohol. Sol. in HCl. The slightest trace of alkali causes decomp. (Adams.)

*Hexa***hydroxylamine cobaltic bromide,** $[Co(NH_2OH)_6]Br_3$.

(Werner, B. 1905, **38.** 897.)

*Hexa***hydroxylamine cobaltic chloride,** $[Co(NH_2OH)_6]Cl_3$.

Very stable toward HCl. (Werner, B. 1905, **38.** 895.)

*Hexa***hydroxylamine cobaltic nitrate,** $[Co(NH_2OH)_6](NO_3)_3$.

(Werner.)

*Hexa***hydroxylamine cobaltic sulphate,** $[Co(NH_2OH)_6]_2(SO_4)_3+2H_2O$.

Easily sol. in H_2O. (Werner.)

Hydroxylamine columbate, $CbO_6N_3H_{12}$.

Explosive. Sl. sol. in H_2O. (Hofmann, Z. anorg. 1898, **16.** 473.)

Hydroxylamine dithionate, $(NH_2OH)_2$, $H_2S_2O_6$.

Sol. in H_2O; decomp. on heating the aq. solution. (Sabanejeff, Z. anorg. 1898, **17.** 485.)

Hydroxylamine fluosilicate, $(NH_3O)_2$, H_2SiF_6 $+2H_2O$.

Easily sol. in H_2O. Nearly insol. in methyl and abs. ethyl alcohol. (Ebler, J. pr. 1908, (2), **78.** 338.)

Hydroxylamine fluotitanate, $(NH_3O)_3$, H_2TiF_6

Sol. in H_2O. Sl. sol. in methyl alcohol. (Ebler, J. pr. 1908, (2) **78.** 340.)

Hydroxylamine hypophosphite, $(NH_3OH)H_2PO_2$.

Very sol. in H_2O. (Sabanejeff, Z. anorg. 1898, **17.** 483.)

Sol. in H_2O and absolute alcohol. Insol. in ether. (Hofmann and Kohlschütter, Z. anorg. 1898, **16**, 469.)

Hydroxylamine potassium hypophosphite, $(H_2PO_2)_2(NH_3O)_3K_2$.

Easily sol. in H_2O, decomp. on heating; sol. in hot abs. alcohol. (Hofmann and Kohlschütter, Z. anorg. 1898, **16.** 468.)

Hydroxylamine hypophosphate, $(NH_3OH)_2H_2P_2O_6$.

Easily sol. in H_2O. (Sabanejeff, Z. anorg. 1898, **17.** 489.)

Hydroxylamine iodide, NH_2OH, HI.

Hydroscopic; sol. in methyl alcohol. Very explosive. (Wolffenstein and Groll, B. 1901, **34.** 2419.)

***Di*hydroxylamine iodide,** $(NH_2OH)_2$, HI.

Deliquescent. More sol. in H_2O, methyl and ethyl alcohol than the tri compound. Is decomp. when recryst. from these solvents. Insol. in ether. (Dunstan, Chem. Soc. 1896, **69.** 841.)

***Tri*hydroxylamine iodide,** $(NH_2OH)_3$, HI.

Deliquescent in moist air. Sol. in H_2O, methyl and ethyl alcohol. Insol. in ether. (Dunstan.)

Hydroxylamine nitrate, $NH_3(OH)NO_3$.

Very sol. in H_2O and absolute alcohol. (Lossen.)

Hydroxylamine *ortho*phosphate, $(NH_3OH)_3PO_4$.

Sl. sol. in cold H_2O. (Lossen.)

Only sl. sol. in H_2O. (Hofmann, A. 1899, **307.** 330.)

Moderately sol. in H_2O. (Ross, Chem. Soc. 1906, **90,** (2) 19.)

Solubility in H_2O.

1 g. of aqueous solution contains at:

0°	10°	
0.012	0.015	g. hydroxylamine phosphate,
20°	30°	
0.019	0.027	g. hydroxylamine phosphate,
40°	50°	
0.040	0.055	g. hydroxylamine phosphate,
60°	70°	
0.077	0.102	g. hydroxylamine phosphate,
80°	90°	
0.133	0.168	g. hydroxylamine phosphate.

(Adams, Am. Ch. J. 1902, **28.** 204.)

$(NH_3OH)H_2PO_4$. Hygroscopic. Aq. solution is decomp. on heating. (Sabanejeff, B. 1897, **30.** 287.)

Hydroxylamine phosphite, $(NH_3OH)_2HPO_3$.

Sol. in H_2O and absolute alcohol. (Hofmann and Kohlschütter, Z. anorg. 1898, **16.** 467.)

$(NH_3OH)H_2PO_3$. Sol. in H_2O. Insol. in alcohol. (Sabanejeff, Chem. Soc. **1900, 78,** (2), 14.)

Hydroxylamine phosphite ammonia, $(NH_3OH)H_2PO_3$, NH_3.

Sol. in H_2O. (Sabanejeff, Chem. Soc. **1900, 78,** (2) 14.)

Hydroxylamine sodium, $NaONH_2$.

Very hygroscopic. (de Bruyn, R. t. c. 1892, **11.** 18.)

Hydroxylamine sulphate, $(NH_3OH)_2SO_4$.

Easily sol. in H_2O. Precipitated from concentrated aqueous solution by alcohol. (Lossen.)

Sol. in conc. NH_4OH+Aq. Insol. in alcohol and ether. (Preibisch, J. pr. 1873, (2) **7.** 480.)

Not deliquescent. Sol. in ¾ of its wt. of H_2O at 20°. (Divers and Haga, Chem. Soc. 1896, **69.** 1665.)

1 g. of aqueous solution contains at:

—8°	0°	+10°	
0.307	0.329	0.366	g. hydroxylamine sulphate,
20°	30°	40°	
0.413	0.441	0.482	g. hydroxylamine sulphate,
50°	60°	90°	
0.522	0.560	0.685	g. hydroxylamine sulphate.

(Adams, Am. Ch. J. 1902, **28.** 203.)

Dry hydroxylamine sulphate is insol. in abs. and almost insol. in 95% alcohol. (Adams.)

For double salts, see under sulphuric acid.

NH_2OH, H_2SO_4. Deliquescent. Sol. in H_2O. (Divers, Chem. Soc. 1895, **67.** 226.)

Hydroxylamine tungstate, $4NH_2OH$, $3WO_3+3H_2O$.

Moderately sol. in H_2O. (Allen and Gottschalk, Am. Ch. J. 1902, **27.** 338.)

Hydroxylamine uranate, $UO_4(NH_3O)_2+H_2O$.

Decomp. by heat. (Hofmann, Z. anorg. 1897, **15.** 78.)

Hydroxylamine uranate ammonia, $UO_4(NH_3O)_2$, $2NH_3$.

Decomp. by H_2O. (Hofmann, Z. anorg. 1897, **15.** 79.)

Hydroxylamine ***meta*****vanadate,** $VO_6N_5H_{15}$.

Decomp. by moisture. (Hofmann Z. anorg. 1898, **16.** 472.)

Hydroxylamine ***meta*****vanadate ammonia,** VO_3H, $(NH_3O)_2$, $2NH_3$.

Easily decomp. by H_2O and HCl. (Hofmann, Z. anorg. 1898, **16.** 471.)

Hydroxylamine ***mono*****sulphonic acid,** $HONH(SO_3H)$.

"Sulphazidic acid" of Fremy.

"Sulphydroxylamic acid" of Claus.

Sol. in H_2O. Slowly decomp. on boiling. (Raschig, A. **241.** 161.)

Ammonium hydroxylamine ***mono*****sulphonate,** .(OH)HN, SO_3NH_4.

(Sabanéjeff, Z. anorg. 1898, **17.** 491.)

*Mono***barium** —— ——, $(HONHSO_3)_2Ba+H_2O$.

Easily sol. in H_2O. (Divers and Haga, Chem. Soc. **55.** 760.)

*Di***barium** —— ——, $Ba(HONSO_3)_2Ba+H_2O$.

Nearly insol. in H_2O; sol. in HCl+Aq. (Divers and Haga, Chem. Soc. **55.** 760.)

Potassium —— ——, $HONH(SO_3K)$.

"Potassium sulphydroxylamate" of Claus.

"Potassium sulphazidate" of Fremy.

Sol. in cold H_2O. Easily sol. in hot H_2O without decomp. Insol. in alcohol. (Raschig.

$+H_2O$. (Divers and Haga, Chem. Soc. **55.** 760.)

Hydroxylamine ***di*****sulphonic acid,** $HON(SO_3H)_2$.

"*Di*sulphydroazotic acid" of Claus.

"Sulphazotic acid" of Fremy.

Not known in free state. (Raschig, A. **241.** 161.)

Barium hydroxylamine ***di*****sulphonate,** $Ba_3(NS_2O_7)_2+4H_2O$ and $+8H_2O$.

Practically insol. in H_2O. Sol. in NH_4Cl+Aq. (Divers, Chem. Soc. 1894, **65.** 559.)

Barium potassium —— ——.

$Ba_3K_8H_4(NS_2O_7)_6+9H_2O$.

$BaKNS_2O_7+H_2O$.

$(HO)_2Ba_6K_4H(NS_2O_7)_5+H_2O$.

$Ba_9K_3(NS_2O_7)_7+14H_2O$.

$3Ba(OH)_2$, $Ba_9K_3(NS_2O_7)_7$.

Above salts are all ppts. (Divers, Chem. Soc. 1894, **65.** 561.)

Barium sodium hydroxylamine ***di*****sulphonate,** $Ba_6Na_3(NS_2O_7)_5+7H_2O$.

$Ba_9Na_3(NS_2O_7)_7+7H_2O$.

$Ba_{18}Na_{15}(NS_2O_7)_{17}+24H_2O$.

Above salts are ppts. (Divers.)

Potassium —— ——, $HON(SO_3K)_2+2H_2O$.

"Potassium *di*sulphydroxyazotate" of Claus (A. **158.** 75). Insol. in cold H_2O.

Very unstable. Very difficultly sol. in H_2O, more easily in dil. KOH+Aq. (Raschig, A. **241.** 161.)

$HON(SO_3K)_2$, $KON(SO_3K)_2+H_2O$. True composition of potassium sulphazotate of Fremy. (Divers and Haga, Chem. Soc. 1900, **77.** 432.)

Potassium sodium —— ——.

$3K_3NS_2O_7$, $2Na_3NS_2O_7+2H_2O$. Sol. in H_2O.

$6K_3NS_2O_7$, $Na_3NS_2O_7$, $H_3NS_2O_7+20H_2O$. Sol. in H_2O.

$K_2Na_{16}H_3(NS_2O_7)_7+5H_2O$. Less sol. in H_2O than the others.

$K_{15}Na_5H_4(NS_2O_7)_8+9H_2O$. Sol. in H_2O.

$KNa_4H(NS_2O_7)_2+H_2O$. Readily sol. in H_2O.

$K_6NaH_2(NS_2O_7)_3+2H_2O$. Moderately sol. in H_2O.

$KNaHNS_2O_7+3H_2O$. Sol. in H_2O.

(Divers, Chem. Soc. 1894, **65.** 552.)

Potassium strontium —— ——, $(HO, Sr)_3NS_2O_7$, $8(SrKNS_2O_7, 2H_2O)$.

Ppt. (Divers.)

Potassium hydroxylamine ***di*****sulphonate nitrite,** $HON(SO_3K)_2$, KNO_2.

Very sl. in H_2O. (Divers and Haga, Chem. Soc. 1900, **77.** 433.)

$K_5H(NS_2O_7)_2$, $3KNO_2+H_2O$. Decomp. by H_2O. (Divers and Haga.)

$2KON(SO_3K)_2$, $KNO_2+4.4H_2O$. Very sol. in H_2O which decomp. it into its constituent salts. (Divers and Haga.)

$+6H_2O$. Very sol. in H_2O which decomp. it into its constituent salts. (Divers and Haga.)

$2K_5H(NS_2O_7)_2$, $7KNO_2+3H_2O$. Decomp. by H_2O. (Divers and Haga.)

$3K_5H(NS_2O_7)_2$, $7KNO_2$. Decomp. by H_2O. (Divers and Haga.)

Potassium hydroxylamine ***di*****sulphonate sodium chloride,** $5K_2HNS_2O_7$, $8NaCl+3H_2O$.

Decomp. by H_2O. (Divers, Chem. Soc. 1894, **65.** 551.)

Sodium hydroxylamine *di*sulphonate, $HON(SO_3Na)_2$.

Sol. in somewhat more than its own wt. of H_2O at 14°. (Divers, Chem. Soc. 1894, **65.** 546.)

$Na_2HNS_2O_7$, $2Na_3NS_2O_7+3H_2O$. Sol. in less than 1.5 pts. H_2O at 14°. (Divers.)

Hydroxylamine *isomono*sulphonic acid, NH_2, O, SO_2, OH.

Very hydroscopic. Sol. in water; sol. in alcohol. (Sommer, B. 1914, **47.** 1226.)

[Compare Raschig, A. 1887, **241.** 161.]

Hydroxylamine *isodi*sulphonic acid.

Ammonium hydroxylamine *isodi*sulphonate, $(SO_3NH_4)ONH(SO_3NH_4)$.

3 pts. are sol. in 2 pts. H_2O at 18°. Apt to form supersat. solutions. (Haga, Chem. Soc. 1906, **89.** 246.)

*Di*potassium ——— ———, $K_2HS_2O_7N$.

Only sl. sol. in cold H_2O. Easily sol. in boiling H_2O. Decomp. by hot dil. HCl. (Raschig, B. 1906, **39.** 246.)

6.44 pts. are sol. in 100 pts. H_2O at 16.4°.
7.18 " " " " 100 " H_2O " 17.8°.
8.05 " " " " 100 " H_2O " 20°.
(Haga, Chem. Soc. 1906, **39.** 243.)

*Tri*potassium ——— ———, $(SO_3K)ONK(SO_3K)+2H_2O$.

Very sol. in H_2O; ppt. by alcohol. (Haga.)

*Di*sodium ——— ———, $(SO_3Na)ONH(SO_3Na)$.

Very sol. in H_2O; insol. in alcohol by which it is ppt. from aqueous solution. (Haga.)

*Tri*sodium ——— ———, $(SO_3Na)ONNa(SO_3Na)+2H_2O$.

Sol. in H_2O; ppt. by alcohol. (Haga.)

$+3H_2O$. Sol. in 1.3 pts. H_2O at 20°. Less sol. in NaOH+Aq. (Divers, Chem. Soc. 1894, **65.** 546.)

Hydroxylamine *tri*sulphonic acid.

Ammonium hydroxylamine *tri*sulphonate, $2(SO_3NH_4)ON(SO_3NH_4)_2+3H_2O$.

Sol. in 0.61 pts. H_2O at 16°. (Haga, Chem. Soc. 1904, **85.** 84.)

Potassium ——— ———, $2(SO_3K)ON(SO_3K)_2+3H_2O$.

1 pt. is sol. in 25.37 pts. H_2O at 18°. (Haga.)

Sodium ——— ———, $(SO_3Na)ON(SO_3Na)_2+2H_2O$.

Sol. in 2.84 pts. H_2O at 21.5°.

***Di*hydroxylamine sulphonic acid,** $(HO)_2N(SO_3H)$.

"Sulphazinous acid" of Fremy.

Known only in its salts. (Raschig, A. **241.** 161.)

Potassium *di*hydroxylamine sulphonate, $(HO)_2NSO_3K$.

Not obtained in pure state; forms basic salt $\begin{matrix}KO\\HO\end{matrix}NSO_3K$, which is quite sol. in H_2O, and corresponds to "sulfazite de potasse" of Fremy (A. ch. (3) **15.** 421).

Sol. in H_2O; insol. in alohol and ether. (Fremy.)

Hydroxyliodoplatin*di*amine sulphate, $(OH)IPt(NH_3)_4SO_4+H_2O$.

Very sl. sol., even in boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 312.)

Hydroxylonitratoplatin*di*amine nitrate, $\begin{matrix}OH\\NO_3\end{matrix}Pt\begin{matrix}N_2H_6NO_3\\N_2H_6NO_3\end{matrix}$.

Sl. sol. in cold, more easily in hot H_2O Very sl. sol. in H_2O containing HNO_3. (Cleve.)

——— *pyro*phosphate, $\left[\begin{matrix}OH\\NO_3\end{matrix}Pt\begin{matrix}N_2H_6\\N_2H_6\end{matrix}\right]_2P_2O_7+H_2O$.

Very sl. sol. in H_2O. (Cleve.)

Hydroxyloplatinamine hydroxide, $(OH)_2Pt(NH_3OH)_2$.

Insol. in H_2O. Easily sol. in dil. acids, even $HC_2H_3O_2+Aq$. Not decomp. by boiling KOH+Aq. (Gerhardt, Compt. Chem. **1849.** 490.)

Hydroxyloplatinamine nitrate, $(OH)_2Pt(NH_3NO_3)_2+2H_2O$.

Sl. sol. in cold, easily in hot H_2O; not attacked by cold HCl+Aq. (Cleve.)

——— **oxalate,** $(OH)_2Pt(NH_3)_2C_2O_4+H_2O$.

Sol. in hot H_2O.

——— **sulphate,** $(OH)_2Pt(NH_3)_2SO_4+HO._2$

Difficultly sol. in H_2O. (Cleve.)

Hydroxyloplatin*di*amine bromide, $(OH)_2Pt(NH_3)_4Br_2$.

Sl. sol., even in boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 320.)

——— **chloride,** $(OH)_2Pt(NH_3)_4Cl_2$.

Sol. in 206 pts. cold, and 49 pts. boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 316.)

——— **chromate,** $(OH)_2Pt(NH_3)_4Cr_2O_7$.

Very sl. sol. in cold or hot H_2O. (Carlgren, Sv. V. A. F. **47.** 319.)

Hydroxyloplatin*di*amine iodide, $(OH)_2Pt(NH_3)_4I_2$.
Sl. sol. in hot or cold H_2O. (Carlgren.)

—— **nitrate,** $(OH)_2Pt(NH_3)_4(NO_3)_2$.
Sl. sol. in cold, moderately sol. in hot H_2O. (Gerhardt, A. **76.** 315.)
Sol. in 343 pts. cold, and 38 pts. boiling H_2O. (Carlgren, Sv. V. A. F. **47.** 318.)

—— **nitrite,** $(OH)_2Pt(NH_3)_4(NO_2)_2$.
Easily sol. in H_2O. (Carlgren.)

—— **sulphate,** $(OH)_2Pt(NH_3)_4SO_4$.
Very sl. sol. in boiling H_2O. (Cleve.)
$+4H_2O$. Efflorescent. (Carlgren, Sv. V. A. F. **47.** 313.)

Hydroxyloplatin*monodi*amine nitrate, $(OH)_2Pt\begin{matrix}NH_3NH_3NO_3\\NH_3NO_3\end{matrix}$.
Very easily sol. in H_2O. (Cleve.)

Hydroxyloplatin*semidi*amine nitrate, $(OH)_3PtNH_3NH_3NO_3$(?).
Easily sol. in H_2O. (Cleve.)

—— **sulphate,**
$$\begin{matrix}(OH)_2PtNH_3NH_3\\ \diagdown\diagup \quad (?).\\ SO_4\end{matrix}$$
Sol. in hot H_2O.

Hydroxylo*di*platin*di*amine chloride, $(OH)_2Pt_2(N_2H_6)_4Cl_4+H_2O$.
Extremely sl. sol. in H_2O.

—— ***di*chromate,** $(OH)_2Pt_2(N_2H_6)_4(Cr_2O_7)_2$.
Ppt. (Cleve.)

—— **nitrate,** $(OH)_2Pt_2(N_2H_6)_4(NO_3)_4$.
Very sl. sol. in cold, more easily in hot H_2O. (Cleve.)

—— **phosphate,** $(OH)_2Pt_2(N_2H_6)_4(PO_4H)_2$.
Ppt.

—— **sulphate,** $(OH)_2Pt_2(N_2H_6)_4(SO_4)_2+2H_2O$.
Ppt. Nearly insol. in H_2O.

Hydroxylosulphatoplatin*di*amine bromide,
$$\begin{matrix}(OH)Pt(N_2H_6)_2Br\\ \diagdown\diagup\\ SO_4\end{matrix} +2H_2O.$$
Easily sol. in H_2O. (Cleve.)

—— **chloride,**
$$\begin{matrix}(OH)Pt(N_2H_6)_2Cl\\ \diagdown\diagup\\ SO_4\end{matrix} +2H_2O.$$
Moderately sol. in cold, very sol. in hot H_2O.

Hydroxylosulphatoplatin*di*amine chloroplatinate,
$$2\left[\begin{matrix}(OH)Pt(N_2H_6)_2Cl\\ \diagdown\diagup\\ SO_4\end{matrix}\right], PtCl_4+2H_2O.$$
Ppt.

—— **chromate,**
$$\left[\begin{matrix}(OH)Pt(N_2H_6)_2\\ \diagdown\diagup\\ SO_4\end{matrix}\right]_2 CrO_4+2H_2O.$$
Sl. sol. in H_2O.

—— ***di*chromate,** $$\left[\begin{matrix}(OH)Pt(N_2H_6)_2\\ \diagdown\diagup\\ SO_4\end{matrix}\right]_2 Cr_2O_7.$$
Sl. sol. in H_2O.

—— **nitrate,** $$\begin{matrix}(OH)Pt(N_2H_6)_2NO_3.\\ \diagdown\diagup\\ SO_4\end{matrix}$$
Sol. in hot H_2O.

—— **sulphate,**
$$\left[\begin{matrix}(OH)Pt(N_2H_6)_2\\ \diagdown\diagup\\ SO_4\end{matrix}\right]_2 SO_4+3H_2O.$$
Sl. sol. in H_2O. (Cleve.)

Hypoantimonic acid.

Calcium hypoantimonate (?), $Ca_2Sb_2O_8$.
Min. *Romeite.* Insol. in acids.

Potassium hypoantimonate, $K_2Sb_2O_5$.
Sol. in hot H_2O. Sol. in 425 pts. boiling H_2O (Brandes). Sol. in boiling KOH+Aq (Berzelius).
$K_2Sb_4O_9$. Ppt.

Hypoboric acid.

Sodium hypoborate, $NaOBH_3$.
Deliquescent, decomp. in aq. solution at room temp. Decomp. by acids. Sl. sol. in alcohol with decomp. (Stock, B. 1914, **47.** 821.)

Hypobromous acid, HBrO.

Known only in aqueous solution.
Solution containing 6.21 pts. Br as HBrO in 100 ccm. H_2O decomposes at 30°. If dilute solution is distilled in vacuo, an acid containing 0.736 pt. Br as HBrO in 100 ccm. is obtained at first, but the distillate slowly grows weaker. Dil. solution, stable at ordinary temp., decomp. by heating over 60°. (Dancer A. **125.** 237.)

Barium hypobromite.
Known only in solution.

Calcium hypobromite bromide.

Deliquescent, and sol. in H_2O with partial decomp. (Berzelius.)

Potassium hypobromite, $KBrO$.

Known only in solution.

Sodium hypobromite.

Known only in solution.

Strontium hypobromite.

Known only in solution.

Hypochlorous acid, $HClO$.

Miscible with H_2O. Decomposes at 0° in the dark, more rapidly at higher temp. or in light. The stronger the solution the more rapid the decomposition. Moderately strong acid may be distilled without any considerable decomp., a stronger acid distilling over at first, and afterwards an acid weaker than the original acid. Very conc. or very dil. acids decomp. by distillation.

Ammonium hypochlorite.

Known only in aqueous solution, which decomposes at once.

Barium hypochlorite.

Known only in solution.

Calcium hypochlorite, $Ca(OCl)_2+4H_2O$.

Deliquescent, and sol. in H_2O. (Kinzgett, Chem. Soc. (2) **13.** 404.)

Calcium hypochlorite chloride, etc. (bleaching powder), $Ca(OCl)_2$, $CaCl_2$, $Ca(OH)_2+H_2O$.

Not deliquescent. Sol. in H_2O. Alcohol does not dissolve out $CaCl_2$. Sol. in 20 pts. H_2O with a slight residue.

Correct formula is $CaOCl_2$ (Lunge and Schäppi; Kraut, A. **214.** 354), $Ca{}^{OCl}_{OH}$ (Stahlschmidt, B. **8.** 869), CaOCl, Cl (Odling).

$CaCl_2$ is dissolved out by alcohol. Formula $=2Ca{}^{OH}_{OCl}CaCl+2H_2O$. (Dreyfuss, Bull. Soc. (2) **41.** 600.)

Didymium hypochlorite, $Di(OCl)_3$.

Difficultly sol. in H_2O. Easily sol. in acids. (Frerichs and Smith, A. **191.** 348.)

Lanthanum hypochlorite, $La(OCl)_3$.

Easily sol. in H_2O. (Frerichs and Smith.)

Lithium hypochlorite, $LiClO$.

Known only in solution. (Kraut, A. 1882, **214.** 356.)

Magnesium hypochlorite.

Known only in solution.

Potassium hypochlorite, $KClO$.

Known only in solution.

Silver hypochlorite, $AgClO$.

Very sol. in H_2O, and decomp. very quickly. (Stas, Acad. R. de Belg. **35.** 103.)

Sodium hypochlorite, $NaClO$.

Known only in solution.

Hypoiodic acid, I_2O_4.

See **Iodine** *textr***oxide.**

Hypoiodous acid, HOI.

Known only in solution which decomp. on standing. (Taylor, C. N. 1897, **76.** 97.)

Calcium hypoiodite iodide, $Ca(OI)_2$, CaI_2.

Not very unstable. (Lunge and Shoch, B. **15.** 1883.)

Hyponitric acid, N_2O_4.

See **Nitrogen** *tetr***oxide.**

Hyponitrous acid, HNO, or better $H_2N_2O_2$.

Known only in aqueous solution. Solution is quite stable. (van der Plaats, B. **10. 1507.**)

Very deliquescent; sol. in H_2O and alcohol; sol. in ether, chloroform, benzene; sl. sol. in petroleum ether. (Hantzsch and Kaufmann, A. 1896, **292.** 323.)

Ammonium hyponitrite, $(NH_4)_2N_2O_2$.

Sol. in H_2O and in alcohol. (Jackson, C. N. 1893, **68.** 266.)

Ammonium hydrogen hyponitrite, $NH_4HN_2O_2$

Easily sol. in H_2O. The solid salt slowly decomp. at ord. temp. into ammonia, H_2O and N_2O. (Hantzsch and Kaufmann, A. 1896, **292.** 328.)

Barium hyponitrite, BaN_2O_2.

Nearly insol. in, but gradually decomp. by H_2O. Sol. in conc. acids with evolution of N_2O, but sol. in dil. $HC_2H_3O_2+Aq$ without decomp. (Zorn, B. **15.** 1007.)

$+4H_2O$. Sl. sol. in H_2O; insol. in alcohol and ether. (Kirschner, Z. anorg. 1898, **16.** 424.)

$+xH_2O$. Efflorescent. (Maquenne, C. R. **108.** 1303.)

Barium hydrogen hyponitrite, $BaH_2(N_2O_2)_2$.

Easily sol. in H_2O. (Zorn, B. 1882, **15.** 1011.)

Calcium hyponitrite, $CaN_2O_2+4H_2O$.

Nearly insol. in H_2O; easily sol. in dil. acids. (Maquenne, C. R. **108.** 1303.)

Sl. sol. in H_2O; insol. in alcohol. (Kirschner, Z. anorg. 1898, **16.** 426.)

Cupric hyponitrite, basic, CuN_2O_2, $Cu(OH)_2$.
Insol. in H_2O; not decomp. by hot H_2O. Sol. in dil. acids and in ammonia. Decomp. by NaOH. (Divers, Chem. Soc. 1899, **75.** 121.)
Insol. in H_2O. Sol. in dil. acids and in NH_4OH+Aq. (Kirschner, Z. anorg. 1898, **16.** 430.)

Cuprous hyponitrite, $Cu_2N_2O_2+2H_2O$.
Ppt. (Kolotow, C. C. **1891**, I. 1859.)
Cannot be formed. (Divers, Chem. Soc. 1899, **75.** 121.)

Lead hyponitrite, basic, PbN_2O_2, PbO.
Insol. in H_2O. Sol. in dil. acids from which it may be pptd. by NaOH+Aq or NH_4OH+Aq. (Kirschner, Z. anorg. 1898, **16.** 430.)

Lead hyponitrite, PbN_2O_2.
Insol. in H_2O; sol. in dil. acids from which it may be pptd. by NaOH+Aq or NH_3+Aq. (Kirschner.)

Mercuric hyponitrite, basic, 3HgO, $HgN_2O_2+3H_2O$.
Ppt. Sl. sol. even in boiling dil. HNO_3. Scarcely sol. in conc., very sol. in warm dil. HCl. (Ray, Chem. Soc. 1897, **71.** 349.)

Mercurous hyponitrite, $Hg_2N_2O_2$.
Sol. in dil. HNO_3 with slow decomp. (Ray, Chem. Soc. 1907, **91.** 1404.)

Mercuric hyponitrite, HgN_2O_2.
Sol. in HCl, and in NaCl+Aq.
Sl. sol. in very dil. alkali. (Divers, Chem. Soc. 1899, **75.** 119.)

Potassium hyponitrite, $K_2N_2O_2$.
Sol. in H_2O. (van der Plaats.)
Stable when dry.
Sol. in 90% alcohol, and sl. sol. in abs. alcohol. (Divers, Chem. Soc. 1899, **75.** 103.)

Silver hyponitrite (nitrosyl silver), $Ag_2N_2O_2$.
Insol. in H_2O. Easily sol. in dil. HNO_3+Aq or H_2SO_4+Aq.
Decomp. by H_3PO_4, H_2S, and boiling $HC_2H_3O_2$+Aq. (van der Plaats.)
Insol. in $HC_2H_3O_2$+Aq; sol. in NH_4OH+Aq. (Divers, C. N. **23.** 206.)
Sol. in dil. HNO_3 and H_2SO_4 and in conc. NH_4OH+Aq; decomp. by HCl. (Kirschner, Z. anorg. 1898, **16.** 431.)

Sodium hyponitrite, $Na_2N_2O_2+6H_2O$.
Sol. in H_2O. (van der Plaats.)

Strontium hyponitrite, SrN_2O_2.
Easily sol. in H_2O. (Roederer, Bull. Soc. 1906, (3) **35.** 715.)
$+5H_2O$. Nearly insol. in H_2O; easily sol. in dil. acids. (Maquenne, C. R. **108.** 1303.)
Sl. sol. in H_2O, insol in alcohol. (Kirschner, Z. anorg. 1898, **16.** 426.)

Hypophosphomolybdic acid, Mo_6O_8, $7H_3PO_2+3H_2O$.
Very sl. sol. in cold H_2O. Scarcely sol. in cold dil. H_2SO_4. Sol. in cold conc. H_2SO_4. Sol. in warm conc. HCl. Warm HNO_3 oxidizes forming clear solution. (Mawrow, Z. anorg. 1901, **28.** 164.)

Ammonium hypophosphomolybdate, $2(NH_4)_2O$, $2H_3PO_2$, $8MoO_3+2H_2O$.
Not very sol. in cold H_2O, readily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 402.)

Hypophosphoric acid, $H_4P_2O_6$.
Very deliquescent, and sol. in the least amount of H_2O. (Joly, C. R. **101.** 1058.)
100 cc. $H_4P_2O_6$+Aq, containing 4.1% P_2O_4 has sp. gr. = 1.036.
100 cc. $H_4P_2O_6$+Aq, containing 12.3% P_2O_4 has sp. gr. = 1.122.
(Salzer, A. 1878, **194.** 28.)
$+H_2O$. (Sanger, A. **232.** 14.)
Does not exist. (Joly.)
$+2H_2O$. Appears to be the only stable hydrate between 0° and 60.°
Sänger's hydrate, $H_4P_2O_6+H_2O$, and Joly's anhydride could not be obtained. (Rosenheim, B. 1908, **41.** 2711.)

Aluminum hypophosphate, $Al_4(P_2O_6)_3+23H_2O$.
Easily sol. in mineral acids. Sol. in $Na_4P_2O_6$+Aq. (Palm, Dissertation, Rostock, **1890.**)

Ammonium hypophosphate, $(NH_4)_4P_2O_6+H_2O$.
Sol. in 30 pts. H_2O. (Salzer, A. **194.** 32.)

Ammonium hydrogen hypophosphate, $(NH_4)_2H_2P_2O_6$.
Sol. in 14 pts. cold, and 4 pts. boiling H_2O. (Salzer, A. **194.** 32.)

Ammonium *tri*hydrogen hypophosphate, $NH_4H_3P_2O_6$.
Sol. in H_2O. (Salzer, A. **211.** 1.)

Ammonium magnesium hypophosphate, $(NH_4)_2MgP_2O_6+6H_2O$.
Precipitate. (Salzer, A. **232.** 114.)

Barium hypophosphate, $Ba_2P_2O_6$.
Very slightly sol., but not wholly insol. in H_2O. Very slightly sol. in acetic acid, but more soluble in hydrochloric, and hypophosphoric acids. (Salzer, A. **194.** 34.)

Barium hydrogen hypophosphate, $BaH_2P_2O_6+2H_2O$.
Soluble in about 1000 pts. H_2O. Solution decomposes by heating. (Salzer, A. **194.** 34.)

Bismuth hypophosphate, $Bi_4(P_2O_6)_3+8\frac{1}{2}H_2O$.

Completely sol. in HCl+Aq, also in warm HNO_3+Aq. Insol. in boiling dil. H_2SO_4+Aq. Sl. sol. by long boiling with conc. H_2SO_4. (Palm, Rostock, **1890.**)

Cadmium hypophosphate, $Cd_2P_2O_6+2H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Cadmium potassium hydrogen hypophosphate, $CdK_2(H_2P_2O_6)_2+2\frac{1}{2}H_2O$.

(Bausa, Z. anorg. 1894, **6.** 147.)

Cadmium sodium hypophosphate, $CdNa_2P_2O_6+6H_2O$.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids. (Drawe.)

Calcium hypophosphate, $Ca_2P_2O_6+2H_2O$.

Insol. in H_2O; difficultly sol. in $HC_2H_3O_2$; easily sol. in $H_4P_2O_6$, or HCl+Aq. (Salzer, A. **194.** 36.)

Calcium hydrogen hypophosphate, $CaH_2P_2O_6+6H_2O$.

Sol. in 60 pts. H_2O. (Salzer, A. **232.** 114.)

Chromic hypophosphate, $Cr_4(P_2O_6)_3+34H_2O$.

Sol. in HCl+Aq on sl. warming, also in HNO_3+Aq. Not completely sol. in dil. H_2SO_4+Aq, but completely sol. in conc. H_2SO_4. (Palm, Dissertation, Rostock, **1890.**)

Cobaltous hypophosphate, $Co_2P_2O_6+8H_2O$.

Insol. in H_2O. Easily sol. in acids. (Drawe, B. **21.** 3403.)

Cobaltous potassium hypophosphate, $CoK_2P_2O_6+5H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 156.)

Cobaltous potassium hydrogen hypophosphate, $CoH_2P_2O_6, 3K_2H_2P_2O_6+15H_2O$.

Cobaltous sodium hypophosphate, $CoNa_2P_2O_6+1\frac{1}{2}H_2O$.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Cupric hypophosphate, $Cu_2P_2O_6+6H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3403.)

Ppt. (Bausa, Z. anorg. 1894, **6.** 145.)

Cupric potassium hydrogen hypophosphate, $CuH_2P_2O_6, 3K_2H_2P_2O_6+15H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 152.)

Glucinum hypophosphate, $Gl_2P_2O_6+7H_2O$.

Insol. in H_2O. Moderately sol. in all mineral acids. (Palm, Rostock, **1890.**)

$+3H_2O$. (Rammelsberg.)

Iron (ferrous) hypophosphate, $Fe_2P_2O_6+4\frac{1}{2}H_2O$.

Insol. in H_2O. Sol. in cold HCl+Aq. Decomp. by hot HNO_3+Aq into $Fe_4(P_2O_6)_3$. Insol. in HNO_3+Aq. Insol. in boiling dil. H_2SO_4+Aq. Somewhat sol. in cold H_2SO_4, but a ppt. separates out on heating. (Palm, Rostock, **1890.**)

Iron (ferric) hypophosphate, $Fe_4(P_2O_6)_3+20H_2O$.

Easily sol. in HCl+Aq. Wholly insol. in HNO_3, and dil. H_2SO_4+Aq. Completely sol. in conc. H_2SO_4 by warming a short time, but a ppt. separates out on boiling. (Palm.)

Lead hypophosphate, $Pb_2P_2O_6$.

Insol. in H_2O, $HC_2H_3O_2$, or $H_4P_2O_6$+Aq; sol. in dil. HNO_3+Aq. (Salzer.)

Lithium hypophosphate, $Li_4P_2O_6+7H_2O$.

Very sl. sol. in H_2O. (Salzer, A. **194.** 28.)

Sol. in 120 pts. H_2O at ord. temp. (Rammelsberg, J. pr. (2) **45.** 153.)

$Li_2H_2P_2O_6+2H_2O$. Deliquescent. (Rammelsberg.)

Magnesium hypophosphate, $Mg_2P_2O_6+12H_2O$.

Sol. in 15,000 pts. H_2O; sl. sol. in acetic, easily in hypophosphoric, or mineral acids. (Salzer, A. **232.** 114.)

$+24H_2O$. (Rammelsberg.)

Magnesium hydrogen hypophosphate, $MgH_2P_2O_6+4H_2O$.

Sol. in 200 pts. H_2O. (Salzer, A. **232.** 114.)

Manganese hypophosphate, $Mn_2P_2O_6+2\frac{1}{2}H_2O$.

Insol. in H_2O; sol. in mineral acids, insol. in acetic acid. (Palm, Dissertation, Rostock, **1890.**)

Manganous potassium hydrogen hypophosphate, $MnH_2P_2O_6, K_2H_2P_2O_6+3H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 150.)

Manganous sodium hypophosphate, $Mn_2P_2O_6, Na_4P_2O_6+11H_2O$.

Insol. in H_2O; sol. in mineral acids. (Palm.)

Nickel hypophosphate, $Ni_2P_2O_6+12H_2O$.

Insol. in H_2O. Sol. in dil. acids. (Drawe, B. **21.** 3401.)

Nickel potassium hypophosphate, $NiK_2P_2O_6+6H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 155.)

Nickel potassium hydrogen hypophosphate, $NiH_2P_2O_6, 3K_2H_2P_2O_6+15H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 144.)

Nickel sodium hypophosphate, $NiNa_2P_2O_6+12H_2O$.

Insol. in H_2O, but decomp. thereby. Easily sol. in dil. acids. (Drawe.)

Potassium hypophosphate, $K_4P_2O_6+8H_2O$.

Sol. in ¼ pt. H_2O; insol. in alcohol. (Salzer, A. **211.** 1.)

Potassium hydrogen hypophosphate, $K_3HP_2O_6+3H_2O$.

Sol. in ½ pt. H_2O. (Salzer, A. **211.** 1.)

Potassium *di*hydrogen hypophosphate, $K_2H_2P_2O_6+3H_2O$, and $+2H_2O$.

Sol. in 3 pts. cold, and 1 pt. boiling H_2O. (Salzer, A. **211.** 1.)

Potassium *tri*hydrogen hypophosphate, $KH_3P_2O_6$.

Sol. in 1½ pts. cold, and ½ pt. hot H_2O. (Salzer, A. **211.** 1.)

Potassium *penta*hydrogen *di*hypophosphate, $K_3H_5(P_2O_6)_2+2H_2O$.

Sol. in 2½ pts. cold, and 4/5 pt. boiling H_2O. (Salzer, A. **211.** 1.)

Potassium sodium hypophosphate, $Na_2K_2P_2O_6+9H_2O$.

Sol. in about 25 pts. cold, and 3 pts. hot H_2O. (Bausa, Z. anorg. 1894, **6.** 158.)

Potassium zinc hydrogen hypophosphate, $ZnH_2P_2O_6$, $3K_2H_2P_2O_6+15H_2O$.

Ppt. (Bausa, Z. anorg. 1894, **6.** 148.)

Silver hypophosphate, $Ag_4P_2O_6$.

Sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. Very sl. sol. in $H_4P_2O_6$+Aq. (Salzer, A. **232.** 114.)

Sodium hypophosphate, $Na_4P_2O_6+10H_2O$.

Sol. in about 30 pts. cold, much more easily in hot H_2O. (Salzer.)

Sodium hydrogen hypophosphate, $Na_3HP_2O_6+9H_2O$.

Sol. in 22 pts. H_2O. (Salzer.)

Sodium *di*hydrogen hypophosphate, $Na_2H_2P_2O_6+6H_2O$.

Sol. in 45 pts. cold, and 5 pts. boiling H_2O. More sol. in dil. H_2SO_4+Aq. Insol. in alcohol. (Salzer, A. **187.** 331.)

Sodium *tri*hydrogen hypophosphate, $NaH_3P_2O_6$.

Sol. in H_2O. (Salzer, A. **211.** 1.)

Sodium *tri*hydrogen *di*hypophosphate,

Very efflorescent. Sol. in 15 pts. cold H_2O. (Salzer, A. **211.** 1.)

Thallium hypophosphate, $Tl_4P_2O_6$.

Sl. sol. in H_2O. Decomp. in sunlight. (Joly, C. R. 1894, **118.** 650.)

Thallium hydrogen hypophosphate, $Tl_2H_2P_2O_6$.

Sol. in H_2O. (Joly.)

Zinc hypophosphate, $Zn_2P_2O_6+2H_2O$.

Insol. in H_2O. Easily sol. in dil. acids. (Drawe, B. **21.** 340[illegible].)

Hypophosphorosomolybidc acid.

Barium hypophosphorosomolybdate, BaO, Mo_7O_{20}, $3H_3PO_2+12H_2O$.

Very sol. in H_2O and $BaCl_2$+Aq. (Mawrow, Z. anorg. 1902, **29.** 156.)

Hypophosphorous acid, H_3PO_2.

Very sol. in H_2O and alcohol. (Rose.)

Aluminum hypophosphite.

Not deliquescent, but very sol. in H_2O. (Rose, Pogg. **12.** 86.)

Ammonium hypophosphite, $NH_4H_2PO_2$.

Sol. in H_2O, less deliquescent than the potassium salt. (Wurtz, A. ch. (3) **7.** 193.)

Very sol. in absolute alcohol. (Dulong.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Barium hypophosphite, $Ba(H_2PO_2)_2+H_2O$.

Sol. in 3.5 pts. cold, and 3 pts. boiling H_2O. Insol. in alcohol. (Wurtz, A. **43.** 323.)

Bismuth hypophosphite, $Bi(H_2PO_2)_3$.

Ppt. (Vanino, J. pr. 1906, (2) **74.** 150.)

$+H_2O$. Sol. in acid $Bi(NO_3)_3$+Aq. (Haga, Chem. Soc. 1895, **67.** 229.)

Cadmium hypophosphite.

Sol. in H_2O. (Rose, Pogg. **12.** 91.)

Calcium hypophosphite, $Ca(PH_2O_2)_2$.

Sol. in 6 pts. cold, and not much more sol. in hot H_2O. Insol. in strong, very sol. in weak alcohol. (Rose, Pogg. **9.** 361.)

Calcium cobaltous hypophosphite. $2Ca(PH_2O_2)_2$, $Co(PH_2O_2)_2+2H_2O$.

Efflorescent. (Rose, Pogg. **12.** 295.)

Calcium ferrous hypophosphite.

Sol. in H_2O. (Rose, Pogg. **12.** 294.)

Cerous hypophosphite, $Ce(PH_2O_2)_3+H_2O$.

Sl. sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 437.)

Chromium hypophosphite, $Cr_2(OH)_2(H_2PO_2)_4$.
Anhydrous. Insol. in H_2O or dil. acids.
$+3H_2O$. Sol. in H_2O. (Wurtz, A. ch. (3) **16.** 196.)

Cobaltous hypophosphite, $Co(PH_2O_2)_2+6H_2O$.
Efflorescent. Easily sol. in H_2O. (Rose, Pogg. **12.** 87.)

Cupric hypophosphite, $Cu(PH_2O_2)_2$.
Very sol. in H_2O, but very easily decomp. on heating. (Wurtz, A. ch. (3) **16.** 199.)

Glucinum hypophosphite.
Sol. in H_2O. (Rose, Pogg. **12.** 86.)

Iron (ferrous) hypophosphite, $Fe(PH_2O_2)_2+6H_2O$.
Sol. in H_2O. (Rose, Pogg. **12.** 294.)

Iron (ferric) hypophosphite.
Difficultly sol. in H_2O or acids. Decomp. on boiling. Sl. sol. in H_3PO_2+Aq. (Rose.)

Lead hypophosphite, $Pb(PH_2O_2)_2$.
Difficultly sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Rose, Pogg. **12.** 288.)

Lithium hypophosphite, $LiH_2PO_2+H_2O$.
Sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 416.)

Magnesium hypophosphite, $Mg(PH_2O_2)_2+6H_2O$.
Efflorescent in dry air. Sol. in H_2O. (Rose.)

Manganous hypophosphite, $Mn(H_2PO_2)_2+H_2O$.
Permanent. Very sol. in H_2O. (Wurtz, A. ch. (3) **16.** 195.)

Mercurous hypophosphite nitrate, HgH_2PO_2, $HgNO_3+H_2O$.
Sl. sol. in H_2O with rapid decomp.
Sol. in hot conc. HNO_3. (Haga, Chem. Soc. 1895, **67.** 227.)

Nickel hypophosphite, $Ni(PH_2O_2)_2+6H_2O$.
Efflorescent. Sol. in H_2O. (Rammelsberg, B. **5.** 494.)

Nickel hypophosphite ammonia,
$Ni(H_2PO_2)_2$, $6NH_3$.
(Ephraim, B. 1913, **46.** 3111.)

Platinous hypophosphite $Pt(PH_2O_2)_2$.
Insol. in H_2O, HCl, H_2SO_4+Aq, etc. Sol. in HNO_3+Aq. Insol. in alcohol. (Engel, C. R. **91.** 1068.)

Potassium hypophosphite, KH_2PO_2.
Very deliquescent. Very sol. in H_2O. sol. in weak, less in absolute alcohol. Insol. in ether. (Wurtz, A. ch. (3) **7.** 192.)
Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sodium hypophosphite, $NaH_2PO_2+H_2O$.
Very deliquescent. Somewhat less sol. than the K salt. Very sol. in absolute alcohol. (Dulong.)
Very sol. in H_2O, and somewhat less sol. in alcohol. (Rammelsberg, B. A. B. **1872.** 412.)
Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Strontium hypophosphite, $Sr(PH_2O_2)_2$.
Very easily sol. in H_2O. (Dulong.)
Insol. in alcohol. (Wurtz.)

Thallous hypophosphite, TlH_2PO_2.
Sol. in H_2O. (Rammelsberg, B. A. B. **1872.** 492.)

Uranyl hypophosphite, $UO_2(H_2PO_2)_2+H_2O$.
Sl. sol. in H_2O. Easily sol. in HCl, or HNO_3+Aq. (Rammelsberg, Chem. Soc. (2) **11.** 1.)

***Di*vanadyl hypophosphite,** $V_2O_2(H_2PO_2)_4+2H_2O$.
Insol. in cold, sl. sol. in hot H_2O.
Sol. in hot dil. HCl, H_2SO_4 and HNO_3 and in warm conc. HCl and H_2SO_4.
Insol. in oxalic acid. (Mawrow, Z. anorg. 1907, **55.** 147.)

Zinc hypophosphite, $Zn(H_2PO_2)_2+H_2O$.
Sol. in H_2O.
$+6H_2O$. Efflorescent. (Wurtz, A. ch. (3) **16.** 195.)

Zirconium hypophosphite, $Zr(OPH_2O)_4+H_2O$.
Sensitive to light. Insol. in alcohol, by which it is pptd. from aqueous solution. (Hauser, Z. anorg. 1913, **84.** 93.)

Hypophosphotungstic acid.

Potassium hypophosphotungstate, $4K_2O$, $6H_3PO_2$, $18WO_3+7H_2O$.
Precipitate. Sol. in hot, very sl. sol. in cold H_2O. (Gibbs, Am. Ch. J. **5.** 361.)

Hyposulpharsenious acid.

Hyposulpharsenites, As_2S_2, M_2S.
Difficultly sol. in H_2O. (Berzelius.)
Do not exist. (Nilson, B. **4.** 989.)

Hyposulphuric acid, $H_2S_2O_6$.

See **Dithionic acid.**

Hyposulphurous acid, $H_2S_2O_3$.
See **Thiosulphuric acid.**

Hyposulphurous (Hydrosulphurous) acid, H_2SO_2.

Known only in dil. aqueous solution, which decomposes rapidly.

Correct formula is $H_2S_2O_4$, according to Bernthsen (A. **211.** 285.)

More sol. in alcohol than in H_2O. (Rössler, Arch. Pharm. (3) **25.** 845.)

Ammonium hyposulphite, $(NH_4)_2S_2O_4$.

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) **21.** 326.)

Ammonium hydrogen hyposulphite, $NH_4HS_2O_4$.

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) **21.** 326.)

Calcium hyposulphite, $CaS_2O_4+1.5H_2O$.

Difficultly sol. in H_2O. (Bazlen, B. 1905, **38.** 1059.)

Magnesium hyposulphite, MgS_2O_4.

(Billy, C. R. 1905, **140.** 936.)

Potassium hyposulphite, $K_2S_2O_4+3H_2O$.

Easily decomp.

Insol. in alcohol. (Bazlen, B. 1905, **38.** 1058.)

Sodium hyposulphite, $Na_2S_2O_4$.

Anhydrous. Stable in dry air. (Bazlen, B. 1905, **38.** 1061.)

100 g. H_2O dissolve 24.1 g. of the anhydrous salt at 20°. (Jellinek, Z. anorg. 1911, **70.** 130.)

$+2H_2O$. Solubility in H_2O.

11.6 g. of the solution contain at:

20°	1.91 g.	$Na_2S_2O_4$
10°	1.67 g.	"
1°	1.49 g.	"

(Jellinek, Z. anorg. 1911, **70.** 128.)

Insol. in alcohol. (Bazlen, B. 1905, **38.** 1058.)

Sodium zinc hyposulphite, $Na_2S_2O_4, ZnS_2O_4$.

Less sol. in H_2O than ZnS_2O_4. (Bazlen, B. 1905, **38.** 1060.)

Strontium hyposulphite, SrS_2O_4.

Sol. in H_2O. (Moissan, C. R. 1902, **135.** 653.)

Zinc hyposulphite, ZnS_2O_4.

Easily sol. in H_2O; about 1 pt. in 7 pts. H_2O. Forms supersat. solutions readily. (Bazlen, B. 1905, **38.** 1060.)

Hypovanadic acid, $V_2O_2(OH)_4$.
See **Vanadium** ***tetr*****hydroxide.**

Hypovanadic acid, $H_2V_4O_9$.
See **Vanadous acid.**

Hypovanadic acid ***with*** **vanadic acid.**
See **Vanadicovanadic acid.**

Imido*dimeta*arsenic acid.

Ammonium imido*dimeta*aresenate, $(NH_4O_2As_2O_3NH$.

(Rosenheim and Jacobsohn, Z. anorg. 1906, **50.** 307.)

Imidochromic acid.

Ammonium imidochromate, $NHCrO(ONH_4)_2$.

Very sol. in H_2O with decomp. (Rosenheim and Jacobsohn, Z. anorg. 1906, **50.** 299.)

Ammonium potassium imidochromate, NH_4KCrO_3NH.

Decomp. on solution in H_2O. (Rosenheim, Z. anorg. 1906, **50.** 302.)

Imido*di*imidochromic acid.

Ammonium imido*di*imido chromate, $NH[CrO(NH)ONH_4]_2$.

(Rosenheim and Jacobsohn, Z. anorg 1906, **50.** 303.)

Imidomolybdic acid.

Potassium imidomolybdate, $NKMoO(OK)_2$.

Unstable in air.

Very hygroscopic. Very sol. in H_2O. (Rosenheim, Z. anorg. 1906, **50.** 305.)

Di**imido*****di*****phosphor*****mon*****amic acid,**

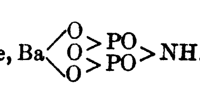
$$HO{-}PO<^{NH}_{NH}>PO{-}NH_2.$$

Correct formula for *pyro*phospho*tri*amic acid of Gladstone. (Mente, A. **248.** 241.)

Imido*di*phosphoric acid,

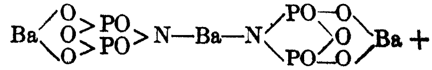
$$HO{-}PO<^{O}_{NH}>PO{-}OH.$$

Correct name for *pyro*phosphamic acid. (Mente, A. **248.** 251.)

Barium imido*di*phosphate, 

Sl. sol. in H_2O. (Mente, A. **248.** 243.)

Barium imido*di*phosphate, basic,



$2H_2O$.

Ppt. (Mente.)

Ferric imido*di*phosphate.
Sl. sol. in conc. acids. (Mente, A. **248.** 241.)

Silver imido*di*phosphate, $Ag_3H_2P_2NO_8$.
Insol. in H_2O. (Stokes, Am. Ch. J. 1896, **18.** 660.)
$Ag_4HP_2NO_6$. Ppt. (Stokes.)

*Di*imido*di*phosphoric acid,

$$HO—PO<{}^{NH}_{NH}>PO—OH.$$

Correct name for *pyro*phospho*di*amic acid. (Mente, A. **248.** 241.)

Barium *di*imido*di*phosphate,

$$NH<{}^{PO}_{PO}>NH{}^{O}_{O}>Ba.$$

Sl. sol. in dil. acids. (Mente, A. **248.** 244.)

Sodium *di*imido*di*phosphate, basic,

$$NaN<{}^{PO}_{PO}{}^{\diagup ONa}_{\diagdown ONa}>NH$$

Sl. sol. in H_2O. (Mente, A. **248.** 245.)

*Di*imido*tri*phosphoric acid.

Silver *di*imido*tri*phosphate, $Ag_3H_4P_3N_2O_8$.
Insol. in H_2O. Very sol. in NH_4OH+Aq. Rather sl. sol. in dil. HNO_3. (Stokes, Am. Ch. J. 1896, **18.** 657.)
$Ag_5H_2P_3N_2O_8$. Insol. in H_2O. Very sol. in NH_4OH+Aq.
Decomp. by HNO_3. (Stokes.)

***Tri*sodium*di*imido*tri*phosphate,**
$P_3N_2O_8H_4Na_3$.
Sol. in H_2O.
Insol. in alcohol. (Stokes.)

*Tri*imido*tetra*phosphoric acid.

Silver *tri*imido*tetra*phosphate.
$Ag_4H_6P_4N_3O_{10}$.
Ppt. (Stokes, Am. Ch. J. 1898, **20.** 755.)

Sodium *tri*imido*tetra*phosphate,
$P_4N_3O_{10}H_5Na_4$.
Easily sol. in H_2O; insol. in sodium acetate solution and dil. alcohol. (Stokes, Am. Ch. J. 1898, **20.** 754.)

Imidosulphamide, $NH_2.SO_2.NH.SO_2.NH_2$.

"Sulphamide" of Traube.
Very sol. in H_2O with decomp. appreciably sol. in cold, easily sol. in hot methyl and ethyl alcohol. Insol. in C_6H_6, and $CHCl_3$. Sl. sol. in ether, cold and hot acetic ether and glacial acetic acid. Moderately stable toward alkalies. (Hantzsch and Stuer, B. 1905, **38.** 1022.)

Ammonium imidosulphamide,
$NH_4S_2O_4N_3H_4$.
(Hantzch and Stuer.)

Imidosulphonic acid,

$$H_3S_2O_6N=HN<{}^{SO_2—OH}_{SO_2—OH.}$$

Ammondisulphonic acid of Claus. Known only in aqueous solution. (Divers and Haga, Chem. Soc. **61.** 943.)
Very unstable. (Berglund, B. **9.** 252.)

Ammonium imidosulphonate, basic,
$(NH_4)N(SO_3NH_4)_2$
Sol. in 9 pts. of H_2O. Solution is stable. Insol. in alcohol.
Sl. sol. in warm conc. H_2SO_4 without decomp. (Rose, Pogg. 1834, **32.** 81.)
Much less sol. than the neutral salt. (Berglund, B. **9.** 255.)
="*Para*sulphatammon."
+H_2O. Gradually effiorescent. Sol. in H_2O with subsequent decomp. (Divers and Haga.)

Ammonium imidosulphonate, $HN(SO_3NH_4)_2$.
Sol. in H_2O. (Raschig, A. **241.** 161.)

Ammonium barium imidosulphonate,
$NH_4BaN(SO_3)_2$(?).
Very sl. sol. in H_2O. (Divers and Haga.)
$(NH_4)_2Ba_5N_4(SO_3)_8+8H_2O$. (D. and H.)

Ammonium calcium imidosulphonate.
(Divers, Chem. Soc. 1892, **61.** 968.)

Ammonium sodium imidosulphonate,
$NH_4Na_5N_2(SO_3)_4+7H_2O$, and $2\frac{1}{2}H_2O$.
Very sl. sol. in NH_4OH+Aq. (Divers and Haga.)

Ammonium sodium imidosulphonate nitrate,
$HN(SO_3NH_4)_2$, $NaNO_3$.
Very sol. in H_2O. (Divers and Haga.)

Barium imidosulphonate, $Ba[N(SO_3)_2Ba]_2+5H_2O$.
Sl. sol. in H_2O. (Berglund, B. **9.** 255.)
Sol. in dil. HNO_3+Aq without decomp. (Divers and Haga.)
$HN(SO_3)_2Ba+H_2O$. Moderately sol. in H_2O. (D. and H.)

Barium mercury imidosulphonate,
$N_2Hg(SO_3)_4Ba_2$.
Almost insol. in cold H_2O. (Divers and Haga, Chem. Soc. 1892, **61.** 977.)

Barium sodium imidosulphonate,
$Ba_{11}Na_8N_{10}(SO_3)_{20}+13H_2O$.
Sparingly sol. in H_2O. Readily sol. in HNO_3 or HCl. (Divers, Chem. Soc. 1892, **61.** 967.)

Calcium imidosulphonate, $Ca[N(SO_3)_2Ca]_2+6H_2O$.

Sl. sol. in H_2O. (Berglund.)

Calcium mercury imidosulphonate, $N_2Hg[(SO_3)_2Ca]_2$.

Very sol. in H_2O. (Divers and Haga, Chem. Soc. 1896, **69.** 1629.)

Calcium mercury imidosulphonate chloride, $(NS_2O_6Ca)_3Hg_2Cl+12H_2O$.

Decomp. by H_2O. (Divers and Haga, Chem. Soc. 1896, **69.** 1629.)

Calcium sodium imidosulphonate, $NaN(SO_3)_2Ca+3H_2O$.

Sl. sol. in cold H_2O. (Divers and Haga, Chem. Soc. **61.** 968.)

Lead imidosulphonate, $(PbOHSO_3)_2NPbOH$.

Ppt. (Berglund.)
Insol. in H_2O. (Divers and Haga.)
$(PbOH)_3N(SO_3)_2$, PbO. Insol. in H_2O; easily sol. in dil. HNO_3+Aq. (D. and H.)

Mercurous imidosulphonate, basic, $[Hg_2N(SO_3)_2Hg_2]_2O+6H_2O$.

Much more sol. in dil. HNO_3 than mercuric salt. Sol. in cold conc. KI+Aq, leaving half Hg as metal. (Divers and Haga, Chem. Soc. 1896, **69.** 1631.)

Mercuric imidosulphonate, basic, $NH(SO_3, HgO)_2Hg$.

Easily decomp. (Divers and Haga.)

Mercuromercuric imidosulphonate, $[Hg^{II}N(SO_3)_2Hg^{I}_2]_2O+3H_2O$.

(Divers and Haga.)
$[Hg^{II}N(SO_3)_2Hg^{I}_2]_2O$, $[Hg^{I}_2N(SO_3)_2Hg_2$, $Hg^{II}N(SO_3)_2Hg^{I}_2]O+6H_2O$. (Divers and Haga.)

Mercury sodium imidosulphonate, basic, $Hg_2ON(SO_3)_2Na+2H_2O$.

Slightly efflorescent. Decomp. by long washing with H_2O. Much more readily sol. in HCl than in HNO_3 or H_2SO_4 and is wholly decomp. thereby. (Divers and Haga, Chem. Soc. 1892, **61.** 983.)

Mercury sodium imidosulphonate, $HgN_2(SO_3Na)_4+6H_2O$.

Sparingly sol. in cold H_2O.
Readily sol in HNO_3 and in HCl.
Decomp. by HCl immediately, but not by HNO_3. (Divers and Haga, Chem. Soc. 1892, **61.** 981.)

Potassium imidosulphonate, basic, $KN(SO_3K)_2+H_2O$.

Sol. in H_2O. (Raschig, A. **241.** 161.)
Less sol. than neutral salt. (Berglund.)

Potassium imidosulphonate, $HN(SO_3K)_2$.

Sol. in H_2O. (Raschig, A. **241.** 161.)
= Potassium ammon*di*sulphonate of Claus.
Difficultly sol. in cold H_2O, sol. in 64 pts. H_2O at 23°. (Fremy.) Gradually decomp. by boiling. (Claus.)
Sl. sol. in H_2O. (Berglund, B. **9.** 255.)

Potassium mercury imidosulphonate, $N_2Hg(SO_3K)_4+4H_2O$.

See **Mercurimidosulphonic acid.**

Silver imidosulphonate, $AgN(SO_3Ag)_2$.

Sl. sol. in H_2O. (Berglund.)

Silver sodium imidosulphonate, $NaN(SO_3Ag)_2$.

Sl. sol. in H_2O. (Divers and Haga.)
$AgNa_2N(SO_3)_2$. Sl. sol. in H_2O, but more sol. than the two preceding salts. (D. and H.)

Sodium imidosulphonate, $HN(SO_3Na)_2+2H_2O$.

Not efflorescent. Very sol. in H_2O. (Diver and Haga.)
$NaN(SO_3Na)_2+12H_2O$. Efflorescent. Sl. sol. in cold H_2O, but very sol. in hot H_2O. Sol. in 5.4 pts. H_2O at 27.5°. (Divers and Haga.)

Sodium strontium imidosulphonate, $SrNaNS_2O_6+3H_2O$.

Sl. sol. in H_2O. (Divers, Chem. Soc. 1896, **69.** 1625.)

Strontium imidosulphonate, $Sr[N(SO_3)_2Sr]_2+6H_2O$.

Sl. sol. in H_2O. (Berglund.)
$+12H_2O$. Somewhat sol. in hot H_2O. (Divers, Chem. Soc. 1896, **69.** 1623.)

Imido*tri*sulpho*ortho*phosphoric acid, $NH:P(SH)_3$.

Insol. in CS_2 and readily decomp. by H_2O. (Stock, B. 1906, **39.** 1991.)

Ammonium imido*tri*sulpho*ortho*phosphate, $NHP(SNH_4)_3$.

Very hydroscopic.
Loses NH_3 in the air.
Somewhat sol. in liquid NH_3.
Decomp. by any other solvent in which it is sol. (Stock, B. 1906, **39.** 1983.)

***Di*ammonium hydrogen imido*tri*sulpho*ortho*phosphate,** $SHP(SNH_4)_2NH$.

(Stock, B. 1906, **39.** 1983.)

Ammonium *di*hydrogen ——, $SNH_4P(SH)_2NH$.

(Stock.)

***Di*sodium hydrogen imido*tri*sulpho*ortho*phosphate,** $SHP(SNa)_2NH$.

Very easily sol. in H_2O. Decomp. by H_2O. Somewhat sol. in methyl and ethyl alcohol. (Stock.)

***Di*imido*penta*sulpho*pyro*phosphoric acid,** $P_2S_5N_2H_6$.

Not known in pure state. (Stock, B. 1906, **39.** 1967.)

Ammonium *di*imido*penta*sulpho*pyro*phosphate, $S[P(SNH_4)_2NH]_2$.

Very hydroscopic.
Sol. in cold H_2O with decomp. (Stock, B. 1906, **39.** 19[illegible].)

Inidosulphurous acid.

Ammonium imidosulphite, $HN(SO_2NH_4)_2$.

Somewhat deliquescent.
Very unstable. Easily sol. in H_2O with decomp. into thiosulphate and amidosulphate.
Insol. in alcohol. (Divers and Ogawa, Chem. Soc. 1901, **79.** 1100.)

Ammonium barium imidosulphite, $Ba(SO_2NHSO_2NH_4)_2$.

Sol. in H_2O. (Divers, Chem. Soc. 1901, **79.** 1102.)

Potassium imidosulphite, $NH(SO_2K)_2$.

(Divers and Owaga, Proc. Chem. Soc. 1900, **16.** 113.)
Very sol. in H_2O. (Divers, Chem. Soc. 1901, **79.** 1101.)

Imidosulphuryl amide, $S_2O_4N_3H_5 =$

$$SO_2 < {NH_2 \atop NH} \atop SO_2 < NH_2.$$

Sol. in NH_4OH+Aq. Decomp. by conc. HCl. Insol. in alcohol sat. with NH_3. (Mente, A. **248.** 265.)

Indic acid.

Magnesium indate, $MgIn_2O_4+3H_2O$.

Ppt. Insol. in H_2O. Sol. in $HCl+Aq$. (Renz, B. 1901, **34.** 2764.)

Indium, In.

Does not decomp. hot H_2O.
Sol. in dil. HCl, and H_2SO_4+Aq. Decomp. by conc. H_2SO_4. Easily sol. in HNO_3+Aq. Insol. in acetic acid. Insol. in $KOH+Aq$. (Winkler, J. pr. **102.** 273.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)
½ ccm. oleic acid dissolves 0.0039 g. In in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Indium *mono*bromide, InBr.

Decomp. by hot H_2O. Easily sol. in acids. Easily sol. in cold conc. HCl. (Thiel, Z. anorg. 1904, **40.** 328.)

Indium *di*bromide, $InBr_2$.

Decomp. by hot H_2O. Easily sol. in acids. (Thiel, Z. anorg. 1904, **40.** 329.)

Indium *tri*bromide, $InBr_3$.

Deliquescent. Very sol. in H_2O.

Indium *mono*chloride, InCl.

Deliquescent. Decomp. by H_2O into $InCl_3$. and In. (Nilson and Pettersson, Chem. Soc. **43.** 820.)

Indium *di*chloride, $InCl_2$.

Deliquescent in moist air; decomp. by H_2O into $InCl_3$ and In. (Nilson and Pettersson, Chem. Soc. **43.** 818.)

Indium *tri*chloride, $InCl_3$.

Very deliquescent; sol. in H_2O with hissing and great evolution of heat.

Indium lithium chloride.

Extremely deliquescent. Sol. in H_2O. (Meyer, A. **150.** 144.)

Indium potassium chloride, $3KCl, InCl_3+1\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Meyer.)

Indium *tri*fluoride, InF_3+3H_2O.

Sol. in H_2O; readily decomp. (Thiel, B. 1904, **37.** 175.)
1 l. H_2O dissolves 86.4 g. at 25°. Decomp. on boiling. (Thiel, Z. anorg. 1904, **40.** 331.)
$+9H_2O$. Sl. sol. in cold H_2O.
Sol. in HCl and in HNO_3.
Insol. in alcohol and ether. (Chabrié, C. R. 1905, **140.** 90.)

Indium hydrosulphide.

Decomp. by acids. (Meyer.)

Indium hydroxide, $In_2O_6H_6$.

Sol. in acids; also in KOH, or $NaOH+Aq$ but the solution clouds up on standing or boiling, with separation of $In_2O_6H_6$. Insol. in NH_4OH, or NH_4Cl+Aq.
Sl. sol. in NH_4OH+Aq. (Renz, B. 1904, **37.** 2110.)
Sl. sol. in alkylamines but completely ppt. by addition of the hydrochloride of the base. (Renz, B. 1903, **36.** 2754.)

Indium *mono*iodide, InI.

Slowly decomp. in moist air. Not attacked by boiling H_2O.
Sol. in dil. HNO_3 in presence of $AgNO_3$. Very slowly sol. in cold, more rapidly sol. in

hot acids with evolution of H_2. Very sol. in sulphurous acid.
Insol. in alcohol. ether and chloroform. (Thiel, Z. anorg. 1910, **66.** 302.)

Indium *di*iodide, InI_2.
(Thiel, Z. anorg. 1910, **66.** 302.)

Indium *tri*iodide, InI_3.
Deliquescent. (Meyer.)
Sol. in $CHCl_3$. Decomp. by xylene. (Thiel, Z. anorg. 1904, **40.** 330.)

Indium nitride, InN.
Decomp. by heat. (Franz Fischer. B. 1910, **43.** 1469.)

Indium *mon*oxide, InO.
Gradually sol. in HCl+Aq. (Winkler, J. pr. **94.** 1.)

Indium *sesqui*oxide, In_2O_3.
Slowly sol. in cold, easily in hot acids.
Four modifications:
(1) Yellow. Amorphous. Sol. in acids. Its hydroxide is insol. in ammonia and NH_4Cl.
(2) White. Amorphous. Insol. in acids.
(3) White. Amorphous. Sol. in acids. Its hydroxide is sol. in ammonia, but pptd. by NH_4Cl.
(4) Crystallized. Crystalline modification is insol. in acids. (Renz, B. 1904, **37.** 2112.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Indium oxide, $In_7O_9 = 3InO, 2In_2O_3$ (?). (Winkler.)
$In_4O_5 = 2InO, In_2O_3$ (?). (Winkler.)

Indium oxybromide (?).
Not decomp. by hot acids or alkalies. (Meyer, A. **150.** 137.)

Indium oxychloride, InOCl.
Very sl. sol. in H_2O. (Thiel, B. 1904, **37.** 176.)
Very sl. sol. in cold or hot dil. acids. Quickly sol. in hot conc. acids. (Thiel, Z. anorg. 1904, **40.** 327.)

Indium *tri*selenide, In_2Se_3.
Sol. in strong acids with evolution of H_2Se. (Thiel, Z. anorg. 1910, **66.** 315.)

***Di*indium sulphide,** In_2S.
Sol. in acids. (Thiel, Z. anorg. 1904, **40.** 326.)

Indium *mono*sulphide, InS.
Easily sol. in HCl with evolution of H_2S. Sol. in HNO_3 with evolution of oxides of nitrogen. (Thiel, Z. anorg. 1910, **66.** 314.)

Indium *sesqui*sulphide, In_2S_3.
Partially sol. in $(NH_4)_2S$+Aq.

Indium potassium sulphide, In_2S_3, K_2S.
Insol. in H_2O; decomp. by weak acids with separation of In_2S_3; sol. in conc. acids. (Schneider, J. pr. (2) **9.** 209.)

Indium silver sulphide, In_2S_3, Ag_2S.
Insol. in H_2O. (Schneider, *l. c.*)

Indium sodium sulphide, In_2S_3, $Na_2S + 2H_2O$.
Insol. in H_2O. (Schneider, *l. c.*)

Indium *mono*telluride, InTe.
Sol. in HNO_3; insol. in HCl+Aq. (Thiel, Z. anorg. 1910, **66.** 318.)

Infusible white precipitate.

***Di*iodamine,** NHI_2.
Decomp. by H_2O.

Iodammonium iodide, NIH_3I.
Decomp. by H_2O, caustic alkalies, and acids. Sol. in KI+Aq, alcohol, ether. CS_2, $CHCl_3$. (Guthrie, Chem. Soc. (2) **1.** 239.)

Iodauric acid, $HAuI_4$ (?).
Not known with certainty.

Ammonium iodaurate.
Deliquescent. Decomp. by H_2O. (Johnston, Phil. Mag. (3) **9.** 266.)

Barium iodaurate.
Sol. in BaI_2+Aq.

Cæsium iodaurate, $CsAuI_4$.
(Gupta, J.Am. Chem. Soc. 1914, **36.** 748.)

Ferrous iodaurate.
Sol. in H_2O. (Johnston.)

Potassium iodaurate, $KAuI_4$.
Decomp. by H_2O. Sol. in KI, and HI+A. (Johnston.)

Sodium iodaurate.
Very deliquescent. (Johnston.)

Iodauricyanhydric acid, $HAu(CN)_2I_2$.
Known only in its salts.

Barium iodauricyanide, $Ba[Au(CN)_2I_2]_2 + 10H_2O$.
Sl. sol. in cold, easily in hot H_2O. Easily sol. in alcohol. (Lindbom, Lund. Univ. Arsk. **12.** No. 6.)

Calcium iodauricyanide, $Ca[Au(CN)_2I_2]_2+10H_2O$.

Not stable. (L.)

Cobalt iodauricyanide, $Co[Au(CN)_2I_2]_2+10H_2O$.

Most insol. of all iodauricyanides, and only sl. sol. in warm H_2O. Easily sol. in alcohol.

Potassium iodauricyanide, $KAu(CN)_2I_2+H_2O$.

Sl. sol. in cold, easily sol. in warm H_2O and alcohol. (L.)

Strontium iodauricyanide, $Sr[Au(CN)_2I_2]_2+10H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

Iodhydric Acid, HI.

Very easily and quickly absorbed by H_2O, with evolution of much heat.

Solution is decomp. on exposure to the air.

1 vol. H_2O absorbs 450 vols. HI at 10°. (Thomson.)

I vol. H_2O absorbs 425 vols. HI at 10°. (Berthelot, C. R. **76.** 679.)

Weak or strong solutions when boiled in an atmosphere of H leave a residue of constant composition, which distils unchanged at 126° (de Luynes), at 127° (Roscoe, Chem. Soc. **13.** 146; Naumann; Topsoë), at 128° (Bineau, A. ch. (3) **7.** 266); and has a sp. gr. of 1.67 (Naumann), of 1.70 (Bineau, de Luynes), of 1.708 (Topsoë); and contains 56.26 % HI (Bineau), 57.0% HI (Roscoe), 57.75% HI (Topsoë.)

By conducting dry H gas through the aqueous solution of HI, a constant residue is obtained, containing 60.3-60.7% HI if temp. is 15-19°, and 58.2-58.5% HI if temp. is 100°. (Roscoe.)

Solubility of HI in H_2O at t°.

t°	% HI	Solid Phase
−10	20.3	Ice
−20	29.3	"
−30	35.1	"
−40	39	"
−50	42	"
−60	44.4	"
−70	46.2	"
−80	47.9	Ice+HI, $4H_2O$
−60	52.6	HI, $4H_2O$
−40	59	"
−35.5	64	"
−40	65.5	"
−49	66.3	HI, $4H_2O$+HI, $3H_2O$
−48	70.3	HI, $3H_2O$
−56	73.5	HI, $3H_2O$+HI, $2H_2O$
−52	74	HI, $2H_2O$

(Pickering, B. 1893, **26.** 2307.)

Solution in H_2O sat. at 0° has sp. gr. =1.99 (de Luynes, A. ch. (4) **2.** 385); 2.0 (Vigier).

Sp. gr. of HI+Aq.

Sp. gr.	% HI	Temp.
1.017	2.286	13.5°
1.0524	7.019	13.5
1.077	10.15	13.5
1.095	12.21	13
1.102	13.09	13.5
1.126	15.73	13.5
1.164	19.97	13.5
1.191	22.63	13.8
1.225	25.86	13.8
1.2535	28.41	13.5
1.274	30.20	13.5
1.309	33.07	13
1.347	36.07	13
1.382	38.68	13
1.413	40.45	13
1.451	43.39	13
1.4865	45.71	13
1.528	48.22	13
1.542	49.13	13.5
1.5727	50.75	13
1.603	52.43	12.5
1.630	53.93	14
1.674	56.15	13.7
1.696	57.28	13
1.703	57.42	12.5
1.706	57.64	13.7
1.708	57.74	12

(Topsoe, B. **3.** 403.)

Sp. gr. of HI+Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
1	1.008	21	1.175	41	1.414
2	1.015	22	1.185	42	1.429
3	1.022	23	1.195	43	1.444
4	1.029	24	1.205	44	1.459
5	1.037	25	1.216	45	1.475
6	1.045	26	1.227	46	1.491
7	1.053	27	1.238	47	1.508
8	1.061	28	1.249	48	1.525
9	1.069	29	1.260	49	1.543
10	1.077	30	1.271	50	1.561
11	1.085	31	1.283	51	1.579
12	1.093	32	1.295	52	1.597
13	1.102	33	1.307	53	1.615
14	1.110	34	1.320	54	1.634
15	1.118	35	1.333	55	1.654
16	1.127	36	1.346	56	1.674
17	1.137	37	1.359	57	1.694
18	1.146	38	1.372	58	1.713
19	1.155	39	1.386	..	...
20	1.165	40	1.400	..	...

(Topsoë, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of HI+Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
5	1.045	25	1.239	45	1.533
10	1.091	30	1.296	50	1.650
15	1.138	35	1.361	52	1.700
20	1.187	40	1.438	..	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. **23.** 253.)

$+2H_2O$. Mpt.—43°. (Pickering, B. 1893, **26.** 2308.)

$+3H_2O$. Mpt.—48°. (Pickering.)

$+4H_2O$. Mpt.—36.5°. (Pickering.)

Iodic acid, HIO_3.

Very sol. in H_2O and alcohol.

100 g. H_2O dissolve 286.1 g. HIO_3 at 13.5°. Sp. gr. of HIO_3+Aq. =2.4256.

100 g. H_2O dissolve 293 g. HIO_3 at 18°. Sp. gr. of HIO_3+Aq. =2.4711.

(Groschuff, Z. anorg. 1905, **47.** 337.)

Solubility of HIO_3 in H_2O at t°.

Solid phase	t°	G. HIO_3 in 100 g. of the solution	G. I_2O_5 in 100 g. of the solution
ice	— 0.30	1.78	1.69
"	— 0.67	4.35	4.13
"	— 1.01	7.17	6.81
"	— 1.90	17.66	16.75
"	— 2.38	27.65	26.22
"	— 4.72	54.19	51.42
"	— 6.32	60 72	57.61
"	—12.25	71.04	67.40
"	—13.5	72.2	68.5
"	—15	73.8	70.0
"	—19	76.2	72.3
ice+HIO_3	—14	72.8	69.1
HIO_3	0	74.1	70.3
"	+16	75.6	71.7
"	40	77.7	73.7
"	60	80.0	75.9
"	80	82.5	78.3
"	85	83.0	78.7
"	101	85.2	80.8
HIO_3+HI_3O_8	110	86.5	82.1
HI_3O_8	125	87.2	82.7
"	140	88.3	83.8
"	160	90.5	85.9

(Groschuff, Z. anorg. 1905, **47.** 343.)

Sat. solution has sp. gr. 2.842 at 12.5°, and boils at 104.° (Ditte, B. **6.** 1533.) Sat. solution has sp. gr. 2.1629 (1.874 pts. I_2O_5 in 1 pt. H_2O) at 13°, and boils at 100°. (Kammerer, Pogg. **138.** 400.)

Sp. gr. of HIO_3+Aq at 15°.

% I_2O_5	Sp. gr.	% I_2O_5	Sp. gr.
1	1.0053	35	1.4428
5	1.0263	40	1.5371
10	1.0525	45	1.6315
15	1.1223	50	1.7356
20	1.2093	55	1.8689
25	1.2773	60	1.9954
30	1.3484	65	2.1269

(Kammerer.)

According to Thomsen (B. **7.** 71) solutions of HIO_3 have sp. gr.—

$HIO_3+\ 10H_2O=1.6609$.
$HIO_3+\ 20H_2O=1.3660$.
$HIO_3+\ 40H_2O=1.1945$.
$HIO_3+\ 80H_2O=1.1004$.
$HIO_3+160H_2O=1.0512$.
$HIO_3+320H_2O=1.0258$.

H_2SO_4 at nearly boiling temp. dissolves 1/8 its weight of iodic acid. (Millon.)

Solubility in HNO_3 containing 27.73% HNO_3.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
18	21	27	38 g. HIO_3.

Solubility in HNO_3 containing 40.88% HNO_3.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
9	10	14	18 g. HIO_3.

(Groschuff, Z. anorg. 1905, **47.** 344.)

Less sol. in HNO_3 than H_2O; nearly insol. in anhydrous HNO_3. (Groschuff, Z. anorg. 1905, **47.** 347.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Unattacked and undissolved by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1362.)

Insol. in absolute alcohol. Alcohol of 35° B. dissolves half its weight in HIO_3. (Kammerer.)

$+4\frac{1}{2}H_2O$.

HIO_3, I_2O_5. (Grosschuff, Z. anorg. 1905, **47.** 343.)

Iodates.

The alkali iodates are sol. in H_2O, the others are sl. sol. or insol. therein.

Aluminum iodate, $Al(IO_3)_3$ (?).

Deliquescent. (Berzelius.)

Ammonium iodate, NH_4IO_3.

Sl. sol. in H_2O. Sol. in 38.5 pts. H_2O at 15°, 6.9 pts .at 100°. (Rammelsberg, Pogg. **44.** 555.)

Solubility of NH_4IO_3 in HIO_3+Aq at 30°.

% HIO_3 in the solution	% NH_4IO_3 in the solution	Solid phase
0	4.20	NH_4IO_3
2.54	3.89	"
4.52	3.83	$NH_4IO_3+NH_4IO_3$, $2HIO_3$
4.51	3.86	"
4.56	3.75	"
4.73	3.53	NH_4IO_3, $2HIO_3$
6.57	1.94	"
8.45	1.09	"
9.12	0.89	"
24.00	0.62	"
36.01	0.41	"
44.43	0.39	"
58.12	0.37	"
76.35	0.31	NH_4IO_3, $2HIO_3+HIO_3$
76.70	0	HIO_3

(Meerburg, Z. anorg. 1905, **45.** 341.)

$+H_2O$. (Ditte, A. ch. (6) **21.** 146.)

Ammonium *di*iodate, $NH_4H(IO_3)_2$.

Sl. sol. in cold H_2O. (Ditte, A. ch. (6) **21.** 145.)

Ammonium *tri*iodate, $NH_4H_2(IO_3)_3$.

Sol. in H_2O. (Blomstrand, J. pr. (2) **42.** 335.)

See also solubility in HIO_3, under **Ammonium iodate.** (Meerburg.)

Ammonium cobalt iodate.

Decomp. by H_2O. Insol. in alcohol. (Rammelsberg.)

Ammonium manganic iodate, $Mn(IO_3)_4$, $2NH_4IO_3$.

Ppt. Insol. in H_2O. Insol. in HIO_3. (Berg, C. R. 1899, **128.** 675.)

Ammonium oxy*di*mercuriammonium iodate.

See **Oxy*di*mercuriammonium ammonium iodate.**

Ammonium tellurium iodate.

See **Iodotellurate, ammonium.**

Ammonium iodate selenate.

See **Iodoselenate, ammonium.**

Barium iodate, $Ba(IO_3)_2$.

Anhydrous salt is sol. in 1746 pts. H_2O at 15°, and 600 pts. H_2O at 100° (Rammelsberg, Pogg. **44.** 577); in 3018 pts. H_2O at 13.5°, and 681 pts. H_2O at 100°. (Kremers, Pogg. **84.** 27.)

Solubility of $Ba(IO_3)_2$ in H_2O. 100 g. sat. $Ba(IO_3)_2$+Aq at t° contain g. anhydrous $Ba(IO_3)_2$.

t°	Grams $Ba(IO_3)_2$	t°	Grams $Ba(IO_3)_2$	t°	Grams $Ba(IO_3)_2$
Eutectic point —0.046° ±0.002°	0.008	30°	0.031	70°	0.093
+10°	0.014	40°	0.041	80°	0.115
20°	0.022	50°	0.056	90°	0.141
25°	0.028	60°	0.074	*99.2°	0.197

*Bpt. at 735 mm. pressure = about 100° at 760 mm. pressure.

(Anschütz, Z. phys. Ch. 1906, **56.** 241.)

1 l. sat. aq. solution contains 0.284 g. $Ba(IO_3)_2$ at room temp. (Hill and Zink, J. Am. Chem. Soc. 1909, **31.** 44.)

1 l. H_2O dissolves 0.3845 g. $Ba(IO_3)_2$ at 25°. (Harkins and Winninghof, J. Am. Chem. Soc. 1911, **33.** 1828.)

Easily sol. in cold HCl+Aq; difficultly sol. in warm HNO_3+Aq. (Rammelsberg.)

Insol. in H_2SO_4. (Ditte.)

100 cc. NH_4OH+Aq (sp. gr. = 0.90) dissolve 0.0199 g. $Ba(IO_3)_2$. (Hill and Zink.)

Solubility in salts+Aq at 25°.

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of $Ba(IO_3)_2$ in salts+Aq expressed in equivalents per l.

Salt	C	S
$Ba(NO_3)_2$	0.001	0.001362
	0.002	0.001212
	0.005	0.0009753
	0.020	0.0006744
	0.050	0.0006131
	0.100	0.0005659
	0.200	0.0005580
KNO_3	0.002	0.001624
	0.010	0.001820
	0.050	0.002640
	0.200	0.003190
KIO_3	0.00010608	0.001510
	0.0005304	0.001242
	0.0010608	0.0009418

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, **33.** 1829.)

Insol. in alcohol.

100 cc. 95% alcohol dissolve 0.0011 g. $Ba(IO_3)_2$ at room temp. (Hill and Zink.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+H_2O$. Sol. in 3333 pts. H_2O at 18°, and 625 pts. H_2O at 100°. (Gay-Lussac, A. ch. **91.** 5.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Barium manganic iodate, $Mn(IO_3)_4$, $Ba(IO_3)_2$.

Insol. in H_2O.

Insol. in HIO_3. (Berg, C. R. 1899, **128.** 675.)

Bismuth iodate, basic.

Insol. in H_2O. Very difficultly sol. in HNO_3+Aq. (Rammelsberg, Pogg. **44.** 568.)

$Bi(IO_3)_3+1\frac{1}{2}H_2O$. Insol. in H_2O.

Cadmium iodate, $Cd(IO_3)_2$.

Very sl. sol. in H_2O. Easily sol. in HNO_3, or NH_4OH+Aq. Sol. in $Cd(C_2H_3O_2)_2$+Aq. (Rammelsberg, Pogg. **44.** 566.)

$+H_2O$. Sl. sol. in H_2O. Very sol. in dil. HNO_3+Aq. (Ditte, A. ch. (6) **21.** 145.)

Cadmium iodate ammonia, $Cd(IO_3)_2$, $2NH_3$.

Insol. in H_2O; sol. in NH_4OH+Aq. (Ditte.) A. ch. (6) **21.** 145.)

$Cd(IO_3)_2, 2NH_3+H_2O$. As above. (Ditte.

Cæsium iodate, $CsIO_3$.

100 pts. H_2O dissolve 2.6 pts. $CsIO_3$ at 24°. Insol. in alcohol. (Wheeler, Sill. Am. J. **144.** 123.)

$2CsIO_3, I_2O_5$. 100 pts. H_2O dissolve 2.5 pts. at 21°. Not decomp. by hot H_2O. (Wheeler.)

$2CsIO_3, I_2O_5, 2HIO_3$. Sl. sol. in cold H_2O. and decomp. thereby into $2CsIO_3, I_2O_5$. (Wheeler.)

Cæsium iodate chloride, $CsCl$, HIO_3.

Decomp. by H_2O into $2CsIO_3, I_2O_5$. (Wheeler.)

Cæsium hydrogen iodate periodate, $HCsIO_3$, IO_4+2H_2O.

Ppt. Sol. in dil. HNO_3. (Wells, Am. Ch. J. 1901, **26.** 280.)

Calcium iodate, $Ca(IO_3)_2$.

100 pts. dissolve 0.22 pt. at 18°, and 0.986 pt. at 100°. (Gay-Lussac.) Sol. in conc. HCl+Aq. (Filhol.) Much more sol. in HNO_3+Aq than in H_2O. (Rammelsberg.) Insol. in H_2SO_4. (Ditte.) Scarcely sol. in sat. KIO_3+Aq. (Sonstadt, C. N. **29.** 209.)

$+H_2O$. Sat. solution contains at:

21°	35°	40°	45°
0.37	0.48	0.52	0.54% $Ca(IO_3)_2$,
50°	60°	80°	100°
0.59	0.65	0.79	0.94% $Ca(IO_3)_2$.

(Mylius and Funk, B. 1897, **30.** 1724.)

$+6H_2O$. Efflorescent.

Sol. in 253 pts. H_2O at 15°, and 75 pts. at 100°. (Rammelsberg.)

Sat. solution contains at:

0°	10°	18°	30°
0.1	0.17	0.25	0.42% $Ca(IO_3)_2$,
40°	50°	54°	60°
0.61	0.89	0.14	1.36% $Ca(IO_3)_2$.

(Mylius and Funk, B. 1897, **30.** 1724.)

Much more sol. in HNO_3+Aq. Pptd. by alcohol from $Ca(IO_3)_2$+Aq.

Insol. in H_2SO_4. (Ditte.)

Pptd. by alcohol from aqueous solution. (Henry.)

Cerous iodate, $Ce(IO_3)_3+2H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O and in acids (Holzmann, J. pr. **75.** 321.)

Solubility in H_2O. 100 cc. of the sat. solution contain 0.1456 g. at 25°. (Rimbach, Z. phys. Ch. 1909, **67.** 199.)

Calc. from electrical conductivity of $Ce(IO_3)_3$+Aq., 100 cc. of the sat. solution contain 0.1636 g. $Ce(IO_3)_3$ at 25°. (Rimbach, Z. phys. Ch. 1909, **67.** 199.)

Ceric iodate, $Ce(IO_3)_4$.

Slightly hydrolyzed by H_2O.

0.34 g. is sol. in 100 cc. hot conc. HNO_3. (Barbieri, Chem. Soc. 1907, **92.** (2) 467.)

Cobaltous iodate, $Co(IO_3)_2$.

Anhydrous. Sol. in warm dil. H_3PO_4, or H_2SO_4+Aq. (Ditte, A. ch. (6) **21.** 14.)

Solubility in H_2O

Form	Temp.	% $Co(IO_3)_2$	Mols. of water free salt to 100 mols H_2O
$Co(IO_3)_2+4H_2O$	0°	0.54	0.028
"	18°	0.83	0.038
"	30°	1.03	0.046
"	50°	1.46	0.065
"	60°	1.86	0.084
"	65°	2.17	0.098
$Co(IO_3)_2+2H_2O$	0°	0.32	0.014
"	18°	0.45	0.020
"	30°	0.52	0.023
"	50°	0.67	0.030
"	75°	0.84	0.038
"	100°	1.02	0.045
$Co(IO_3)_2$	18°	1.03	0.046
"	30°	0.89	0.040
"	50°	0.85	0.036
"	75°	0.75	0.033
"	100°	0.69	0.031

(Meusser, B. 1901, **34.** 2435.)

$+H_2O$. Sol. in 148 pts. H_2O at 15° and 90 pts. at 100°. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **44.** 561.)

Does not exist. (Meusser, B. 1901, **34.** 2434.)

$+2H_2O$. (Meusser.)

$+4H_2O$. (Meusser.)

Cupric iodate, basic, $6CuO, 3I_2O_5+2H_2O$.

Insol. in H_2O. (Millon, A. ch. (3) **9.** 400.)

Mixture of CuO and $Cu(IO_3)_2$. (Ditte, A. ch. (6) **21.** 175.)

$2CuO, I_2O_5+H_2O$. Slowly sol. in dil. H_2SO_4. (Granger and de Schulten, Bull. Soc. 1904, (3) **31.** 1027.)

Cupric iodate, $Cu(IO_3)_2$.

1 l. H_2O dissolves 3.32×10^{-3} mol. $Cu(IO_3)_2$ at 25°. (Spencer, Z. phys. Ch. 1913, **83.** 295.)

Solubility in $CuSO_4$+Aq$=3.28\times10^{-3}$ mol. per l. at 25°.

Solubility in KIO_3+Aq$=3.29\times10^{-3}$ mol. per l. at 25°. (Spencer.)

$+H_2O$. (Ditte.)

$+2H_2O$. Sol. in 302 pts. H_2O at 15°, and 154 pts. at 100°. Sol. in HCl+Aq or NH_4OH+Aq. (Millon.)

Cupric iodate ammonia, $Cu(IO_3)_2, 2NH_3+H_2O$.

Insol. in H_2O. (Ditte, A. ch. (6) **21.** 145.)

$Cu(IO_3)_2, 4NH_3+2H_2O$. Ppt. (Ephraim, B. 1915, **48.** 52.)

$+3H_2O$. Partially sol. in H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol. (Rammelsberg.)

$Cu(IO_3)_2, 5NH_3$. (Ephraim.)

$Cu(IO_3)_2, 8NH_3+4H_2O$. Sol. in H_2O. Sol. in NH_4OH+Aq. Insol. in alcohol. (Ditte, A. ch. (6) **21.** 145.)

Decipium iodate, $Dp(IO_3)_3+3H_2O(?)$.

Precipitate; scarcely sol. in H_2O. (Delafontaine.)

Didymium iodate, $Di(IO_3)_3+2H_2O$.

Ppt. (Cleve.)

Erbium iodate, $Er(IO_3)_3+3H_2O$.

Very sl. sol. in H_2O. (Hoglund.)

Glucinum iodate.

Deliquescent.

Indium iodate, $In(IO_3)_3$.

1 pt. is sol. in 1500 pts. H_2O at 20°.

1 pt. is sol. in 150 pts. HNO_3 (1:5) at 80°. Sol. in HCl with decomp. Sol. in dil. H_2SO_4. (Mathers, J. Am. Chem. Soc. 1908, **30.** 213.)

Iodine iodate, $I(IO_3)_3$.

Decomp. by H_2O or by alcohol. (Fichter, Z. anorg. 1915, **91.** 142.)

Iron (ferrous) iodate.

Ppt. Sl. sol. in H_2O; more sol. in $FeSO_4$+Aq. (Geiger, Mag. Pharm. **29.** 252.)

Iron (ferric) iodate, Fe_2O_3, I_2O_5.

Insol. in acids. (Ditte, A. ch. (6) **21.** 145.)

$Fe_2O_3, 2I_2O_5+8H_2O$. Sol. in 500 pts. H_2O. Difficultly sol. in HNO_3+Aq. Sol. in $FeCl_3$+Aq. (Geiger.)

$3Fe_2O_3, 5I_2O_5+15H_2O$. Sol. in HCl, or HNO_3+Aq. (Rammelsberg.)

Lanthanum iodate, $La(IO_3)_3+1\frac{1}{2}H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. Very sol. in warm HCl+Aq. (Holzmann, J. pr. **75.** 349.)

100 cc. of the sat. solution in H_2O contain 0.1681 g. at 25°. (Rimbach, Z. phys. Ch. 1909, **67.** 199.)

Calc. from electrical conductivity of $La(IO_3)_3$+Aq, 100 cc. of the sat. solution contain 0.1871 g. $La(IO_3)_3$ at 25°. (Rimbach.)

Lead iodate, basic, $3PbO, Pb(IO_3)_2+2H_2O$.

Ppt. (Strömholm, Z. anorg. 1904, **38.** 442.)

Lead iodate, $Pb(IO_3)_2$.

Very sl. sol. in H_2O (Pleischl), and difficultly sol. in HNO_3+Aq. (Rammelsberg.)

Insol. in H_2O and H_2SO_4+Aq. Very sl. sol. in HNO_3+Aq, and wholly insol. therein after being heated to 100°. (Ditte, A. ch. (6) **21.** 169.)

Sl. sol. in H_2O. 1.83×10^{-2} are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O dissolves 19 mg. $Pb(IO_3)_2$ at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

17.8 mg. are dissolved in 1 l. sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

1 l. H_2O dissolves 0.0307 g. $Pb(IO_3)_2$ at 25°. (Harkins, J. Am. Chem. Soc. 1911, **33.** 1830.)

Solubility of $Pb(IO_3)_2$ in salts+Aq at 25°.

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of $Pb(IO_3)_2$ in salt solution expressed in equivalents per l.

Salt	C	S
$Pb(NO_3)_2$	0.0001	0.0000870
	0.001	0.0000411
	0.010	0.0000185
	0.100	0.000016
	0.500	0.000028
	3.0	0.000015
KNO_3	0.002	0.0001141
	0.010	0.0001334
	0.050	0.0002037
	0.200	0.0002544
KIO_3	0.00005304	0.0000697
	0.0001061	0.0000437

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, **33.** 1830.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Lithium iodate, $LiIO_3+\frac{1}{2}H_2O$.

Deliquescent, and very sol. in H_2O.

Sol. in 2 pts. cold, and not much less hot H_2O. Insol. in alcohol. (Rammelsberg, Pogg. **44.** 555.)

Sp. gr. of solution sat. at 18° = 1.568, containing 44.6% $LiIO_3$. 100 g. H_2O dissolve 80.3 pts. $LiIO_3$. (Mylius and Funk, B. 1897, **30.** 1718.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+H_2O$. Very deliquescent. (Ditte, A. ch. (6) **21.** 145.)

Magnesium iodate, $Mg(IO_3)_2$.

Anhydrous. Insol. in H_2O. (Millon, A. ch. (3) **9.** 422.)

$+4H_2O$. Very sol. in H_2O. (Ditte.)

Sol. in 9.43 pts. H_2O at 15°, and 3.04 pts at 100°. (Berzelius.) Very sl. sol. in H_2O. (Serullas, A. ch. **45.** 279.) Easily sol. in dil. H_2SO_4+Aq. (Ditte.)

Sat. solution contains at:

0°	10°	20°
6.8	6.4	7.7% $Mg(IO_3)_2$,
35°	63°	100°
8.9	12.6	19.3% $Mg(IO_3)_2$.

(Mylius and Funk, B. 1897, **30.** 1722.)

Sat. aq. solution at 18° contains 6.44% $Mg(IO_3)_2$ or 6.88 g. are sol. in 100 g. H_2O. Sp. gr. of sat. solution = 1.078. (Mylius and Funk, B. 1897, **30.** 1718.)

$+10H_2O$. Sat. aq. solution contains at:

0°	20°	30°	35°	50° (m.pt.).
3.1	10.2	17.4	21.9	67.5% $Mg(IO_3)_2$.

(Mylius and Funk, B. 1897, **30.** 1723.)

Manganous iodate, $Mn(IO_3)_2+H_2O$.

Sol. in about 200 pts. H_2O. (Rammelsberg.)

Insol. in H_2O and HNO_3+Aq, even on boiling. Insol. in NH_4OH+Aq. (Ditte.)

Manganous manganic iodate,

$Mn(IO_3)_4$, $Mn(IO_3)_2$.

Insol. in H_2O. (Berg, C. R. 1899, **128.** 675.)

Manganic potassium iodate,

$Mn(IO_3)_4$, $2KIO_3$.

Insol. in and only sl. attacked by H_2O.

Insol. in HIO_3. (Berg, C. R. 1899, **128.** 674.)

Mercurous iodate, $Hg_2(IO_3)_2$.

Insol. in boiling H_2O, or cold HNO_3+Aq. Easily sol. in dil. HCl+Aq. Sol. in very conc. HIO_3+Aq. (Lefort, J. Pharm. **1845.** 5.)

Mercuric iodate, $Hg(IO_3)_2$.

Insol. in H_2O or alcohol. (Millon, A. ch. (3) **18.** 367.) Sol. in H_2O. (Berzelius.) Sol. in dil. HCl+Aq. (Rammelsberg.)

Nearly insol. in H_2O. Easily sol. in HCl, HBr, or HI+Aq; very sl. sol. in HNO_3+Aq; insol. in HF, H_2SiF_6, or $HC_2H_3O_2$+Aq. Sol. in alkali chlorides, bromides, iodides, cyanides, and cyanates+Aq; also in $Na_2S_2O_3$, dil. $MnCl_2$ and $ZnCl_2$+Aq. Insol. in KOH, NaOH, NH_4OH, Na_2S, $Na_2B_4O_7$, Na_2HPO_4, and the alkali chlorates, bromates, and iodates +Aq. (Cameron, C. N. **33.** 253.)

Nickel iodate, $Ni(IO_3)_2$.

Solubility in H_2O.

Form	Temp.	Percent of $Ni(IO_3)_2$ in solution	Mols. water free salt to 100 mols. H_2O
$Ni(IO_3)_2+4H_2O$	0°	0.73	0.033
"	18°	1.01	0.045
"	30°	1.41	0.063
$\alpha Ni(IO_3)_2+2H_2O$	0°	0.53	0.023
"	18°	0.68	0.030
"	30°	0.86	0.039
"	50°	1.78	0.080
$\beta Ni(IO_3)_2+2H_2O$	8°	0.52	0.023
"	18°	0.55	0.0245
"	50°	0.81	0.035
"	75°	1.03	0.045
"	100°	1.12	0.049
$Ni(IO_3)_2$	30°	1.135	0.050
"	50°	1.07	0.046
"	75°	1.02	0.045
"	100°	0.988	0.044

(Meusser, B. 1901, **34.** 2440.)

$+H_2O$. Sol. in 120.3 pts. H_2O at 15°, and 77.35 pts. at 100°. (Rammelsberg, Pogg. **44.** 562.)

Sol. in HNO_3, and dil. H_2SO_4+Aq. (Ditte.)

Sol. in NH_4OH+Aq.

Does not exist (Meusser.)

$+2H_2O$. See Meusser above.

$+3H_2O$. Insol. in H_2O. Sol. in HNO_3. (Ditte, A. ch. 1890, (6) **21.** 160.)

$+4H_2O$. See Meusser above.

Nickel iodate ammonia, $Ni(IO_3)_2$, $4NH_3$.

Sol. in NH_4OH+Aq. Insol. in alcohol. (Rammelsberg, Pogg. **44.** 562.)

$Ni(IO_3)_2$, $5NH_3$. Ppt. (Ephraim, B. 1915, **48.** 53.)

$+3H_2O$. (Ephraim.)

Potassium iodate, KIO_3.

1 pt. KIO_3 dissolves in 13 pts. H_2O at 14°. (Gay-Lussac.)

1 pt. KIO_3 dissolves at:

0°	in 21.11 pts. H_2O	
20°	" 12.29	"
40°	" 7.76	"
60°	" 5.40	"
80°	" 4.02	"
100°	" 3.10	"

Sat. solution boils at 102°. (Kremers, Pogg. **97.** 5.)

Sp. gr. of KIO_3+Aq containing:

1	2	3	4	5	% KIO_3,
1.010	1.019	1.027	1.035	1.044	
6	7	8	9	10	% KIO_3.
1.052	1.061	1.071	1.080	1.090	

(Kremers, Pogg. **96.** 62.)

Stable at 10° in H_2O or potassium acetate +Aq. (Eakle, C. C. **1896,** II. 649.)

Solubility of KIO_3 in HIO_3+Aq at 30°.

% HIO_3 in the solution	% KIO_3 in the solution	Solid phase
0	9.51	KIO_3
0.64	9.48	KIO_3+KIO_3, HIO_3
0.66	9.52	"
0.65	9.46	"
0.65	8.90	KIO_3, HIO_3
0.67	6.6	"
1.14	4.57	"
1.69	3.63	"
2.02	3.10	"
3.34	2.14	"
5.00	1.32	"
7.09	1.0	"
8.04	0.85	$KIO_3HIO_3+KIO_3$, $2HIO_3$
3.47	3.57	KIO_3, $2HIO_3$ (labile)
4.80	2.90	"
6.45	1.35	"
9.35	0.64	KIO_3, $2HIO_3$
12.04	0.44	"
17.50	0.30	"
31.20	0.52	"
53.64	0.68	"
62.52	0.72	"
76.40	0.80	KIO_3, $2HIO_3+HIO_3$
76.70	0	HIO_3

(Meerburg, Z. anorg. 1905, **45.** 330.)

More sol. in KI+Aq than in H_2O. Sol. in warm H_2SO_4+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol.

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43** 314.)

+½H_2O. (Ditte, C. R. **70.** 621.)

Potassium hydrogen iodate, $KH(IO_3)_2$.

Sol. in 18.65 pts. H_2O at 17°. (Meineke, A. **261.** 360.)

Sol. in 75 pts. H_2O at 15°. Insol. in alcohol. (Serullas, A. ch. **22.** 181.)

See also Meerburg under KIO_3.

Potassium dihydrogen iodate, $KH_2(IO_3)_3$.

Sol. in 25 pts. H_2O at 15°. (Serullas, A. ch. **43.** 117.)

See also Meerburg under KIO_3.

Potassium tellurium iodate.

See **Iodotellurate, potassium.**

Potassium uranyl iodate, $KUO_2(IO_3)_3+3H_2O$.

Decomp. by H_2O, dil. salt solutions and $UO_2(NO_3)_2$+Aq. (Artmann, Z. anorg. 1913, **79.** 340.)

Potassium iodate chloride, $KH(IO_3)_2$, 2KCl.

Sol. in 19 pts. H_2O at 15° with decomp. Cold alcohol dissolves out KCl.

Potassium iodate molybdate, KIO_3, MoO_3+2H_2O.

See **Molybdatoiodate, potassium.**

Potassium iodate selenate.

See **Iodoselenate, potassium.**

Potassium iodate sulphate, KIO_3 $KHSO_4$.

Decomp. by H_2O. (Marignac, J. B. **1856.** 299.)

$KHIO_3$, $KHSO_4$. More sol. in H_2O than $KHIO_3$. (Serullas.)

Potassium iodate tungstate.

See **Tungstoiodate, potassium.**

Rubidium iodate, $RbIO_3$.

100 pts. H_2O dissolve 2.1 pts. $RbIO_3$ at 23°. Easily sol. in cold HCl+Aq. (Wheeler Sill. Am. J. **144.** 123.)

Rubidium hydrogen iodate, $RbH(IO_3)_2$.

Sl. sol. in cold, more readily in hot H_2O, $RbIO_3$ separating on cooling. Insol. in alcohol. (Wheeler.)

$RbH_2(IO_3)_3$. As above. (Wheeler.)

Rubidium iodate chloride, $RbIO_3$, HCl, or HIO_3, RbCl.

Decomp. by cold H_2O. (Wheeler.)

3RbCl, $2HIO_3$. Sol. in H_2O, from which $RbIO_3$ separates. (Wheeler.)

Rubidium iodate selenate.

See **Iodoselenate, rubidium.**

Samarium iodate, $Sm(IO_3)_3+6H_2O$.

Precipitate. (Cleve.)

Scandium iodate, $Sc(IO_3)_3+10$, 13, 15, and $18H_2O$.

Nearly insol. in H_2O. (Crookes, Phil. Trans. 1910, **210.** A, 361.)

Silver iodate, $AgIO_3$.

1.89×10^{-4} moles or 5.36×10^{-2} g. $AgIO_3$ are sol. in 1 liter H_2O at 25°. (Noyes and Kohr, Z. phys. Ch. 1903, **42.** 338.)

Sl. sol. in H_2O. 4.35×10^{-2} g. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O dissolves 40 mg. $AgIO_3$ at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1 l. H_2O dissolves 0.0275 g. $AgIO_3$ at 9.43°; 0.039 g. at 184°; 0.0539 g. at 26.6°. Solubility increases rapidly with temp. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

1 l. H_2O dissolves 0.039 g. $AgIO_3$ at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)

Not completely insol. in H_2O. (Rose.) Sol. in NH_4OH+Aq; sol. in HNO_3+Aq. (Naquet, J. B. **1860.** 201.) Sol. in conc. KI+Aq. (Ladenburg, A. **135.** 1.)

Sol. in 27,700 pts. H_2O at 25°; in 42.4 pts. 5% NH_4OH+Aq at 25°; in 2.1 pts. 10% NH_4OH+Aq at 25°; in 1044.3 pts. 35% HNO_3+Aq (sp. gr. 1.21) at 25°. (Longi, Gazz. ch. it. **13.** 87.)

Solubility in HNO_3+Aq at 25°.

Normality HNO_3	G. $AgIO_3$ dissolved per l.
0.000	0.0503
0.125	0.0864
0.250	0.1075
0.500	0.1414
1.00	0.2067
2.00	0.3319
4.00	0.6985
8.00	1.5875

(Hill and Simmons, Z. phys. Ch. 1909, **67.** 602.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Insol. in methyl acetate. (Bezold, Dissert. **1906**; Naumann, B. 1909, **42.** 3790); ethyl acetate. (Hamers, Dissert. **1906**; Naumann, B. 1910, **43.** 314.)

Silver iodate ammonia, $2AgIO_3$, $3NH_3+1\frac{1}{2}H_2O$.

Very sol. in cold H_2O. (Ditte, A. ch. (6) **21.** 145.)

$AgIO_3$, $2NH_3$.

Sl. sol. in conc. NH_4OH+Aq. (Rosenheim, A. 1899, **308.** 52.)

Sodium iodate, $NaIO_3$.

100 pts. H_2O dissolve 7.25 pts. $NaIO_3$ at 14.5°. (Gay-Lussac.) 100 pts. H_2O dissolve 2.52 pts. at 0°; 9.07 pts. at 20°; 14.39 pts. at 60°; 27.7 pts. at 80°; 33.9 pts. at 100°. (Kremers, Pogg. **97.** 5.) Sat. solution boils at 102° (Kremers), 105° (Ditte).

Sol. in warm H_2SO_4+Aq diluted with ½ vol. H_2O. Crystallizes out on standing over H_2SO_4. (Ditte.)

Solubility of $NaIO_3$ in HIO_3+Aq at 30°.

% HIO_3 in the solution	% $NaIO_3$ in the solution	Solid phase
0	9.36	$NaIO_3+1\frac{1}{2}H_2O$
1.98	9.52	"
4.86	10.22	"
5.86	11.04	"
7.40	11.60	" labile
9.73	14.73	" labile
6.76	11.18	$NaIO_3+1\frac{1}{2}H_2O+Na_2O, 2I_2O_5$
6.66	11.28	"
7.80	10.30	$Na_2O, 2I_2O_5$
9.15	9.00	"
9.93	8.71	"
11.20	7.54	"
11.89	7.21	$Na_2O, 2I_2O_5+NaIO_3, 2HIO_3$
11.75	7.18	"
14.62	5.65	$NaIO_3, 2HIO_3$
23.23	3.69	"
32.68	2.91	"
40.91	2.64	"
46.02	2.67	"
55.48	2.12	"
65.47	1.83	"
76.19	1.42	$NaIO_3, 2HIO_3+HIO_3$
76.70	0	HIO_3

(Meerburg, Z. anorg. 1905, **45.** 334.)

Insol. in alcohol. Sol. in dil. $HC_2H_3O_2$+Aq.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+1\frac{1}{2}H_2O$. See Meerburg above.

Sodium *di*iodate, Na_2O, $2I_2O_5$.

See Meerburg under $NaIO_3$.

Sodium *tri*iodate, $NaIO_3$, $2HIO_3+\frac{1}{2}H_2O$.

Very sol. in H_2O. (Blomstrand, J. pr. (2) **42.** 337.)

See also Meerburg under $NaIO_3$.

Sodium iodate bromide, $NaIO_3$, $2NaBr+9H_2O$.

Sol. in H_2O. (Rammelsberg.)

Sodium iodate chloride, $NaIO_3$, $NaCl+4H_2O$, and $2NaIO_3$, $3NaCl+18H_2O$.

Cold H_2O dissolves out NaCl.

Sodium iodate iodide, $NaIO_3$, NaI.

Hot H_2O or alcohol dissolves out NaI.

$+8H_2O$.

$+10H_2O$.

$2NaIO_3$, $3NaI+20H_2O$. (Penny, A. **37.** 202.)

Stable in a solution of $NaI+NaOH+Aq$. (Eakle, C. C. **1896**, II. 650.)

Strontium iodate, $Sr(IO_3)_2$.

Anhydrous. Insol. in H_2SO_4 (Ditte); easily sol. in cold $HCl+Aq$. (Rammelsberg, Pogg. **44.** 575.)

$+H_2O$. Difficultly sol. in H_2O.

$+6H_2O$. Sol. in 416 pts. H_2O at 15°, and 138 pts. at 100° (Gay-Lussac); 342 pts. at 15°, and 110 pts. at 100°. Difficultly sol. in warm HNO_3+Aq. (Rammelsberg, Pogg. **44.** 575.)

Thallous iodate, $TlIO_3$.

Difficultly sol. in warm H_2O. (Oettinger.)

Insol. in H_2O; difficultly sol. in HNO_3+Aq. (Rammelsberg.)

Sl. sol. in H_2O.

0.58×10^{-1} g. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

2.12×10^{-3} mols. = 0.667 g. are sol. in 1 l. H_2O at 25°. (Spencer, Z. phys. Ch. 1912, **80.** 707.)

Sol. in a little NH_4OH+Aq, also in boiling HNO_3, H_2SO_4, or $HCl+Aq$. Insol. in alcohol. (Oettinger.)

$+\frac{1}{2}H_2O$. Very sl. sol. in H_2O or dil. boiling acids. (Ditte, A. ch. (6) **21.** 145.)

Thallic iodate, basic, $Tl(OH)(IO_3)_2+H_2O = Tl_2O_3, 2I_2O_5+3H_2O$.

Insol. in H_2O; sol. in cold $HCl+Aq$, and warm dil. H_2SO_4+Aq. (Ditte, A. ch. (6) **21.** 145.)

Thallic iodate, $Tl(IO_3)_3+1\frac{1}{2}\ H_2O$.

Insol. in H_2O; sl. sol. in HNO_3+Aq. Decomp. by alkalies. (Rammelsberg.)

$+12H_2O$. Difficultly sol. in H_2O.

Easily sol. in dil. acids. (Gewecke, Z. anorg. 1912, **75,** 275.)

Thorium iodate, $Th(IO_3)_4$.

Precipitate. (Cleve.)

Tin (stannous) iodate.

Ppt. Sol. in $SnCl_2+Aq$; insol. in $NaIO_3+Aq$.

Tin (stannic) iodate.

Ppt.

Uranous iodate.

Precipitate. Very unstable. (Rammelsberg.)

Uranyl iodate, $UO_2(IO_3)_2$.

Sol. or insol. in HNO_3 and H_3PO_4+Aq, according to method of preparation. (Ditte.)

$+H_2O$. Sl. sol. in HNO_3+Aq. (Rammelsberg.)

Ytterbium iodate, $Yb(IO_3)_3+6H_2O$.

Ppt. (Cleve, Z. anorg. 1902, **32.** 136.)

Yttrium iodate, $Y(IO_3)_3+3H_2O$.

Sol. in 190 pts. H_2O. (Berlin.)

Zinc iodate, $Zn(IO_3)_2$.

Anhydrous. (Ditte, A. ch. (6) **21.** 145.)

$+2H_2O$. Sol. in 114 pts. cold, and 76 pts. hot H_2O. (Rammelsberg, Pogg. **43.** 665.)

Sol. in HNO_3, and NH_4OH+Aq.

Exists also in a very sol. modification. (Mylius and Funk, B. 1897, **30.** 1723.)

Zinc iodate ammonia, $3Zn(IO_3)_2, 8NH_3$.

Decomp. by H_2O; sol. in NH_4OH+Aq, from which it is pptd. by alcohol. (Rammelsberg, Pogg. **44.** 563.)

$Zn(IO_3)_2, 2NH_3$. Insol. in H_2O. (Ditte, A. ch. (6) **21.** 145.)

$Zn(IO_3)_2, 3NH_3+H_2O$. Insol. in H_2O. (Ditte.)

$Zn(IO_3)_2, 4NH_3$. (Ditte, A. ch. 1890, (6) **21.** 164.) (Ephraim, B. 1915, **48.** 53.)

*Per*iodic acid.

See **Periodic acid.**

Iodides.

The iodides are in general easily sol. in H_2O; exceptions are HgI_2, PbI_2, AgI, Cu_2I_2, and BiI_3, also the iodides of the Pt metals, all of which are insol. SnI_4, SbI_3, and TlI_3 are decomp. by H_2O. Many iodides are more sol. in solutions of salts than in H_2O, and several are sol. in alcohol or ether.

See under each element.

Iodine, I_2.

Sol. in 5524 pts. H_2O at 0-12°. (Wittstein, J. B. **1857.** 123.)

Sol. in 7000 pts. H_2O. (Gay-Lussac.)

Sol. in 3800 pts. H_2O at 15°. (Basse.)

Sol. in 500 pts. H_2O. (Jacquelain.)

Sol. in 7196.4 pts. B_2O at 18.75. (Abl.)

Pure H_2O dissolves 0.01519173 g. I per litre, or I is sol. in 6582 pts. H_2O at 6.3°. (Dossius and Weith, Zeit. Ch. **12.** 378.)

Sol. in about 4500 pts. H_2O. (Hager, Comm. **1883.**)

Sol. in 7000 pts. H_2O. (Cap and Garot, J. Pharm. (3) **26.** 80.)

1 l. H_2O at 25° dissolves 0.3387 g. I_2. (Jakowkin, Z. phys. Ch. 1895, **18.** 590.)

1 l. H_2O dissolves 1.342 millimols of iodine at 25°. (Noyes, Z. phys. Ch. 1898, **27.** 359.)

When iodine is shaken with H_2O at 15°, 1 pt. dissolves in 3750 pts. H_2O; when iodine and H_2O are heated together and then cooled to 15°, 1 pt. iodine dissolves in 3500 pts. H_2O.

At 30°, 1 pt. is sol. in 2200 pts. H_2O. (Dietz, Chem. Soc. 1899, **76,** (2) 150.)

1 l. H_2O dissolves 0.279 grams I_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Solubility of I_2 in H_2O at t°.

t°	g. I_2 per l. H_2O
18	0.2765
25	0.3395
35	0.4661
45	0.6474
55	0.9222

(Hartley, Chem. Soc. 1908, **93.** 744.)

Solubility of I_2 in H_2O at t°.

t°	g. per l.	milliat. per l.
0	0.1649	1.30
20	0.2941	2.30
40	0.5684	4 56

(Fedotieff, Z. anorg. 1910, **69.** 30.)

1.32 millimol I_2 are sol. in 1 l. H_2O. (Bray' J. Am. Chem. Soc., 1910, **32.** 938.)

Calculated from electrical conductivity of sat. I_2+Aq. 1 l. H_2O dissolves 0.0006383 mols. I_2 at 0°. (Jones, J. Am. Chem. Soc. 1915, **37.** 256.)

Conc. H_2SO_4, HCl, HNO_3, H_3PO_4, $HC_2H_3O_2$, tartaric, or citric acids+Aq dissolve I, but give it up to CS_2 on shaking therewith. (Tessier, Z. anal. **11.** 313.)

Sol. in 150 pts. H_2SO_4 on warming, but crystallizes out in part on cooling. (Kraus.)

Much more sol. in HBr+Aq than in pure H_2O; HBr+Aq of sp. gr. 1.486 dissolves 3–4%. (Bineau.)

Sl. sol. in HCl+Aq. Easily sol. in even dil. HI+Aq.

1 l. 0.001 N-HCl+Aq sat. with I_2 contains 0.338 g. I_2. (Bray and Mackay, J. Am. Chem. Soc. 1910, **32.** 1919.)

1 l. 0.1 N-HNO_3+Aq sat. with I_2 contains 0.340 g. I_2. (Sammet, Z. phys. Ch. 1905, **53.** 644.)

1 l. 0.1 N-H_2SO_4+Aq sat. with I_2 contains 0.341 g. I_2. (Sammet.)

Sol. in H_2SO_3+Aq with decomp.

1 l. 0.9 N. H_3BO_3 dissolves 0.300 g. I_2 at 25°. (McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

100 cc. of a 10% solution of $BaBr_2$ dissolve 0.231 g. I_2 at 13.5°. (Meyer, Z. anorg. 1902, **30.** 114.)

100 cc. of a 10% solution of $BaCl_2$ dissolve 0.067 g. I_2 at 18.5°. (Meyer.)

100 cc. of a 10% solution of BaI_2 dissolve 6.541 g. I_2 at 13.5.° (Meyer.)

100 cc. of a 10% solution of $CaBr_2$ dissolve 0.274 g. I_2 at 13.5.° (Meyer.)

100 cc. of a 10% solution of $CaCl_2$ dissolve 0.078 g. I_2 at 18.5° (Meyer.)

100 cc. of a 10% solution of CaI_2 dissolve 8.062 g. I_2 at 13.5°. (Meyer.)

Easily sol. in boiling dil. $HgCl_2$+Aq. (Selmi.)

Solubility in $HgCl_2$+Aq at 25°.

10 ccm. of the solution contain:

millimols I_2	millimols Hg
0.0134	0
0 1294	0.9444
0.1460	1.2442
0.1806	1.9542
0.2543	3.3460

(Herz and Paul, Z anorg. 1914, **85.** 214.)

Sol. in solutions of soluble iodides.

100 pts. KI+200 pts. H_2O dissolve 153 pts. I; from this solution H_2O precipitates ½ the dissolved I. 100 pts. KI+400 pts. H_2O dissolve quickly 76.5 pts. I. If more water is present, the solution takes place more slowly. (Baup.)

CS_2 extracts the I from the above solutions.

Solubility of I in KI+Aq at 7–7.3°.

% KI in KI+Aq	Pts I dissolved	Sp. gr. of solution
1.802	1.173	1.0234
3.159	2.303	1.0433
4.628	3.643	1.0668
5.935	4.778	1.0881
7.201	6.037	1.1112
8.663	7.368	1.1382
10.036	8.877	1.1637
11.034	9.949	1.1893
11.893	11.182	1.2110
12.643	12.060	1.2293

(Dossius and Weith, Zeit. Ch. (2) **5.** 379.)

Solubility of I_2 in KI+Aq at room temperature, 14.5°–15.1°.

% KI	% I	I/KI
1.80	1.17	0.651
3.16	2.30	0.729
4.63	3.64	0.786
5.93	4.78	0.805
7.20	6.04	0.839
8.66	7.37	0.851
10.04	8.88	0.884
11.03	9.95	0.902
11.89	11.18	0.940
12.64	12.06	0.954

(Weith and Dossius, Z. phys. Ch. 1898, **26.** 150.)

Solubility of I_2 in KI+Aq at 15°

% KI	ccm. 1/10-n. iodine in 5cmm. of the solution	I/KI
10	35.0	35.0
8	27.1	33.9
6	19.7	32.8
4	12.7	31.8
2	6.25	31.2
1	3.04 *	30.4

* Obtained with 1/100-normal iodine.
(Bruner, Z. phys. Ch. 1898, **26.** 151.)

Solubility of I_2 in KI+Aq at 25°.

Millimols KI per liter	Millimols dissolved iodine per liter
106.3	55.28
53.15	28.03
26.57	14.68
13.29	8.003
6.643	4.667
3.322	3.052
1.661	2.235
0.8304	1.814

(Noyes and Seidenstricker, Z. phys. Ch. 1898, **27.** 359.)

Solubility in KI+Aq at 25°.

KI mol./l.	I G. atoms/l.
1.91	3.29
2.85	5.45
4.51	11.52
5.36	17.12
5.55	17.16

(Abegg, Z. anorg. 1906, **50.** 427.)

Solubility of I_2 in KI+Aq at 25°.

Millimol KI per l.	Millimol I_2 dissolved
100	51.35
50	25.77
20	11.13
10	6.185
5	3.728
2	2.266
1	1.788

(Bray and MacKay, J. Am. Chem. Soc. 1910, **32.** 919.)

Solubility in KI+Aq at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I
(a) In equilibrium with excess of KI.				
1.733	60.39	0.0		0.0
1.888	54.415	11.63	84.92	4.05
2.066	49.045	23.085	85.94	6.32
2.216	44.82	31.01	80.46	10.84
2.539	38.065	44.56	78.56	15.23
2.560	37.655	45.55	77.32	16.73
2.665	35.805	49.61		
3.232	29.71	62.81	39.99	56.10
3.246	27.92	66.45	38.78	56.27
(b) In equilibrium with excess of I.				
1.349	16.025	18.49	3.04	85.43
1.516	19.705	26.16	4.48	83.87
1.769	22.88	36.06	3.70	89.33
1.910	23.55	40.515	6.49	83.62
2.403	24.78	53.605	8.62	83.81
2.904	24.995	63.125	4.82	92.41
3.082	25.18	66.04	4.00	94.39
(c) Invariant point. Excess of KI and I.				
	26.05	68.06		
3.316	25.96	68.01	16.14	83.77
	26.04	68.16		
	25.92	68.13	11.32	86.56

(Parsons and Whittemore, J. Am. Chem. 1911, **33.** 1934.)

Solubility in KI+Aq at 0°.

KI+Aq		KI+Aq. sat. with I_2	
Wt. norm.	Sp. gr. 0°/4°	G. I_2 in 1 g. of solution	Sp. gr. 0°/4°
0.09871	(1.0123)	0.01199	(1.0219)
0.09861	1.01231	0.01199	1.02187
0.04969	(1.0061)	0.006094	(1.0109)
0.04966	1.00610	0.006083	1.01089
0.01992	1.00236	0.002535	1.00429
0.01983	(1.0024)	0.0025325	(1.0044)
0.00998	(1.0011)	0.0013532	(1.0020)
0.00992	(1.0011)	0.0013585	(1.0020)
0.004999	(1.0005)	0.0007609	(1.0010)
0.004991	(1.0005)	0.0007577	(1.0011)
0.002000	(1.0001)	0.0004137	(1.0004)
0.002000	(1.0001)	0.0004015	(1.0004)
0.000999	(0.9999)	0.0002839	(1.0002)
0.000992	(1.0000)	0.00028125	(1.0002)

Values in parentheses are found by interpolation.

(Jones and Hartman, J. Am. Chem. Soc. 1915, **37.** 247.)

1 mol. KI in alcohol dissolves 2 atoms I, and the solution does not give up I to CS_2. (Jörgensen, J. pr. (2) **2.** 347.)

Solubility in KI+60% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% I	% KI
(a) In equilibrium with excess KI.				
1.148	30.93	0.0		0.0
1.191	29.87	4.51	89.13	0.71
1.285	28.39	12.48	86.60	2.27
1.368	28.00	18.60	87.30	3.21
1.427	27.60	21.80	85.75	4.25
1.533	27.00	28.00	84.39	6.05
1.776	25.90	40.52	81.05	10.30
2.250	24.90	52.42	76.21	16.73
2.507	24.40	58.93	73.20	21.04
2.845	22.49	65.75	71.66	24.15
	21.50	68.95	70.04	26.42
(b) In equilibrium with excess I.				
1.134	0.0	23.04	0.0	1
1.530	7.36	43.05	1.40	88.76
1.721	10.60	49.38	2.50	88.21
1.90	12.44	55.33	3.72	87.10
2.11	13.74	59.26	4.41	86.60
2.22	15.20	62.66	5.80	85.20
2.80	17.72	69.10	7.15	85.49
2.99	19.30	71.90	7.45	88.96
(c) Invariant point. Excess KI and I.				
3.162	20.11	72.51	...	....
	20.03	72.46	21.84	74.64 KI+I
	20.05	72.54	...	....
	19.98	72.44	7.40	89.81 I
	20.08	72.51	20.61	74.09 KI+I
	20.06	72.44	...	....
	20.05	72.48	33.46	63.19 KI

(Parsons and Corliss, J. Am. Chem. Soc. 1910, **32.** 1370.)

Solubility in KI+40% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor.	
	% KI	% I	% KI	% I.
(a) In equilibrium with excess KI.				
1.339	42.10	0.0		0.0
1.377	40.83	3.76	89.21	0.70
1.455	38.94	10.09	88.80	1.90
1.532	37.41	15.71	88.19	3.02
1.605	36.25	20.52	87.04	4.21
1.655	35.38	24.44	86.08	5.11
1.847	33.26	33.62	83.61	8.41
2.024	31.71	39.99	82.06	10.76
2.169	30.59	44.76	80.80	12.35
2.558	28.56	55.30	75.90	18.63
2.784	26.95	60.27	74.77	20.86
...	24.52	65.93	72.98	23.61
...	23.04	69.93	72.45	25.04

Solubility in KI+40% alcohol at 25°.—*Continued.*

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I
(b) In equilibrium with excess I.				
0.962	0.0	2.97	0.0	
1.292	8.45	28.70	1.85	84.51
1.581	12.56	40.63	3.41	84.02
...	15.20	49.95	4.98	83.81
2.000	16.02	52.95	5.60	82.96
2.173	17.18	57.38	6.61	83.60
1.749	19.20	66.89	8.45	85.16
2.902	20.12	69.10	7.08	88.81
(c) Invariant point. Excess KI and I.				
3.246	22.50	70.79	19.48	76.24
...	22.43	70.88	69.37	26.14

(Parsons and Corliss, J. Am. Chem. Soc. 1910, **32.** 1372.)

See also under KI.

Sol. in KI+nitrobenzene. (Dawson, Chem. Soc. 1902, **81.** 529.)

Solubility in KIO_3+Aq is the same as in H_2O. (Lami, C. A. **1909.** 1622.)

Solubility of I_2 in KBr+Aq at 25°.

G. KBr per l.	G. atoms I_2 per l.
60.6	0.0176
106.9	0.0278
175.9	0.0415
229.8	0.0532
281.9	0.0628
330.6	0.0717
377.1	0.0797
411.0	0.0864
461.7	0.0948
509.8	0.1006
548.0	0.1062
567.9 sat.	0.1094

(Bell and Buckley, J. Am. Chem. Soc. 1912, **34.** 13.)

Solubility in NaBr+Aq at 25°.

G. NaBr per l.	G. atoms I_2 per l.
96.4	0.0266
187.7	0.0425
271.8	0.0538
357.4	0.0598
422.4	0.0638
499.1	0.0648
569.9	0.0644
632.0	0.0622
679.7	0.0595
750.5	0.0551
756.1 sat.	0.0550

(Bell and Buckley, J. Am. Chem. Soc. 1912, **34.** 13.)

100 cc. of a 10% solution of $SrBr_2$ dissolve 0.270 g. I_2 at 13.50. (Meyer, Z. anorg. 1902, **30.** 114.)

100 cc. of a 10% solution of $SrCl_2$ dissolve 0.066 g. I_2 at 18.5°. (Meyer.)

100 cc. of a 10% solution of SrI_2 dissolve 6.616 g. I_2 at 13.5°. (Meyer.)

Solubility in salts+Aq at 25°.

Salt +Aq	Grams I_2 sol. in 1 liter	Salt +Aq	Grams I_2 sol. in 1 liter
½-N.Na_2SO_4	0.160	N.NaCl	0.575
½-N.K_2SO_4	0.238	N.KCl	0.658
½-N.$(NH_4)_2SO_4$	0.246	N.NH_4Cl	0.735
N.$NaNO_3$	0.257	N.NaBr	3.29
N.KNO_3	0.266	N.KBr	3.801
N.NH_4NO_3	0.375	N.NH_4Br	4.003

(McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

1.14 g. are sol. in 100 ccm. liquid H_2S. (Antony, Gazz. ch. it. 1905, **35,** (1) 206.)

Sol. in liquid NH_3. (Franklin, Am. ch. J. 1898, **20.** 822.)

Sl. sol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Sol. in liquid SO_2 (Sestini), and SO_2 (Weber).

100 pts. $AsCl_3$ dissolve 8.42 pts. I at 0°; 11.88 pts. I at 15°; 36.89 pts. I at 96°. (Sloan, C. N. **46.** 194.)

Sol. in liquid SO_2, $AsCl_3$, SO_2Cl_2, and acetaldehyde. (Walden, Z. phys. Ch. 1903, **43.** 407.)

Very sol. in liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Sol. in 10–12 pts. alcohol. (Wittstein.)

Sol. in wood-spirit. (Playfair.)

Abundantly sol. in amyl (Pelletan), and hexyl alcohol (Bouis).

Iodine is sol. in 20 pts. alcohol, 110 pts. oil, 7000 pts. H_2O, 100 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 80.)

Solubility of I_2 in C_2H_5OH+Aq at room temperature (14.5°—15.1°).

Volumes of C_2H_5OH in 100 volumes of C_2H_5OH +H_2O	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	29.4
80	16.6
70	9.2
60	4.45
50	3.4
40	1.0
30	0.4
20	0.25
10	0.2
0	0.0

(Bruner, Z. phys. Ch. 1898, **26.** 150.)

Solubility of I_2 in C_3H_7OH+Aq at room temperature (14.5°—15.1°).

Volumes of C_3H_7OH in 100 volumes of C_3H_7OH +H_2O	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	36.0
80	23.6
70	16.1
60	10.7
50	6.4
40	3.7
30	1.56
20	0.42
10	0.19
0	....

(Bruner, Z. phys. Ch. 1898, **26.** 150.)

Solubility in ethyl alcohol+Aq at 25°.

Molecules of C_2H_5OH in 100 molecules C_2H_5OH +H_2O	Molecules of H_2O in 100 molecules C_2H_5OH +H_2O	Normality of the iodine solution
0.0	100	0.0022
0.03	99.7(?)	0.0024
0.06	99.4(?)	0.0024
1.12	98.88	0.0023
1.83	98.27(?)	0.0025
9.40	90.60	0.0059
13.48	86.52	0.0111
23.80	76.20	0.0617
50.80	49.20	0.4326
100	0	1.590

(McLauchlan, Z. phys. Ch. 1903, **44.** 627.)

Solubility in acetic acid+Aq at 25°.

Molecules of CH_3COOH in 100 molecules CH_3COOH +H_2O	Molecules of H_2O in 100 molecules CH_3COOH +H_2O	Normality of the iodine solution
0.0	100	0.0022
6.98	93.02	0.0049
16.40	83.60	0.0112
31.90	68.10	0.0331
55.70	44.30	0.0882
100	0	0.205

(McLauchlan, Z. phys. Ch. 1903, **44.** 627.)

Very sol. in ether, chloroform, and bromoform.

Solubility in ether.

100 g. of the sat. solution contain at:

—83°	—90°	—108°
15.39	14.58	15.09 g. I_2.

(Arctowski, Z. anorg. 1896, **11.** 276.)

About as sol. in all fatty oils as in $CHCl_3$, etc. (Gruel, Arch. Pharm. **223.** 431.)

Sol. in 56.6 pts. chloroform at 10°. (Duncan, Pharm. J. Trans. **51.** 544.)

Solubility in $CHCl_3$.

100 g. of the sat. solution contain at:

−49°	−55.5°	−60°	−69.5°	−73.5°
0.188	0.144	0.129	0.089	0.080 g. I_2

(Arctowski, Z. anorg. 1896, **11.** 276.)

Very sol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Solubility of I_2 in $C_6H_6+CHCl_3$ at room temperature (14.5°—15.1°).

Volumes of C_6H_6 in 100 volumes of $C_6H_6+CHCl_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	38.8
80	34.6
70	30.5
60	27.4
50	24.4
40	21.0
30	19.2
20	17.8
10	16.0
0	14.3

(Bruner, Z. phys. Ch. 1898, **26.** 147.)

Solubility of I_2 in CS_2+CHCl_3 at room temperature (14.5°—15.1°).

Volumes of CS_2 in 100 volumes of CS_2+CHCl_3	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	69.4
90	62.7
80	55.9
70	47.9
60	42.0
50	35.8
40	30.4
30	25.3
20	20.8
10	17.0
0	14.3

(Bruner.)

Solubility of I_2 in $C_6H_6+CCl_4$ at room temperature (14.5°—15.1°).

Volumes of C_6H_6 in 100 volumes of $C_6H_6+CCl_4$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	37.2
80	33.6
70	29.6
60	26.1
50	22.4
40	19.25
30	16.1
20	13.4
10	10.75
0	8.1

(Bruner.)

Solubility of I_2 in CS_2+CCl_4 at room temperature (14.5°—15.1°).

Volumes of CS_2 in 100 volumes of CS_2+CCl_4	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	69.1
90	56.9
80	48.6
70	40.7
60	33.9
50	26.9
40	21.8
30	17.7
20	13.25
10	10.2
0	8.1

(Bruner.)

Solubility of I_2 in $C_2H_5OH+CHCl_3$ at room temperature (14.5°—15.1°).

Volumes of C_2H_5OH in 100 volumes of $C_2H_5OH+CHCl_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	37.1
80	34.2
70	30.7
60	27.9
50	26.1
40	24.6
30	22.7
20	19.9
10	17.1
0	14.25

(Bruner.)

Solubility of I_2 in $C_3H_7OH+CHCl_3$ at room temperature (14.5°—15.1°).

Volumes of C_3H_7OH in 100 volumes of $C_3H_7OH+CHCl_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	51.9
80	44.2
70	35.4
60	31.8
50	30.8
40	27.9
30	25.3
20	21.8
10	17.8
0	14.25

(Bruner.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328); (Eidmann, C. C. 1999, II. 1014.)

Sol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Sol. in allyl mustard oil, phenyl mustard

oil, phenyl isocyanate, pyridine, and alcohol. (Mathews, J. phys. Chem. 1905, **9.** 649.)

Solubility of I_2 in glycerine+Aq at 25°.
G=g. glycerine in 100 g. glycerine+Aq.
I_2=g. I_2 in 100 cc. of the solution.

G	I_2	Sp. gr.
0	0.0304	0.9979
7.15	0.0342	1.0198
20.44	0.0482	1.0471
31.55	0.0621	1.0750
40.95	0.0875	1.0995
48.7	0.135	1.1207
69.2	0.278	1.1765
100	1.223	1.2646

(Herz and Knoch, Z. anorg. 1905, **45.** 269.)

1 l. N-$NH_4C_2H_3O_2$+Aq dissolves 0.440 g. I_2 at 25°.

1 l. 0.7 N-$(NH_4)_2C_2O_4$+Aq dissolves 0.980 g. I_2 at 25°.

(McLauchlan, Z. phys. Ch. 1903, **44.** 617.)

Very sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Solubility in CS_2 at t°.

t°.	Grams iodine in 100 g. of sat. solution
—100	0.32
— 95	0.37
— 90	0.41
— 85	0.46
— 80	0.51
— 75	0.55
— 25	3.47
— 20	4.14
— 15	4.82
— 10	5.52
— 5	6.58
0	7.89
+ 5	9.21
10	10.51
15	12.35
20	14.62
25	16.92
30	19.26
36	22.67
40	25.22
42	26.75

(Arctowski, Z. anorg. 1894, **6.** 404.)

1 l. CS_2 dissolves 230 g. I_2 at 25°.
1 l. $CHBr_3$ dissolves 189.55 g. I_2 at 25°.
1 l. CCl_4 dissolves 30.33 g. I_2 at 25°.
(Jakowkin, Z. phys. Ch. 1895, **18.** 590.)

Solubility in CS_2.
100 g. of the sat. solution contain at:

—80°	—87°	—92.5°	—94°
0.509	0.440	0.391	0.378 g. I_2.

(Arctowski, Z. anorg. 1896, **11.** 274.)

When an aqueous solution of I is shaken with CS_2, 400 pts. go into solution in CS_2 for 1 pt. remaining in H_2O. (Berthelot and Jungfleisch, C. R. **69.** 338.)

Abundantly sol. in methane. (Villard, A. ch. 1897, (7) **10.** 387.)

Easily sol. in hot, less in cold naphtha. (Pelletier and Walker.)

Sol. in about 8 pts. hot petroleum from Amiano. (de Saussure.)

Sl. sol. in cold, more readily in hot benzene. (Mansfield.) Easily sol. in benzene. (Moride, A. ch. (3) **39.** 452.)

Solubility in benzene.
100 g. of the sat. solution contain at:

4.7°	6.6°	10.5°	13.7°	16.3°
8.08	8.63	9.60	10.44	11.23 g. I_2.

(Arctowski, Z. anorg. 1896, **11.** 276.)

1 l. benzene sat. with iodine at 25° contains 139 g. iodine. Abegg, Z. anorg. 1906, **50.** 409.)

1 l. nitrobenzene dissolves 50.62 g. I_2 at 16–17°. (Dawson and Gawler, Chem. Soc. 1902, **81.** 524.)

Solubility of I_2 in nitrobenzene+iodides at room temp.

Salt	G. per l.	
	Salt	I_2
KI	12.35	112.7
"	45.56	295.7
"	115.8	698.2
"	155.2	943.6
NaI	13.55	125
"	57.7	393
"	109.1	738
"	228.	1251
RbI	85.4	421
"	217.5	1060
LiI	84.1	642
CsI	48.2	213
"	223.	858
NH_4I	69.5	482
"	94.3	669
SrI_2	106.5	599
BaI_2	42.2	237
"	158.5	809
Aniline hydriodide	164	721
Dimethyl aniline hydriodide	160	626
Tetramethylammonium iodide	49.3	266
"	51.4	280

(Dawson and Goodson, Chem. Soc. 1904, **85.** 796.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Easily sol. in oil of turpentine, but an explosion soon occurs. (Walker.)

Sol. in oil of mandarin. (Luca.)

Sol. in oil of arnica root. (Zeller.)

Very sol. in CS_2, lignone, furfurol, glycerine, aldehyde, chloral, warm retinole, toluene, salicylic acid, methyl nitrate, methyl salicylate, mercaptan, amyl carbamate, ethyl sulphydrate, allyl iodide, ethyl disulphocarbonate, carbon chloride, SCl_2, ICl_3, H_2S_5, chlorochromic acid, amyl valerianate, valerianic acid, warm butyric acid, creosote, aniline, quinoline, methylsalicylic acid. Quickly sol. in oil of dill, peppermint, sassafras, and tansy. Slowly sol. in oil of cloves, cinnamon, cajeput, and rue. Other essential oils decompose it. (Various authorities.)

Sol. in potassium croconate+Aq. (Gmelin.)

Sol. in potassium antimony tartrate+Aq. 176 pts. H_2O+6 pts. potassium antimony tartrate dissolve 2.75 pts. I; 378 pts. H_2O +6 pts. potassium antimony tartrate dissolve 4.12 pts. I

More sol. in tannic acid than in H_2O. 1 pt. I is sol. in 450 pts. H_2O with 3.3 pts. tannic acid at 12°; 1 pt. I is sol. in 240 pts. H_2O with 0.015 pt. tannic acid at about 30°. (Koller, Zeit. Ch. **1866.** 380.)

200 g. H_2O containing 0.3 g. tannic acid dissolve 1.0 g. I. (Hager, Comm. **1883.**)

Sol. in considerable quantity, especially on warming, in resorcin, orcin, or phloroglucin+Aq, without coloration or formation of HI+Aq. These solutions withdraw I from CS_2 solution, and do not give it up on boiling, but on evaporation in vacuo the I is sublimed in a pure state. (Hlasiwetz, Z. anal. **6.** 447.)

Partition coefficient for iodine between CS_2 and Aq at 25°C.

A = concentration of the water layer.
C = concentration of the carbon bisulphide layer.

A	C	h = C/A
0.2571	167.6	651.8
0.2195	140.2	638.7
0.1947	122.0	626.4
0.1743	108.3	620.0
0.1605	98.27	612.2
0.1229	73.23	595.8
0.1104	65.81	596.0
0.0939	55.29	590.5
0.0518	30.36	586.2

Partition coefficient for iodine between $CHBr_3$ and Aq at 25°C.

A = concentration of the water layer.
C = concentration of the $CHBr_3$ layer.

A	C	g = C/A
0.2736	144.36	527.6
0.1752	85.11	485.7
0.1084	49.93	460.5
0.0757	32.65	431.7
0.0517	22.19	429.3

Partition coefficient for iodine between CCl_4 and Aq at 25°C.

A = concentration of the water layer.
C = concentration of the CCl_4 layer.

A	C	h = C/A
0.2913	25.61	87.91
0.1934	16.54	85.51
0.1276	10.88	85.30
0.0818	6.966	85.13
0.0516	4.412	85.77

(Jakowkin, Z. phys. Ch. 1895, **18.** 586–588.)

G. alcohol in 100 cc. of mixture	$\frac{C \text{ aq. alcohol}}{C\ CS_2} \times 10^3$
30.5	1.29
26.7	0.76
22.9	0.49
19.1	0.34
16.3	0.28
11.4	0.23
7.6	0.20

(Osaka, Chem. Soc. 1905, **88.** (2) 811.)

Division of iodine between CS_2 and Na_2SO_4+Aq at 25°.

A = concentration of I in H_2O layer.
C = concentration of I in CS_2 layer.

Na_2SO_4+Aq	A	C
1-N	0.1518	142.4
1/2-N	0.1809	141.7
1/4-N	0.2022	143.6
1/8-N	0.2138	142.4

Division of iodine between CS_2 and $NaNO_3$ +Aq.

$NaNO_3$+Aq	A	C
1-N	0.1923	142.4
1/2-N	0.2090	143.7
1/4-N	0.2164	143.5

(Jakowkin, Z. phys. Ch. 1896, **20.** 25.)

Partition between $CHCl_3$ and glycerine.

C = millimols iodine in 10 g. $CHCl_3$ layer.
W = millimols iodine in 10 g. glycerine layer.

C	W	C/W
0.564	0.244	2.31
0.919	0.397	2.32
0.151	0.500	2.30

(Herz, Z. Elektrochem. 1910, **16.** 870.)

Partition of I_2 between $CHCl_3$ and other solvents.

C = millimols iodine in 10 ccm. of the $CHCl_3$ layer.

W = millimols iodine in 10 ccm. of the other layer.

Other Solvent	C	W	C/W
Water	0.338	0.0025	134.6
	1.546	0.0120	129.0
	2.318	0.0184	126.3
	3.207	0.0242	132.8
	3.439	0.0259	132.8
75% by vol. H_2O+ 25% by vol. glycerine	1.217	0.0183	66.32
	1.893	0.0290	65.33
	2.434	0.0367	66.31
	3.219	0.0483	66.65
50% by vol. H_2O+ 50% by vol. glycerine	1.217	0.0405	30.0
	1.835	0.0609	30.1
	2.376	0.0782	30.4
	3.294	0.1020	32.2
25% by vol. H_2O+ 75% by vol. glycerine	1.188	0.116	10.25
	1.806	0.173	10.45
	2.656	0.249	10.66
	2.859	0.265	10.80
	3.400	0.312	10.93

(Herz, Z. Flektrochem. 1910, **16.** 870.)

Distribution of I_2 between benzene and glycerine at t°.

M_1 = concentration of I_2 in benzene layer expressed in g.-mol. per l.

M_2 = concentration of I_2 in glycerine layer expressed in g.-mol. per l.

t°	M_1	M_2
25°	0.00757	0.001604
	0.01610	0.002664
	0.02719	0.004115
	0.04024	0.005794
	0.06255	0.00834
	0.07923	0.01033
	0.10243	0.01324
	0.12201	0.01559
	0.13342	0.01668
	0.16734	0.02081
40°	0.008545	0.00181
	0.01544	0.002593
	0.04432	0.006242
	0.095004	0.012013
	0.13271	0.01632
	0.18508	0.02193
50°	0.00865	0.00184
	0.01523	0.00253
	0.02683	0.00390
	0.04413	0.00576
	0.0620	0.00744
	0.07832	0.00942
	0.10153	0.01214
	0.12166	0.0145
	0.13199	0.01560
	0.18438	0.02122

(Landau, Z. phys. Ch. 1910, **73.** 202.)

Distribution of I_2 between glycerine and CCl_4 at t°.

M_1 = concentration of I_2 in CCl_4 layer expressed in g.-mol. per l.

M_2 = concentration of I_2 in glycerine layer expressed in g.-mol. per l.

t°	M_1	M_2
25°	0.002230	0.0014386
	0.0024113	0.0014595
	0.0048227	0.0027014
	0.010452	0.005581
	0.038973	0.019959
	0.04598	0.023948
	0.05820	0.030097
40°	0.00227	0.00127
	0.00239	0.00138
	0.00461	0.00272
	0.01092	0.00482
	0.02540	0.01116
	0.04091	0.01749
	0.06074	0.02701
50°	0.00257	0.00118
	0.00500	0.00225
	0.01363	0.00596
	0.02549	0.01050
	0.04167	0.01693
	0.06309	0.02502

(Landau, Z. phys. Ch. 1910, **73.** 203.)

Distribution of I_2 between ether and ethylene glycol at t°.

M_1 = concentration of I_2 in ether layer, expressed in g.-mol. per l.

M_2 = concentration of I_2 in $C_2H_6O_2$ layer, expressed in g.-mol. per l.

t°	M_1	M_2
0°	0.00843	0.00571
	0.03082	0.01713
	0.06551	0.03736
	0.08105	0.04605
	0.12528	0.07148
	0.31511	0.17524
25°	0.00870	0.00571
	0.01677	0.01001
	0.02710	0.01586
	0.03046	0.01713
	0.06385	0.03594
	0.11951	0.06725
	0.30820	0.17524

(Landau, Z. phys. Ch. 1910, **73.** 205.)

Iodine *mono*bromide, IBr.

Slowly sol. in H_2O with slight decomp. Sol. in $CHCl_3$, CS_2, ether, and alcohol.

$+5H_2O$. (Löwig, Pogg. **14.** 485.) Does not exist. (Bornemann, A. **189.** 183.)

Iodine *penta***bromide,** IBr_5(?).

Sol. in H_2O with separation of iodine. (Löwig, Pogg. **14.** 485.)

Iodine *mono***chloride,** ICl.

Decomp. by H_2O; sol. without decomp. in alcohol, ether, and $HCl+Aq$.
Sol. in CS_2.

Iodine hydrogen chloride, ICl, HCl.

Unstable. Sol. in ether. (Schützenberger, C. R. **84.** 389.)

Iodine *tri***chloride,** ICl_3.

Deliquescent. With H_2O, a part is dissolved without decomp., and the rest is decomp. The aqueous solution contains more unchanged ICl_3, the more conc. it is. (Serullas.) Precipitated from aqueous solution by H_2SO_4. Sol. in $HCl+Aq$. Sol. in warm conc. H_2SO_4 without decomp. Sol. in alcohol, and benzene. Decomp. by small amount of CS_2. (Christomanos, B. **10.** 434.) Ether does not remove it from aqueous solution. (Serullas.)

Iodine lithium chloride, ICl_3, $LiCl+4H_2O$.

See **Lithium chloroiodide.**

Iodine *tri***chloride magnesium chloride,** $2ICl_3$, $MgCl_2+5H_2O$.

Very deliquescent and easily decomposed. (Filhol, J. Pharm. **25.** 442.)
$+8H_2O$. Hydroscopic. (Weinland, Z. anorg. 1902, **30.** 141.)

Iodine *tri***chloride manganous chloride,** $2ICl_3$, $MnCl_2+8H_2O$.

Hydroscopic. (Weinland, Z. anorg. 1902, **30.** 139.)

Iodine *tri***chloride nickel chloride,** $2ICl_3$, $NiCl_2+8H_2O$.

Hydroscopic. CCl_4 dissolves out ICl_3. (Weinland, Z. anorg. 1902, **30.** 138.)

Iodine *mono***chloride phosphorus** *penta***chloride,** ICl, PCl_5.

Very deliquescent; decomp. by H_2O.

Iodine potassium chloride, ICl_3, KCl.

Sol. in H_2O with decomp.
Ether dissolves out ICl_3. (Filhol, J. Pharm. **25.** 433, 506.)
See **Potassium chloroiodide.**

Iodine sodium chloride, ICl_3, $NaCl+2H_2O$.

See **Sodium chloroiodide.**

Iodine *tri***chloride strontium chloride,** $2ICl_3$; $SrCl_2+8H_2O$.

Hydroscopic. (Weinland, Z. anorg. 1902, **30.** 142.)

Iodine *tri***chloride sulphur** *tetra***chloride,** ICl_3, SCl_4.

Very deliquescent in air; decomp. by H_2O. Decomp. with formation of clear solution by dil. HNO_3+Aq. (Weber, Pogg. **128.** **459.**)
SCl_2, $2ICl_3$. (Jaillard, J. B. **1860.** **95.**)
Correct formula is as above. (Weber, *l. c.*)
$2ICl_3$, SCl_4. Sol. in SO_2Cl_2, $SOCl_2$, $POCl_3$, warm SCl_2, petroleum ether, ligroin, $CHCl_3$, CCl_4, CS_2 and abs. ether. (Ruff, B. 1904, **37.** 4519.)

Iodine *tri***chloride zinc chloride,** $2ICl_3$, $ZnCl_2+8H_2O$.

Unstable. Hydroscopic. (Weinland, Z. anorg. 1902, **30.** 140.)

Iodine *penta***fluoride,** IF_5.

Fumes in air; decomp. with H_2O. (Gore, C. N. **24.** 291.)
Decomp. by H_2O into iodic acid and HF. Decomp. by solutions of the alkalies. (Moissan, C. R. 1902, **135.** 564.)

Iodine *tri***oxide,** I_2O_3.

Decomp. by H_2O. (Ogier, C. R. **85.** 957; **86.** 722.)
Probably a mixture.

Iodine *tetr***oxide,** I_2O_4(?).

Insol. in cold, decomp. by hot H_2O; insol. in alcohol. Decomp. by HNO_3+Aq. Sol. in H_2SO_4. (Millon, J. pr. **34.** 319, 337.)

Iodine *pent***oxide,** I_2O_5.

Very sol. in H_2O, and in dil. alcohol. Insol. in absolute alcohol, ether, CS_2, chloroform, and hydrocarbons.
Forms hydrates, iodic acid HIO_3, and $3I_2O_5$, H_2O; insol. in ordinary alcohol.
For sp. gr. of aqueous solution, see *iodic acid.*

Iodine oxides, $I_{10}O_{19}$, I_3O_{13}.

The compounds, $I_{10}O_{19}$ (Millon, J. pr. **34.** 336), and I_3O_{13} (Kämmerer, J. pr. **83.** 81), are probably mixtures.
Millon's oxides are impure I_2O_4. (Kappeler, B. 1911, **44.** 3496.)

Iodine sulphur oxide, $5I_2O_5$, SO_3.

Decomp. by H_2O. (Kämmerer.)
I_2O_5, $3SO_3$. Decomp. by H_2O; sl. sol. in hot SO_4. (Weber, B. **20.** 86.)
$=(IO)_2(SO_4)_3$. Iodyl sulphate (?).

Iodine oxyfluoride, IOF_3+5H_2O.

Fumes in the air. (Weinland, Z. anorg. 1908, **60.** 163.)

Iodine sulphide, S_2I_2.

Sol. in CS_2. (Linebarger, Am. Ch. J. 1895, **17.** 57.)

Iodine sulphoxide, I_2SO_3(?).
Decomp. by H_2O. (Schultz-Sellack.)
$I_2(SO_3)_2$(?). Decomp. by H_2O. (Weber, J. pr. (2) **25.** 224.)
$I_2(SO_3)_6$(?). As above. (Weber.)
See also **Iodosulphuric anhydride.**

Iodiridic acid.

Ammonium iodiridate, $(NH_4)_2IrI_6$.
Very easily sol. in cold H_2O, decomp. on warming. Insol. in alcohol. (Oppler, J. B. **1857.** 263.)

Potassium iodiridate, K_2IrI_6.
Very easily sol. in H_2O. Insol. in alcohol.

Sodium iodiridate, Na_2IrI_6.
Insol. in cold, sl. sol. in hot H_2O. Easily sol. in acids. (Oppler.)

Iodiridous acid.

Ammonium iodiridite, $(NH_4)_6Ir_2I_{12}+H_2O$.
Very sol. in H_2O, but decomp. on warming. (Oppler.)

Potassium iodiridite, $K_6Ir_2I_{12}$.
Insol. in H_2O, or alcohol. Slowly sol. in acids; easily in warm alkalies+Aq.

Silver iodiridite, $Ag_6Ir_2I_{12}$.
Ppt.

Iodochloroplatin*di*amine chloride,
$\frac{I}{Cl}Pt(N_2H_6Cl)_2$.
Sl. sol. in H_2O.

Iodochromic acid.

Potassium iodochromate, $KCrO_3I$.
Decomp. by boiling H_2O. (Guyot, C. R. **73.** 46.)
See also **Chromoiodic acid.**

Iodomolybdic acid.
See **Molybdoiodic acid.**

Iodonitratoplatin*monodi*amine bromide,
$\frac{I}{NO_3}Pt\frac{(NH_3)_2Br}{NH_3Br}$(?).
Very sl. sol. in H_2O. (Cleve.)

Iodonitritoplatin*di*amine nitrate,
$I(NO_2)Pt(N_2H_6)_2(NO_3)_2$.
Quite easily sol. in hot H_2O. (Cleve.)

Iodopalladous acid.

Potassium iodopalladite.
Deliquescent. (Lassaigne.)

Iodophosphoric acid.
See **Phosphoiodic acid.**

Iodoplatinamine iodide, $I_2Pt(NH_3I)_2$.
Sol. in H_2O, especially easily if boiling. (Cleve.)

Iodoplatin*di*amine iodide, $I_2Pt(N_2H_6I)_2$.
Sol. in H_2O, especially when hot. (Cleve.)

—— **mercuric iodide, $I_2Pt(N_2H_6I)_2$, $2HgI_2$.**
Extremely difficultly sol. in cold H_2O; partly decomp. by boiling. (Jörgensen, Gm. K. **3.** 1214.)

—— **nitrate, $I_2Pt(N_2H_6NO_3)_2$.**
More sol. in hot than cold H_2O.

—— **sulphate, $I_2Pt(N_2H_6)_2SO_4$.**
Very sl. sol. in H_2O. (Jörgensen, J. pr. (2) **15.** 429.)

Iodoplatin*semidi*amine iodide,
$I_3Pt(NH_3)_2I$(?).
Sl. sol. in H_2O. (Jörgensen, J. pr. (2) **16.** 345.)

—— ***per*iodide, $I_3Pt(NH_3)_2I$, I_2.**
Moderately sl. sol. in H_2O. (Cleve.)

Iodo*di*platinamine iodide, $I_2Pt_2(N_2H_6)_2I_4$.
Insol. in H_2O.

Iodo*di*platin*di*amine anhydroiodide,
$I_2Pt_2(N_2H_6)_4OI_2$.
Insol. in NH_4OH+Aq.

—— **anhydronitrate, $I_2Pt_2(N_2H_6)_4O(NO_3)_2$.**
Easily sol. in warm H_2SO_3+Aq. (Cleve.)

—— **iodide, $I_2Pt_2(N_2H_6)_4I_4$.**
Ppt.

—— **nitrate, $I_2Pt_2(N_2H_6)_4(NO_3)_4+4H_2O$.**
Sl. sol. in cold, moderately sol. in hot H_2O. (Cleve.)

—— **phosphate, $I_2Pt_2(N_2H_6)_4[O_3P(OH)]_2$.**
Nearly insol. in H_2O.

—— **sulphate, $I_2Pt_2(N_2H_6)_4(SO_4)_2$.**
Nearly insol. in H_2O.

—— **plato*di*amine sulphate, $I_2Pt_2(N_2H_6)_4SO_4$, $Pt(NH_3)_2SO_4$.**
Very sl. sol. in H_2O. (Carlgren Sv. V. A. **F. 47.** 306.)

Iodoplatinic acid, $H_2PtI_6+9H_2O$.
Deliquescent. Easily sol. in H_2O, with decomp. into PtI_4 and HI on standing or warming. (Topsoë.)

Ammonium iodoplatinate, $(NH_4)_2PtI_6$.
Easily sol. in H_2O. (Topsoë.)
NH_4I, PtI_4. Sl. sol. in H_2O; insol. in alcohol. (Lassaigne, A. ch. (2) **51.** 128.)

Barium iodoplatinate, $BaPtI_6$.
Deliquescent, but less so than Na_2PtI_6 which it otherwise resembles. (Lassaigne.)

Calcium iodoplatinate, $CaPtI_6+12H_2O$.
Not so deliquescent as Na salt.

Cobalt iodoplatinate, $CoPtI_6+9H_2O$.
Very deliquescent.

Lead *tetra***iodoplatinate,** $[PtI_4(OH)_2]Pb$, $Pb(OH)_2$.
Ppt. (Belluci, C. C. **1902,** I. 625.)

Magnesium iodoplatinate, $MgPtI_6+9H_2O$.
Sol. in H_2O.

Manganese iodoplatinate, $MnPtI_6+9H_2O$.
Very deliquescent.

Mercuric *tetra***iodoplatinate,** $[PtI_4(OH)_2]Hg$.
Ppt. (Belluci, C. C. **1902,** I. 625.)

Nickel iodoplatinate, $NiPtI_6+9H_2O$.
Very deliquescent.

Potassium iodoplatinate, K_2PtI_6.
Easily sol. in H_2O. Insol. in alcohol. Not attacked by cold conc. H_2SO_4.

Silver *tetra***iodoplatinate,** $Pt[I_4(OH)_2]Ag_2$.
Ppt. (Belluci, C. C. **1902,** I. 625.)

Sodium iodoplatinate, $Na_2PtI_6+6H_2O$.
Not deliquescent, but easily sol. in H_2O and alcohol. (Vauquelin.) Deliquescent. (Lassaigne.)

Thallium *tetra***iodoplatinate,** $[PtI_4(OH)_2]Tl_2$.
Ppt. (Belluci, C. C. **1902,** I. 625.)

Zinc iodoplatinate, $ZnPtI_6+9H_2O$.
Easily sol. in H_2O.

Iodoplatinocyanhydric acid, $H_2Pt(CN)_4I_2$.
See **Periodoplatinocyanhydric acid.**

Silver iodoplatinocyanide, $Ag_2(PtI_2(CN_4)_2$.
Ppt. (Miolati, Gazz. ch. it. 1900, **30.** 588.)

Strontium iodoplatinocyanide platinocyanide, $SrPt(CN)_4I_2$, $10SrPt(CN)_4+xH_2O$.
(Holst.)

Iodopurpureochromium chloride, $ICr(NH_3)_5Cl_2$.
Quite sol. in H_2O. (Jörgensen, J. pr. (2) **25.** 83.)

—— **chloroplatinate,** $ICr(NH_3)_5PtCl_6$.
Precipitate. (Jörgensen, *l. c.*)

—— **iodide,** $ICr(NH_3)_5I_2$.
Difficultly sol. in H_2O. Insol. in HI, or KI+Aq; insol. in alcohol. (Jörgensen, l. c.)

—— **nitrate,** $ICr(NH_3)_5(NO_3)_2$.
Much less sol. in H_2O than the chloride. (Jörgensen, l. c.)

Iodopurpureocobaltic iodide, $CoI(NH_3)_5I_2$.
(Claudet.)
Does not exist. (Jörgensen, J. pr. (2) **25.** 94.)

Iodopurpureorhodium chloride, $IRh(NH_3)_5Cl_2$.
Relatively easily sol. in H_2O; insol. in HCl +Aq and alcohol. Insol. in KI+Aq. (Jörgensen, J. pr. (2) **27.** 433.)

—— **fluosilicate,** $IRh(NH_3)_5SiF_6$.
Nearly insol. in cold H_2O.

—— **iodoplatinate,** $IRh(NH_3)_5PtI_6$.
Ppt.

—— **iodide,** $IRh(NH_3)_5I_2$.
Very sl. sol. in cold H_2O; more sol. in hot H_2O; insol. in dil. HI+Aq, and alcohol. (Jörgensen, J. pr. (2) **27.** 433.)

—— **nitrate,** $IRh(NH_3)_5(NO_3)_2$.
Sl. sol. in H_2O, more easily sol. in hot H_2O; insol. in dil. HNO_3+Aq, and alcohol.

—— **sulphate,** $IRh(NH_3)_5SO_4$, and $+3H_2O$.
Sl. sol. in even hot H_2O. (Jörgensen.)

Iodoselenic acid.

Ammonium iodoselenate, $2(NH_4)_2O$, I_2O_5 $2SeO_3+H_2O$.
Decomp. by H_2O. (Weinland, B. 1903, **36.** 1400.)
$2(NH_4)_2O$, $3I_2O_5$, $2SeO_3+5H_2O$. Sol. in H_2O with decomp.(?). (Weinland.)

Potassium iodoselenate, $2K_2O$, I_2O_5, $2SeO_3+H_2O$.
Decomp. by H_2O. (Weinland.)
$2K_2O$, $3I_2O_5$, $2SeO_3+5H_2O$. Sol. in H_2O with decomp.(?) (Weinland.)

Rubidium iodoselenate, $2Rb_2O, 3I_2O_5, 2SeO_3+5H_2O$.

Sol. in H_2O. (Weinland.)

Iodostannous acid.

Data concerning solubility of SnI_2 in HI+Aq indicate formation of this compound. (Young, J. Am. Chem. Soc. 1897, **19**. 853.)

Iodosulphobismuthous acid.

Cuprous iodosulphobismuthite, $2Cu_2S, Bi_2S_3, 2BiSI$.

Decomp. by H_2O at ord. temp. Decomp. by mineral acids with evolution of H_2S. (Ducatte, C. R. 1902, **134**. 1213.)

Lead iodosulphobismuthite, $PbS, Bi_2S_3, 2BiSI$.

Insol. in H_2O. Partially decomp. by boiling H_2O. Decomp. by dil. mineral acids with evolution of H_2S. (Ducatte.)

Iodosulphuric acid.

Ammonium iodosulphate, $(NH_4)_2SO_3I_2$(?).

Very sol. in H_2O. (Zinno, N. Rep. Pharm. **20**. 449.)

Mercuric iodosulphate, $Hg_2(SO_4)I_2$.

See **Mercuric sulphate iodide.**

Potassium iodosulphate, $K_2SO_3I_2$(?).

Sol. in 7.14 pts. H_2O at 15°. (Zinno, N. Rep. Pharm. **20**. 449.)

Sodium iodosulphate, $Na_2SO_3I_2+10H_2O$.

Sol. in 3.64 pts. H_2O at 15° and in dil. alcohol. (Zinno, N. Rep. Pharm. **20**. 449.)

Does not exist. (Michaelis and Koethe, B. **6**. 999.)

Iodosulphuric anhydride, ISO_3.

Decomp. very violently by H_2O. (Weber, J. pr. (2) **25**. 224.)

***Di*iodosulphuric anhydride,** I_2SO_3.

Decomp. with H_2O, but not so violently as ISO_3. (Weber, J. pr. (2) **25**. 224.)

Iodo*tri*sulphuric anhydride, $I(SO_3)_3$.

Decomp. by H_2O. (Weber, J. pr. (2) **25**. 224.)

Iodotelluric acid.

Ammonium iodotellurate, $(NH_4)_2O, I_2O_5, 2TeO_3+6H_2O$.

Sol. in H_2O. (Weinland, Z. anorg. 1901, **28**. 52.)

$(NH_4)_2O, I_2O_5, 2TeO_3+8H_2O$. Sol. in H_2O. (Weinland, B. 1900, **33**. 1017.)

Cæsium iodotellurate, Cs_2TeI_4.

Insol. in CsI, or HI+Aq. Decomp. slowly by cold, rapidly by hot H_2O. (Wheeler, Sill. Am. J. **145**. 267.)

Potassium iodotellurate, $K_2TeI_6+2H_2O$.

Sl. efflorescent. Somewhat sol. in KI+Aq, and dil. HI+Aq. (Wheeler.)

$K_2O, I_2O_5, TeO_3+3H_2O$. Sol. in H_2O. Partially decomp. on recryst. from H_2O. (Weinland, Z. anorg. 1901, **28**. 53.)

$K_2O, I_2O_5, 2TeO_3+6H_2O$. Sol. in H_2O without decomp. (Weinland.)

Rubidium iodotellurate, Rb_2TeI_6.

Sl. sol. in HI, or RbI+Aq. Decomp. by H_2O. Somewhat sol. in alcohol. (Wheeler.)

$Rb_2O, I_2O_5, 2TeO_3+6H_2O$. Sol. in H_2O. (Weinland.)

Iodotetramine chromium iodide, $ICr(NH_3)_4I_2+H_2O$.

Sol. in H_2O. Pptd. by alcohol. (Cleve.)

Iodotetramine cobaltic sulphate, $ICo(NH_3)_4SO_4$.

(Vortmann and Blasberg, B. **22**. 2652.)

Iodotungstic acid.

See **Tungstoiodic acid.**

Iodous acid, I_2O_3.

See **Iodine *tri*oxide.**

Iodovanadic acid, $I_2O_5, V_2O_5+5H_2O$.

Very easily sol. in H_2O.

$2V_2O_5, 3I_2O_5+18H_2O$. (Ditte, C. R. **102**. 757.)

Ammonium iodovanadate, $3(NH_4)_2O, 2V_2O_5, 5I_2O_5+20H_2O$.

Sol. in H_2O. (Ditte, C. R. **102**. 1019.)

Irid*di*amine compounds, $Cl_2Ir(NH_3)_4X_2$.

See **Chlorir													*di*amine compounds.**

Iridic acid.

Potassium iridate (?).

Sol. in H_2O and HCl+Aq.

Iridicyanhydric acid, $H_3Ir(CN)_6$.

Easily sol. in H_2O, still more easily in alcohol, less in ether. (Martius, A. **117**. 369.)

Barium iridicyanide, $Ba_3[Ir(CN)_6]_2+18H_2O$.

Efflorescent. Easily sol. in hot or cold H_2O. Nearly insol. in alcohol. Not decomp. by acids.

Cupric iridicyanide ammonia, $Cu_3Ir_2(CN)_{12}$, $6NH_3+4H_2O$.

Ppt. · Decomp. in air. (Rimbach, Z. anorg. 1907, **52.** 413.)

Potassium iridicyanide, $K_3Ir(CN)_6$.

Easily sol. in H_2O.

Silver iridicyanide ammonia, $Ag_3Ir(CN)_6$, $2NH_3+3H_2O$.

Ppt. Decomp. in the light. (Rimbach, Z. anorg. 1907, **52.** 414.)

Iridium, Ir.

Insol. in all acids, including aqua regia, except when in finely divided state, as "iridium black," when it is sol. in aqua regia. (Claus, J. pr. **42.** 251.)

Iridium ammonia compounds.

See—

Chloririd*idi*amine comps., $ClIr(NH_3)_2X$.
Irido*tri*amine " $Ir(NH_3)_3X_3$.
Irido*pent*amine " $Ir(NH_3)_5X_3$.
Irido*tetr*amine " $Ir(NH_3)_4X_2$.
Iridoaquo*pent*amine " $Ir(NH_3)_5(OH_2)X_3$.
Iridosoamine " $Ir(NH_3)_2X_2$.
Iridoso*di*amine " $Ir(NH_3)_4X_2$.

Iridium *tri*bromide, $IrBr_3+4H_2O$.

Easily sol. in H_2O. Insol. in alcohol or ether. (Birnbaum.)

Iridium *tetra*bromide, $IrBr_4$, or H_2IrBr_6.

Deliquescent. Sol. in H_2O and alcohol. (Birnbaum.)

See **Bromiridic acid.**

Iridium hydrogen *sesqui*bromide, 3HBr, $IrBr_3+H_2O=H_3IrBr_6+3H_2O$.

See **Bromiridous acid.**

Iridium *sesqui*bromide *with* MBr.

See **Bromiridite, M.**

Iridium *tetra*bromide *with* MBr.

See **Bromiridate, M.**

Iridium phosphorous bromide, $IrBr_3$, $3PBr_3$.

Partially decomp. by H_2O into a sol., and insol. modification. Sol. in PBr_3. (Geisenheimer.)

$IrBr_3$, $2PBr_3$. Not easily attacked by H_2O.

$IrBr_4$, $2PCl_3$.

See **Iridium phosphorus chlorobromide.**

Iridium carbide, IrC_4(?).

(Berzelius.)

Stable toward H_2O, acids, and alcohol. (Strecker, B. 1909, **42.** 1773.)

Iridium *mono*chloride, IrCl.

Insol. in acids and bases. (Wöhler, B. 1913, **46.** 1584.)

Iridium *di*chloride, $IrCl_2$.

Insol. in acids and bases. (Wöhler, B. 1913, **46.** 1585.)

Iridium *tri*chloride, $IrCl_3$.

Insol. in acids or alkalies. (Claus, C. C. **1861.** 690.)

Insol. in H_2O, acids and alkalies. (Leidié, C. R. 1899, **129.** 1251.)

$+4H_2O$. Sol. in H_2O. (Claus.)

Iridium *tetra*chloride, $IrCl_4$, or H_2IrCl_6(?).

Deliquescent, and easily sol. in H_2O.

Iridium *tri*chloride *with* MCl.

See **Chloriridite, M.**

Iridium *tetra*chloride *with* MCl.

See **Chloriridate, M.**

Iridium chloride *with* potassium chloride *and* sulphite.

See **Chloriridosulphite, potassium.**

Iridium phosphorus chloride, IrP_2Cl_9.

Insol. in cold H_2O. Sl. decomp. by hot H_2O. (Geisenheimer, A. ch. (6) **23.** 254.)

IrP_2Cl_{10}. Very sol. in chloroform. (G.)

IrP_3Cl_{12}. Easily sol. in PCl_3, or $CHCl_3$, also in CS_2 with gradual decomp. Sl. sol. in cold H_2O. Decomp. by boiling into $IrCl_3$, $3H_3PO_4$. Sl. sol. in benzene, ligroin and CCl_4. (Strecker, B. 1909, **42.** 1772.)

$+H_2O$. Insol. in PCl_3 at 100°. Very slowly sol. in boiling H_2O. (Geisenheimer, A. ch. (6) **23.** 266.)

IrP_3Cl_{15}. Decomp. by H_2O into $2IrCl_3$, $3H_3PO_3$, $3H_3PO_4$. Violently decomp. by alcohol. Sl. sol. in cold, more in hot $POCl_3$, without decomp. Very sol. in PCl_3 with decomp. into IrP_3Cl_{12}; similarly in PBr_3. Sol. in $AsCl_3$ with combination. Sol. in CS_2 with decomp. Sol. in SCl_2 with combination. Easily sol. in cold C_6H_6 with decomp. Insol. in CCl_4. Sol. in $CHCl_3$ with decomp. (Geisenheimer, A. ch. (6) **23.** 254.)

Iridium phosphorus arsenic chloride, $2IrP_3Cl_{15}$, $5AsCl_3$.

Sol. in H_2O with decomp. into corresponding acid. (Geisenheimer, C. R. **110.** 1336.)

$IrCl_3$, $2PCl_3$, $2AsCl_3$. Very sol. in H_2O with decomp. Sol. in $AsCl_3$; insol. in CCl_4. (Geisenheimer.)

Iridium phosphorus sulphur chloride, $IrCl_3$, $2PCl_3$, $2SCl_2$.

Very sol. in sl. amt. H_2O, with decomp. into an acid analogous to chlorophosphoiridic acid. Sol. in SCl_2. (Geisenheimer.)

Iridium phosphorus chlorobromide, $IrBr_4$, $2PCl_3$.

(Geisenheimer, C. R. **111.** 40.)

Iridium ***di*****hydroxide,** IrO_2, $2H_2O = IrO_4H_4$.

Insol. in dil. HNO_3, or H_2SO_4+Aq. Slowly but completely sol. in HCl+Aq. Sol. in KOH, and NaOH+Aq. (Claus, J. pr. **39.** 104.)

Iridium ***sesqui*****hydroxide,** $Ir_2O_6H_6$.

Not attacked by acids, except slightly by conc. HCl+Aq. (Claus, C. C. **1861.** 690.)

Iridium ***tri*****iodide,** IrI_3.

Very sl. sol. in cold, somewhat more in hot H_2O. Insol. in alcohol. (Oppler, J. B. **1857.** 263.)

Iridium ***tetra*****iodide,** IrI_4.

Insol. in H_2O or acids. (Lassaigne.)
Sol. in solutions of iodides. (Oppler.)

Iridium ***tri*****iodide** with **MI.**

See **Iodiridite, M.**

Iridium ***tetra*****iodide** with **MI.**

See **Iodiridate, M.**

Iridium ***di*****oxide,** IrO_2.

Very sl. sol. in acids.
Freshly pptd. Sol. in conc. H_2SO_4, hot 2-N H_2SO_4, HNO_3, HCl. Insol. in 2-N KOH and sl. sol. in hot 1-N KOH.
Dried in a dessicator. Sol. in HCl. Insol. in H_2SO_4, HNO_3 and KOH.
Dried at 100°. Sol. in hot conc. HCl. Insol. in H_2SO_4, HNO_3 and KOH. (Wöhler, Z. anorg. 1908, **57.** 334.)
See also **Iridium** ***di*****hydroxide.**

Iridium ***tri*****oxide,** IrO_3.

Unstable. (Wöhler, Z. anorg. 1908, **57.** 340.)

Iridium ***sesqui*****oxide,** Ir_2O_3.

Insol. in acids.
Sol. in conc. H_2SO_4, and hot conc. HCl. Forms colloidal solution with dil. HCl. Conc. HNO_3 converts it into the dioxide.
Insol. in KOH+Aq. (Wöhler, Z. anorg. 1908, **57.** 339.)

Iridium oxybromide, $Ir_3Br_8O_2 = 2IrBr_4$, IrO_2.

Not decomp. by H_2O. (Geisenheimer, A. ch. (6) **23.** 286.)

Iridium phosphide, Ir_2P.

(Clarke and Joslin, Am. Ch. J. **5.** 231.)

Iridium ***sesqui*****selenide,** Ir_2Se_3.

Insol. in HNO_3; slowly sol. in hot aqua regia. (Chabrié and Bouchonnet, C. R. 1903, **137.** 1060.)

Iridium ***mono*****sulphide,** IrS.

Insol. in HNO_3+Aq, and very sl. sol. if at all in aqua regia. (Berzelius.)
Sol. in K_2S, and KSH+Aq.
$+xH_2O$. Sl. sol. in H_2O; sol. in cold HNO_3+Aq. Insol. in NH_4Cl+Aq or dil. acids. More sol. in K_2S+Aq than PtS_2. (Berzelius.)

Iridium ***di*****sulphide,** IrS_2.

Not attacked by H_2O, but decomp. when exposed moist in air. Not attacked by sat. HCl+Aq or by conc. HNO_3+Aq, but is oxidised by fuming HNO_3+Aq, and aqua regia. Insol. in NH_4 sulphides, or polysulphides+Aq. Slowly sol. in alkali polysulphides+Aq. (Antony, Gazz. ch. it. **23, 1.** 190.)

Iridium ***sesqui*****sulphide,** Ir_2S_3.

Sl. sol. in H_2O. Sol. in HNO_3, or K_2S+Aq.

Irido***tri*****amine chloride,** $Ir(NH_3)_3Cl_3$.

Sl. sol. in H_2O. Not attacked by boiling H_2SO_4. (Palmaer, B. **22.** 15.)

Irido***tetra*****amine chloride,** $Ir(NH_3)_4Cl_3$.

Very sol. in H_2O. (Palmaer, B. **22.** 15.)

——**chlorosulphate,** $[Ir(NH_3)_4Cl_2]SO_4 + 4H_2O$.

(Palmaer.)

Irido***pent*****amine bromide,** $Ir(NH_3)_5Br_3$.

Sol. in 352 pts. H_2O at 12.5°. (Palmaer, B. **23.** 3817.)

—— **bromochloride,** $Ir(NH_3)_5ClBr_2$.

Sol. in H_2O. (Palmaer, B. **24.** 2090.)

—— **bromonitrite,** $Ir(NH_3)_5Br(NO_2)_2$.

Sol. in 17.9 pts. H_2O at 18°. (Palmaer.)

—— **bromosulphate,** $Ir(NH_3)_5BrSO_4 + H_2O$.

Sol. in H_2O. (Palmaer.)

—— **carbonate,** $[Ir(NH_3)_5]_2(CO_3)_3 + 3H_2O$.

Sol. in H_2O. (Claus, J. pr. **63.** 99.)

—— ***tri*****chloride,** $Ir(NH_3)_5Cl_3$.

Sol. in 153.1 pts. H_2O at 15.1°. (Palmaer, B. **23.** 3810.)
Sol. in hot H_2O containing HCl. (Claus, J. pr. **69.** 30.)

—— **chlorobromide,** $Ir(NH_3)_5ClBr_2$.

Sol. in 213.6 pts. H_2O at 15°. (Palmaer.)

—— **chloroiodide,** $Ir(NH_3)_5ClI_2$.

Sol. in 104.5 pts. H_2O at 15°. (Palmaer.)

—— **chlorooxalate,** $Ir(NH_3)_5ClC_2O_4$.

Sl. sol. in H_2O. (Palmaer.)

Iridopentamine chloronitrate, $Ir(NH_3)_5Cl_3NO_3)_2$.

Sol. in 51.54 pts. H_2O at 15.4°. (Palmaer.)

—— **chloronitrite,** $Ir(NH_3)_5Cl(NO_2)_2$.

Easily sol. in H_2O. (Palmera.)

—— **chloroplatinate,** $Ir(NH_3)_5Cl_3, PtCl_4$.

Very sl. sol. in H_2O. (Palmear.)

—— **chlorosulphate,** $Ir(NH_3)_5ClSO_4+2H_2O$.

Sol. in 134.5 pts. H_2O at 15°. (Palmaer.)

—— **hydroxide,** $Ir(NH_3)_5(OH)_3$.

Known only in solution, which decomp. on evaporation. (Claus.)

—— **nitrate,** $Ir(NH_3)_5(NO_3)_3$.

Moderately sol. in H_2O. (Claus.)
Sol. in 349 pts. H_2O at 16°. (Palmaer.)

—— **sulphate,** $[Ir(NH_3)_5]_2(SO_4)_3$.

Sol. in H_2O. (Claus.)

Iridoaquopentamine bromide, $Ir(NH_3)_5(OH_2)Br_3$.

Sol. in 4 pts. H_2O. Pptd. from aqueous solution by HBr+Aq. (Palmaer, B. **24.** 2090.)

—— **chloride,** $Ir(NH_3)_5(OH_2)Cl_3$.

Sol. in 1.2 to 1.5 pts. H_2O at ord. temp. Pptd. by HCl+Aq from aqueous solution. (Palmaer, B. **24.** 2090.)

—— **nitrate,** $Ir(NH_3)_5(OH_2)(NO_3)_3$.

Sol. in about 10 pts. H_2O at 17°. Pptd. from aqueous solution by HNO_3+Aq. (Palmaer.)

Iridonitrous acid, $H_6Ir_2(NO_2)_{12}$.

Easily sol. in H_2O. (Gibbs, B. **4.** 281.)

Ammonium iridonitrite, $(NH_4)_6Ir_2(NO_2)_{12}$.

Almost insol. in cold H_2O; decomp. by hot H_2O with evolution of N_2. Decomp. by hot conc. H_2SO_4 or HCl. Insol. in sat. NH_4Cl+Aq. (Leidié, C. R. 1902, **134.** 1583.)

Barium iridonitrite iridochloride, $Ba_3Ir_2(NO_2)_{12}, Ba_3Ir_2Cl_{12}$.

Sol. in H_2O. (Lang.)

Mercuric iridonitrite, $Hg_3Ir_2(NO_2)_{12}$.

Insol. in H_2O. (Gibbs, B. **4.** 280.)

Potassium iridonitrite, $K_6Ir_2(NO_2)_{12}$.

Sl. sol. in cold, more sol. in boiling H_2O. Decomp. by hot HCl or H_2SO_4. Insol. in KCl+Aq. (Leidié, Bull. Soc. 1902, (3) **27.** 937.)

$+2H_2O$. Moderately sol. in H_2O.

Potassium iridonitrite iridochloride, $K_6Ir_2(NO_2)_{12}, K_6Ir_2Cl_{12}$.

Sol. in H_2O.

Silver iridonitrite, $Ag_6Ir_2(NO_2)_{12}$.

Difficultly sol. in cold, more easily in hot H_2O.

Sodium iridonitrite, $Na_6Ir_2(NO_2)_{12}+2H_2O$.

Sl. sol. in H_2O. Sol. in cold H_2O. Decomp. by hot conc. H_2SO_4 or HCl. (Leidié, C. R. 1902, **134** 1583.)

Sodium iridonitrite iridochloride, $Na_4Ir_2Cl_2(NO_2)_8+2H_2O$.

Sl. sol. in H_2O. (Gibbs.)
$Na_6Ir_2(NO_2)_{12}, Na_6Ir_2Cl_6$. Insol. in cold, sl. sol. in hot H_2O. (Lang.)

Iridosamine chloride, $Ir(NH_3)_2Cl_2$.

Nearly insol. in H_2O. (Skoblikoff, A. **84.** 275.)

—— **sulphate,** $Ir(NH_3)_2SO_4$.

Easily sol. in H_2O. (Skoblikoff.)

Iridosodiamine chloride, $Ir(N_2H_6)_2Cl_2$.

Insol. in cold, decomp. by hot H_2O. (Skoblikoff.)

—— **nitrate,** $Ir(N_2H_6NO_3)_2$.

Easily sol. in H_2O.

—— **sulphate,** $Ir(N_2H_6)_2SO_4$.

Sl. sol. in cold, easily in boiling H_2O. Sl. sol. in alcohol.

Iridosulphuric acid.

Potassium iridosulphate, $K_6Ir_2(SO_4)_6$.

Sol. in H_2O. (de Boisbaudran, C. R. **96.** 1406.)

Iridosulphurous acid.

Ammonium iridosulphite, $(NH_4)_6Ir_2(SO_3)_6+6H_2O$.

Slightly sol. in H_2O. (Birnbaum, A. **136.** 179.)

Potassium iridosulphite, $K_6Ir_2(SO_3)_6+6H_2O$.

Slightly sol. in H_2O.

Sodium iridosulphite, $Na_6Ir_2(SO_3)_6+8H_2O$.

Scarcely sol. in H_2O.

Iron, Fe.

Permanent in dry air; oxidises only slowly in moist air, but rapidly when in contact with air and H_2O simultaneously.

Fe does not rust in contact with air and

H_2O containing alkalies even in very small amounts. (Payen, A. ch. **50.** 305.)

Not attacked at ord. temp. by H_2O free from air. More easily oxidised by NH_4 salts $+Aq$ than by H_2O when exposed to air simultaneously. (Persoz, A. ch. (3) **24.** 506.)

Iron is slowly attacked by distilled H_2O in presence of air. 100 ccm. distilled water removed 29 mg. from 11.8 sq. cm. iron in one week, while air free from CO_2 was passed through the solution. In presence of CO_2, 54 mg. were removed. (Wagner, Dingl. **221.** 260.)

CO_2 acts as a catalyst for the solution of Fe by H_2O. (Whitney, J. Am. Chem. Soc. 1903, **25.** 394.)

Iron is most easily oxidised when it is exposed to air, and H_2O is deposited on it at the same time in liquid form.

100 l. sea water dissolve 27.37 g. from 1 sq. metre Fe; 29.16 g. from 1 sq. metre steel; 1.12 g. from 1 sq. metre galvanised Fe. (Calvert and Johnson, C. N. **11**). 171.)

Readily sol. in HCl, dil. H_2SO_4+Aq, and most other acids.

Action of H_2SO_4+Aq (1:12) is very much accelerated by a few drops of $PtCl_4+Aq$; the addition of As_2O_3 arrests the action completely. Tartar emetic and $HgCl_2$ diminish the action, but do not arrest it. $CuSO_4+Aq$ strongly accelerates the action, and Ag_2SO_4+Aq also to a less extent.

In the case of $HCl+Aq$, the addition of small amts. of metallic salts also influences the action. Weak $HC_2H_3O_2+Aq$ has but little action, and the addition of $PtCl_4$ increases it; As_2O_3 stops it; other solutions have no effect. With racemic and tartaric acids the phenomena are the same.

With oxalic acid, $PtCl_4$ prevents the action. Saline solutions and even distilled H_2O, when mixed with $PtCl_4$, have slight solvent action. (Millon, C. R. **21.** 45.)

Above phenomena are due to galvanic action from metal deposited on the iron. (Barreswill, C. R. **21.** 292.)

H_2SO_4 has only sl. action on cast-iron at ord. temp. with exclusion of air.

Weak acids have a strong action at higher temperatures.

Charcoal pig-iron, and case-hardened cast-iron are much less attacked by weak acids at b.-pt. than other sorts of Fe. Scotch pig-iron is most strongly attacked.

99.8% H_2SO_4 has very sl. action on iron at ord. temp. when air is excluded. (Lunge, Dingl. **261.** 131.)

Resistance against dil. H_2SO_4+Aq is greatly increased by increase in amt. of C if chemically combined, less so by P or Si. (Ledebur, Dingl. **223.** 326.)

Passive Iron.—When Fe is treated with pure conc. HNO_3+Aq of 1.512–1.419 sp. gr., it soon becomes coated with a bluish or black coating, apparently FeO, and when thus covered Fe is not attacked by HNO_3+Aq of any strength at ord. temp. or at the temp. of a freezing mixture; but action occurs on heating. Nor is Fe attacked at ord. temp. by acid of 1.401 sp. gr. or even somewhat weaker acid, though action begins at once on heating. Very dil. HNO_3+Aq attacks Fe at ord. temp. with formation of NH_4NO_3 and $Fe(NO_3)_2$. The action of HNO_3+Aq is influenced by $PtCl_4$. If acid containing 4.5 equivalents of H_2O is diluted with 2–3 vols. H_2O, and then poured on Fe turnings, they dissolve at once with evolution of nitrous fumes and formation of ferric salt, but if to the acid one drop of $PtCl_4$ be added, only H gas is evolved, and NH_4NO_3 and $Fe(NO_3)_2$ are formed. (Millon, C. R. **21.** 47.)

The more H_2O the acid contains the lower will be the temp. at which the Fe remains passive. Shaking the wire hastens the passivity. Contact with Pt, Au, or C does not prevent it. Fe wire becomes passive by remaining 10 min. in HNO_3 vapour. (Renard, C. R. **79.** 159.)

Iron may be made passive by $HClO_3$, $HBrO_3$, HIO_3, H_2CrO_4, in the same way as by HNO_3.

Iron may also be made passive by moderate ignition.

Passivity occurs with HNO_3+Aq of 1.38 sp. gr. after a short time at 31°; but if temp. is 32°, passivity does not occur.

Colourless HNO_3+Aq of 1.42 sp. gr. produces passivity at 55° but not at 56°. Red fuming HNO_3+Aq of 1.42 sp. gr. produces passivity at 82° but not at 83°. (Ordway, Sill. Am. J. (2) **40.** 316.)

The passivity of Fe is destroyed when it is placed in a magnetic field at a much lower temperature than when in normal condition. (Nichols and Franklin, Sill. Am. J. (3) **34.** 419.)

Passivity depends on a coating of NO which hinders the action of the acid. All operations which remove this layer terminate the passivity, as shaking, rubbing, placing in a vacuum, etc. (Varenne, C. R. **89.** 783.)

When Fe is plunged in HNO_3+Aq of 1.42 sp. gr. there is a sudden evolution of gas which ceases after 3 to 20 seconds, and the surface becomes bright. The same phenomena take place with a more dilute acid, if of not less than 1.32 sp. gr. In the latter case, there is an immediate evolution of gas, which suddenly ceases and the metal becomes bright, but soon the acid begins to act again at a single point, and the action gradually spreads over the whole surface; this, however, soon ceases again, and we have an "intermittent passivity."

If a part of a piece of iron is immersed in strong acid, the whole of it is made passive. This is explained by the NO spreading over the whole surface by capillarity.

The passivity ceases when the Fe is placed in dil. acid, after a longer or shorter time,

according to the dilution of the acid,—when the acid has sp. gr. = 1.30, after 11 days

"	"	"	1.28	"	5 "
"	"	"	1.26	"	32 hours
"	"	"	1.16	"	12 "

Iron may also be made passive by long standing in NO gas under pressure. (Varenne, C. R. **90.** 998.)

Fe is made passive by a coating of Fe_3O_4, not by NO. (Schonbein, Pogg. **39.** 342.) (Beetz, Pogg. **67.** 286.) (Ramann, B. **14.** 1430.)

Passivity may also be caused by NH_4NO_3 +Aq, ammoniacal $AgNO_3$+Aq, $Fe(NO_3)_3$, $Fe(NO_3)_2$, $Al(NO_3)_3$, $Co(NO_3)_2$, $Ni(NO_3)_2$, etc.+Aq instead of HNO_3+Aq. (Ramann, B. **14.** 1933.)

Hardly attacked by either dil. or conc. acids when they are under high pressure. (Cailletet C. R. **68.** 395.)

Iron is dissolved by HNO_3+Aq, even when very conc., but no gas is evolved and the process is very slow.

HNO_3+Aq of the following sp. gr. dissolves the given amts. from strips of pure Fe.

Sp. gr. of acid	Diminution of weight in 24 hours
1.28	0.82%
1.34	0.75
1.38	0.29
1.48	0.34
1.53	5.80

(Gautier and Charpy, C. R. **113.** 1451.)

Insol. in liquid chlorine below 90°. (Lange, Zeit. angew. Ch. 1900, **13.** 686.)

Insol. in liquid NH_3. (Gore, Am. ch. J. 1898, **20.** 828.)

Not attacked by alkalies.

Sol. in NaOH+Aq (34%) when air is blown through the liquid. (Zirnité, Ch. Ztg. **12.** 355.)

NaOH+Aq attacks iron and steel. (Venator, Dingl. **261.** 133.)

NaOH+Aq has slight action on Fe between 15° and 100°. (Lunge, Dingl. **261.** 131.)

Presence of alkalies prevent rusting entirely, and fats and oils greatly hinder it. (Wagner.)

Sol. in alkali hydrogen carbonates+Aq. (Berzelius.)

Sat. NaCl+Aq has sl. but perceptible action on Fe. NH_4Cl+Aq has stronger action than NaCl+Aq. (Lunge.)

100 ccm. H_2O containing 0.5 g. NaCl or KCl removed 42 mg. from 11.8 sq. cm. iron in one week, while air free from CO_2 was passed through the solution, and 72 mg. in presence of CO_2.

100 ccm. H_2O containing 1 g. NH_4Cl removed 45 mg., and 76 mg. respectively under the above conditions.

100 ccm. H_2O containing 0.8 g. $MgCl_2$ removed 49 mg., and 65 mg. respectively under the above conditions.

Not attacked by 100 ccm. H_2O containing 1 g. Na_2CO_3, or by CaO_2H_2+Aq. (Wagner, Dingl. **221.** 260.)

Action of $KClO_3$+Aq. $KClO_3$+Aq (6.3% $KClO_3$) oxidised 11.21 g. cast iron and 20.1 g. pure iron from a surface of 1 sq. metre in 7 hours; $KClO_3$+Aq (25% $KClO_3$) oxidised 24.59 g. cast, and 44.90 g. pure Fe under above conditions; $Ca(ClO_3)_2$, $CaCl_2$+Aq (20° Baume) obtained by passing Cl through CaO_2H_2+Aq oxidised 85 g. cast, and 95 g. pure Fe under the above conditions. (Lunge and Deggeler, J. Soc. Chem. Ind. **4.** 32.)

Easily sol. in organic acids.

Comparative action of oils on Fe.

	Amount Fe dissolved
Neatsfoot oil	0.0875 grains
Colza "	0.0800 "
Sperm "	0.0460 "
Lard "	0.0250 "
Olive "	0.0062 "
Linseed "	0.0050 "
Seal "	0.0050 "
Castor "	0.0048 "
Paraffine "	0.0045 "
Almond "	0.0040 "
"Lubricating" oil	0.0018 "

(Watson, C. N. **42.** 190.)

½ ccm. oleic acid dissolves 0.0097 g. Fe in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Fe dissolves in albumen solution to the extent of 1 to 2 per cent. (Buchner, Arch. Pharm. (3) **20.** 417.)

Attacked by sugar+Aq at 115–120°, also by inverted sugar or malt extract, not by glycerine or mannite+Aq. (Klein and Berg, C. R. **102.** 1170.)

Iron arsenide, $FeAs_2$.

Min. *Löllingite.* Sol. in HNO_3+Aq with separation of As_2O_3.

Fe_3As_4. Min. *Leucopyrite.*

Iron arsenide sulphide, $FeAs_2$, FeS_2.

Min. *Arsenopyrite.* Sol. in HNO_3+Aq with separation of S and As_2O_3; wholly sol. in aqua regia; not attacked by HCl+Aq.

Iron boride, Fe_2B.

Decomp. by H_2O. Sol. in hot dil. HCl or H_2SO_4 and in hot conc. HCl or H_2SO_4. Sol. in hot dil., or cold conc. HNO_3. (Jassonneix, C. R. 1907, **145.** 122.)

FeB. Sol. in molten alkali carbonates; not sol. in dil. or conc. H_2SO_4 in the cold; sol. in boiling H_2SO_4 and in HNO_3. (Moissan, Bull. Soc. 1895, (3) **13.** 958.)

Stable in dry air. Decomp. by aqua regia,

but not readily sol. in conc. H_2SO_4 and HCl. (Moissan, C. R. 1895, **120.** 176.)

FeB_2. Decomp. by H_2O. Sol. in HNO_3 and in hot conc. HCl. (Jassonneix, C. R. 1907, **145.** 122.)

Iron (**ferrous**) **bromide,** $FeBr_2$.

Sol. in H_2O. Decomp. by heating on air.

Sat. $FeBr_2$+Aq contains at:

—21°	—7°	+10°	21°
47.0	48.3	52.3	53.7% $FeBr_2$,
37°	50°	65°	95°
56.0	58.0	59.4	63.3% $FeBr_2$.

(Étard, A. ch. 1894, (7) **2.** 541.)

$+4H_2O$. Very sol. in H_2O; pptd. from cooled aq. solution. (Volkmann, C. C. **1894,** II. 611.)

$+6H_2O$. Sol. in H_2O. (Löwig.)

$+9H_2O$. (Volkmann.)

Ferric bromide, $FeBr_3$.

Deliquescent. Sol. in H_2O, alcohol, and ether. (Löwig.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

$+6H_2O$. Sol. in alcohol and ether. (Bolschakoff, C. C. **1898,** II. 660.)

Ferrous mercuric bromide.

Deliquescent. (v. Bonsdorff.)

Ferric rubidium bromide, $Rb_2FeBr_5+H_2O$.

Sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)

Ferrous stannic bromide.

See **Bromostannate, ferrous.**

Ferrous bromide nitric oxide, $3FeBr_2$, 2NO.

Sol. in H_2O. Not isolated. (Thomas, C. R. 1896, **123.** 944.)

Ferric bromochloride, $FeCl_2Br$.

Very deliquescent, and sol. in H_2O, alcohol, and ether. Notably sol. in chloroform, benzene, and toluene. Insol. in CS_2. (Lenormand, C. R. **116.** 820.)

Iron carbide, Fe_3C.

(Gurlt, J. B. **1856,** 781.)

Mixture of Fe and FeC_4. (Tunner, Polyt. Centralbl. **1861.** 1227.)

Fe_4C. (Karsten, J. pr. **40.** 229.)

Fe_3C. Sol. in hot conc. HCl; oxidized slowly by moist air. (Campbell, Am. Ch. J. 1896, **18.** 840–841.)

Fe_2C_2. (Rammelsberg, C. C. **1847.** 60.)

Iron molybdenum carbide, Fe_3C, Mo_2C.

Sol. in hydracids; insol. in HNO_3. (Williams, C. R. 1898, **127.** 484.)

Iron tungsten carbide, $2Fe_3C$, $3W_2C$.

Insol. in H_2O and hydracids; sol. in HNO_3 and H_2SO_4. (Williams, C. R. 1898, **127.** 411.)

Iron carbonyl, $Fe(CO)_5$.

Slowly decomp. on air. Not attacked by dil. H_2SO_4, HNO_3, or HCl+Aq. Conc. HNO_3, Cl_2+Aq, or Br_2+Aq decomp. easily. Sol. in alcoholic solution of KOH or NaOH with subsequent decomp. Sol. in alcohol, ether, benzene, mineral oils, etc. (Mond and Langer, Chem. Soc. **59.** 1090.)

$Fe_2(CO)_7$. Decomp. on air. Not attacked by H_2SO_4 or HCl+Aq. Sol. in alcoholic potash. Very much less sol. in organic solvents than $Fe(CO)_5$. (Mond and Langer.)

Ferrous chloride, $FeCl_2$.

Deliquescent. Easily sol. in H_2O with evolution of heat, or in alcohol. Insol. in ether. (Jahn.)

Sol. in 2 pts. H_2O at 18.75°. (Abl.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

Sp. gr. of $FeCl_2$=Aq at 15.5°.

Sp. gr.	% $FeCl_2$	% $FeCl_2$, $4H_2O$
1.05	5.40	8.45
1.06	6.43	10.09
1.07	7.47	11.69
1.08	8.48	13.29
1.09	9.49	14.86
1.10	10.47	16.41
1.11	11.45	17.86
1.12	12.42	19.46
1.13	13.37	20.96
1.14	14.31	22.41
1.15	15.24	23.87
1.16	16.15	25.31
1.17	17.05	26.73
1.18	17.94	28.13
1.19	18.83	29.51
1.20	19.68	30.85
1.21	20.50	32.14
1.22	21.39	33.53
1.23	22.24	34.84
1.24	23.05	36.11
1.25	23.86	37.38
1.26	24.68	38.67
1.27	25.44	39.87
1.28	26.19	41.04
1.29	26.98	42.29
1.30	27.75	43.49
1.31	28.49	44.65
1.32	29.23	45.81
1.33	29.96	46.94
1.34	30.68	48.08
1.35	31.39	49.18
1.36	32.10	50.30
1.37	32.79	51.39
1.38	33.47	52.46
1.39	34.14	53.50
1.40	34.80	54.55
1.41	35.46	55.57
1.42	36.09	56.56
1.43	36.73	57.55
1.44	37.33	58.51

(Dunn, J. Soc. Chem. Ind. 1902, **21.** 390.)

Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)
Sol. in acetone; insol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)
Sl. sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
Yellow modification is sol. in benzonitrile (Naumann, B. 1914, **47.** 1369.)
Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 21.)
$+2H_2O$. (Jonas.)
$+4H_2O$. Deliquescent. Easily sol. in alcohol. Sol. in 0.68 pt. cold H_2O. (Reimann, Mag. Pharm. **17.** 215.)
Sat. aq. solution contains at:

16°	18°	25°	28°	43°	
40.5	40.9	41.0	42.5	44.4	% $FeCl_2$,
50°	53°	72°	89°	96°	118°
45.0	45.9	49.2	51.3	51.0	51.7% $FeCl_2$.

(Étard, A. ch. 1894, (7) **2.** 537.)

100 g. $FeCl_2$, $4H_2O$+Aq contain 17.54 g. Fe at 22.8°; 18.59 g. at 43.2°. (Boecke, N. Jahrb. Min. **1911,** I, 61.)

More sol. in water containing NO than in pure H_2O. (Gay, Bull. Soc. (2) **44.** 175.)
Sol. in hot HCl+Aq. (Sabatier, Bull. Soc. 1895, (3) **13.** 599.)
[Sabatier could not obtain $FeCl_2+6H_2O$ of Lescœur.]

Ferroferric chloride, $Fe_3Cl_8+18H_2O$.
Deliquescent. (Lefort, J. Pharm. (4) **10.** 85.)

Ferric chloride, Fe_2Cl_6 or $FeCl_3$.
Very deliquescent, and sol in H_2O with evolution of great heat.

100 mols. H_2O dissolve mols. anhydrous Fe_2Cl_6 at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
66	29.20	80	29.20
70	29.42	100	29.75
75	28.92	..	...

(Roozeboom, Z. phys. Ch. **10.** 477.)

See also hydrated salts below.
Solution in H_2O is decomp. into colloidal Fe_2O_3, xH_2O and HCl, upon heating if conc., and on simple standing if dil.

Krecke (J. pr. (2) **3.** 286) gives the following table.

% Fe_2Cl_6 in solution	Temp. at which Graham's colloidal hydrate is formed		Temp. at which Saint Gilles' colloidal hydrate is formed	Temp. at which oxychlorides are formed	Temp. at which Fe_2O_3 is formed
32	100–130°	Fe_2Cl_6 reformed on cooling.	...	100°+	140°
16	100–120		...	"	120
8	100–110		...	"	110
4	90–100		...	90	...
2	87		...	87	...
1	83	Fe_2Cl_6 not reformed on cooling.	100–130°	...	...
0.5	75		"	....	...
0.25	64		"	...	...
0.125	54		"	...	...
0.0625	36		"	...	...

Sp. gr. of Fe_2Cl_6+Aq.

% Fe_2Cl_6	Sp. gr. at 4.8°	Sp. gr. at 9.7°	Sp. gr. at 14.6°	Sp. gr. at 19.7°
49.61	1.5609	1.5575	1.5540	1.5497
41.00	1.4413	1.4387	1.4361	1.4335
36.95	...	1.3847	1.3824	1.3800
33.25	1.3381	1.3359	1.3339	1.3317
24.60	1.2351	1.2334	1.2318	1.2298
22.54	1.2140	1.2129	1.2107	1.2090
16.79	1.1534	1.1521	1.1507	1.1491
10.45	1.0939	1.0930	1.0918	1.0901
4.65	....	....	1.0382	...
2.70	....	....	1.0221	...

(Schult, from Gerlach, Z. anal. **27.** 278.)

Sp. gr. of Fe_2Cl_6+Aq increases or diminishes between 8° and 24° for a decrease or increase of temp. of 1° by the following amts.

% Fe_2Cl_6	Corr.	% Fe_2Cl_6	Corr.
50–60	0.0008	30–39	0.0005
45–49	0.0007	20–29	0.0004
40–44	0.0006	10–19	0.0003

(Hager, l. c.)

Sp. gr. of Fe_2Cl_6+Aq at 17.5°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.
1	1.0073	21	1.1644	41	1.3746
2	1.0146	22	1.1746	42	1.3870
3	1.0219	23	1.1848	43	1.3994
4	1.0292	24	1.1950	44	1.4118
5	1.0365	25	1.2052	45	1.4242
6	1.0439	26	1.2155	46	1.4367
7	1.0513	27	1.2258	47	1.4492
8	1.0587	28	1.2365	48	1.4617
9	1.0661	29	1.2464	49	1.4742
10	1.0734	30	1.2568	50	1.4867
11	1.0814	31	1.2673	51	1.5010
12	1.0894	32	1.2778	52	1.5153
13	1.0974	33	1.2883	53	1.5296
14	1.1054	34	1.2988	54	1.5439
15	1.1134	35	1.3093	55	1.5582
16	1.1215	36	1.3199	56	1.5729
17	1.1297	37	1.3305	57	1.5876
18	1.1378	38	1.3411	58	1.6023
18	1.1378	38	1.3411	58	1.6023
19	1.1458	39	1.3517	59	1.6170
20	1 1542	40	1.3622	60	1.6317

(Franz, J. pr. (2) **5.** 283.)

Sp. gr. of Fe_2Cl_6+Aq at 17.5°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr	% Fe_2Cl_6	Sp. gr.
1	1.008	21	1.191	41	1.428
2	1.016	22	1.202	42	1.441
3	1.025	23	1.212	43	1.454
4	1.033	24	1.223	44	1.469
5	1.042	25	1.234	45	1.481
6	1.051	26	1.245	46	1.494
7	1.060	27	1.256	47	1.507
8	1.069	28	1.268	48	1.520
9	1.078	29	1.280	49	1.533
10	1.087	30	1.292	50	1.547
11	1.095	31	1.304	51	1.560
12	1.104	32	1.316	52	1.573
13	1.113	33	1.328	53	1.587
14	1.123	34	1.340	54	1.600
15	1.131	35	1.352	55	1.612
16	1.140	36	1.364	56	1.624
17	1.150	37	1.376	57	1.636
18	1.160	38	1.390	58	1.648
19	1.170	39	1.403	59	1.659
20	1.180	40	1.415	60	1.670

(Hager, Comm. **1883.**)

Sp. gr. of conc. Fe_2Cl_6+Aq at 20–21°.

% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.	% Fe_2Cl_6	Sp. gr.
60	1.669	65	1.715	70	1.758
61	1.679	66	1.724	71	1.766
62	1.688	67	1.733	72	1.774
63	1.697	68	1.742	73	1.782
64	1.706	69	1.750	74	1.790

(Hager, l. c.)

Solubility of Fe_2Cl_6 in HCl+Aq.

t°	Sat. solution contains per 100 mols. H_2O		Solid phase
	mols. HCl	mols. $FeCl_3$	
30	0	12.70	$Fe_2Cl_6+12H_2O$
"	5.92	16.07	
"	0	20.90	
25	0	10.90	
"	2.33	23.72	
"	0	24.50	
20	0	10.20	
"	5.60	23.60	
"	0	25.70	
10	0	9.10	
"	8.75	8.00	
"	16.70	16.65	
"	13.80	23.35	
0	0	8.25	
"	7.52	6.51	
"	13.37	6.33	
"	16.80	8.70	
"	18.45	10.23	
"	20.40	15.40	
"	20.10	16.00	
"	19.95	17.70	
"	19.00	22.75	
"	18.05	23.40	
—10	0	7.40	
"	19.46	10.37	
"	20.48	20.54	
"	20.25	21.56	
—12.5	22.14	16.69	
—15	0	6.98	
"	21.30	9.65	
—20	0	6.56	
"	7.50	4.90	
"	15.30	5.09	
"	20.56	7.08	
30	0	25 20	$Fe_2Cl_6+7H_2O$
"	4.25	27.80	
"	0	30.24	
25	0	23.50	
"	2.33	23.72	
"	7.50	29.75	
"	0	31.50	
20	0	22.50	
"	5.60	23.60	
"	11.05	29.20	
"	11.05	29.20	
"	0	32.00	
15	10.75	23.50	
"	14.90	28.35	
10	13.80	23.35	
"	17.80	27.75	
"	17.80	27.75	
0	18.05	23.40	
"	19.50	25.93	

Solubility of Fe_2Cl_6 in HCl+Aq.—*Continued.*

t°	Sat. solution contains per 100 mols. H_2O		Solid phase
	mols. HCl	mols. $FeCl_3$	
50	0	35.00	
"	3.25	39.95	
44	0	33.50	
"	3.04	33.80	
"	10.62	34.64	
"	11.50	35.60	
"	10.70	38.00	
40	0	32.40	
"	13.40	37.45	
33	0	31.00	
"	15.70	37.06	
30	0	30.24	
"	17.20	34.00	
"	17.15	36.75	
25	0	29.00	
"	7.50	29.75	$Fe_2Cl_6+5H_2O$
"	19.50	35.25	
20	0	27.90	
"	11.05	29.20	
"	15.80	30.68	
"	21.25	34.25	
15	14.90	28.35	
"	16.40	29.32	
10	17.80	27.75	
"	18.80	28.70	
"	24.50	32.75	
0	24.12	30.04	
"	26.00	32.16	
—10	24.95	29.60	
"	26.05	30.50	
"	27.30	32.05	
70	0	44.0	
"	6.75	50.00	
"	0	55.80	
65	0	42.50	
"	10.25	50.00	
"	3.75	57.25	
"	0	59.00	
60	0	41.40	
"	14.25	50.00	
"	10.70	55.25	
"	0	61.00	
55	0	40.64	
"	19.00	50.72	
"	16.71	53.60	
"	0	62.00	$Fe_2Cl_6+4H_2O$
50	0	39.92	
"	3.25	39.95	
"	21.24	49.33	
"	20.04	52.50	
44	0	39.00	
"	10.70	38.00	
"	14.80	38.70	
"	24.14	50.10	
40	13.40	37.45	
"	27.00	50.80	
33	15.70	37.06	
"	29.20	42.70	
"	31.08	46.85	
"	30.81	47.65	

t°	Sat. solution contains per 100 mols. H_2O		Solid phase
	mols. HCl	mols. $FeCl_3$	
33	30.45	48.70	
30	17.15	36.75	
"	31.20	43.49	
"	35.80	47.80	
"	32.60	49.93	
25	19.50	35.25	
"	20.60	35.34	
"	31.34	41.58	
"	33.00	43.00	
"	34.65	44.80	
20	21.25	34.25	
"	28.81	37.57	
"	34.23	42.02	$Fe_2Cl_6+4H_2O$
"	35.40	43.16	
15	29.40	36.50	
"	33.60	40.03	
10	24.50	32.75	
"	35.04	39.95	
0	26.00	32.16	
"	34.60	38.11	
—10	27.30	32.05	
"	33.56	36.25	
—20	30.08	32.76	
"	32.65	35.44	
45	0	58.00	
"	31.28	50.08	
"	40.65	48.60	
40	0	58.00	
"	27.00	50.80	
"	42.01	48.64	Fe_2Cl_6
35	0	58.00	anhydrous
"	29.01	50.33	
"	37.04	49.20	
30	0	58.00	
"	32.60	49.93	
"	34.40	49.72	
40	42.50	47.52	
"	42.01	48.64	
35	39.47	46.57	
"	37.04	49.20	
30	40.21	42.54	
"	38.20	44.70	
"	35.55	47.30	
"	34.40	49.72	
25	40.41	40.25	
"	39.03	41.38	
"	35.74	45.24	
20	39.50	39.25	Fe_2Cl_6, 2HCl,
"	35.40	43.16	$4H_2O$
10	38.62	37.48	
"	37.46	38.33	
"	36.30	38.70	
"	35.04	39.93	
0	37.27	36.60	
"	34.60	38.11	
—10	37.92	35.32	
"	34.54	36.00	
"	33.56	36.25	
—20	37.80	34.50	
"	34.10	34.84	
"	32.56	35.44	

Solubility of Fe_2Cl_6 in HCl+Aq.—*Continued.*

t°	Sat. solution contains per 100 mols. H_2O: mols. HCl	mols. $FeCl_3$	Solid phase
— 4.5	20.50	24.50	Fe_2Cl_6, 2HCl, $8H_2O$
"	20.66	25.74	
"	23.42	27.40	
— 6	29.10	24.73	
"	26.18	21.75	
"	24.41	21.50	
"	23.25	21.35	
"	21.73	21.84	
"	19.73	25.50	
"	[illegible].42	28.45	
"	28.20	27.04	
—10	20.48	20.54	
"	24.90	18.94	
"	28.75	20.34	
"	31.42	28.53	
"	28.25	30.25	
"	26.05	30.50	
—15	24.50	15.83	
—15	28.40	31.89	
—20	19.44	12.10	
"	22.83	11.63	
"	25.20	11.60	
"	27.20	11.31	
"	31.08	11.51	
"	34.13	12.90	
"	33.93	31.77	
"	30.08	32.76	
"	28.70	32.88	
—10	12.01	11.99	Fe_2Cl_6, 2HCl, $12H_2O$
"	19.78	14.02	
"	20.95	16.20	
"	20.25	20.20	
"	17.73	20.70	
"	15.44	19.65	
—12.5	22.14	16.69	
—15	21.30	9.65	
"	24.50	15.83	
—20	9.96	9.94	
"	13.32	8.57	
"	16.90	7.35	
"	18.97	7.16	
"	20.56	7.08	
"	23.40	7.20	
"	24.85	9.88	
"	25.20	11.60	
"	25.40	12.37	
"	25.59	13.39	

(Roozeboom and Schreinemakers, Z. phys. Ch. 1894, **15.** 633.)

Solubility of Fe_2Cl_6+NH_4Cl.
See NH_4Cl+Fe_2Cl_6 under NH_4Cl.

Solubility of Fe_2Cl_6 in CsCl.
See CsCl+Fe_2Cl_6 under CsCl.

Solubility of $FeCl_3$+KCl in H_2O at 21°.

Substance added: $FeCl_3$ grams	KCl grams	Pts. by weight sol. in 100 pts. of solution: $FeCl_3$	KCl
0	25	0	34.97
13	28	13.44	24.45
18	21	23.18	16.54
3	18.5	28.05	11.69
28	16	35.72	11.68
31	10.5	36.62	11.19
36.2	9	37.35	13.67
41.5	8	42.03	7.88
46.5	6	51.69	7.54
52	0.5	. . .	. . .
155	0	83.89	0

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, **50.** 95.)

$FeCl_3$+NaCl.

Solubility of $FeCl_3$+NaCl in H_2O at 21°.

Substance added: $FeCl_3$ grams	NaCl grams	Pts. by weight sol. in 100 pts. of solution: $FeCl_3$	NaCl
0	3.6	0	36.10
1.8	3.0	24.27	9.10
3.6	2.5	25.40	8.45
5.5	2.0	26.40	5.25
7.2	1.5	38.15	3.90
9.0	1.0	43.38	2.45
10.8	0.5	46.75	2.11
10.8	0	83.39	0

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, **50.** 94.)

Solubility of $FeCl_3$ in NaCl+Aq at t°.

t°	Substance added: $FeCl_3$	NaCl	% of Fe in the solution
10	40	20	15.2
10	60	20	15.2
10	100	20	15.16
20	60	20	16.2
20	80	20	16.18
20	100	20	16.2
30	70	30	17.7
30	90	30	17.6
30	110	30	17.67
50	30	20	23.5
50	45	20	23.9
40	35	30	25.4
40	50	30	25.5
30	30	20	23.8
30	45	20	24.0
17.6	30	20	24.47
17.6	50	20	24.5

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, **50.** 95.)

Difficultly sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Attacked by liquid NO_2 in the presence of traces of moisture. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Sol. in liquid SO_2. (Walden, B. 1899, **32.** 2864.)

Sol. in alcohol ether, acetic ether (Cann, C. R. **102.** 363), and acetone (Krug and M'Elroy, J. anal. Ch. **6.** 184).

Sl. sol. in ethylamine. (Shinn, J. phys. Chem 1907, **11.** 538.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

1 g. $FeCl_3$ is sol. in 1.59 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 1.160. (Naumann, B. 1904, **37.** 4333.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Sl. sol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 22.)

Sublimed.

Sol. in $AsCl_3$, $POCl_3$, SO_2Cl_2 and PBr_3; sl. sol. in PCl_3. (Walden, Z. anorg. 1900, **25.** 214.)

The salts with different amts. of crystal H_2O have different solubilities. (Roozeboom.)

$+4H_2O$. Melts in crystal H_2O at 73.5°.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+4H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols Fe_2Cl_6	t°	Mols. Fe_2Cl_6
50	19.96	69	21.53	72.5	26.15
55	20.32	72.5	23.35	70	27.90
60	20.70	73.5	25.00	66	29.20

(Roozeboom, Z. phys. Ch. **10.** 477.)

$+5H_2O$. Correct formula for $+6H_2O$ salt.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+5H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
12	12.87	30	15.12	55	19.15
20	13.95	35	15.64	56	20.00
27	14.85	50	17.50	55	20.32

(Roozeboom.)

Melts in crystal H_2O at 31° (Engel, C. R. **104.** 1708); at 56° (Roozeboom).

$+6H_2O$. Very deliquescent. Sol. in alcohol. Ether dissolves out Fe_2Cl_6.

M.-pt. is 31°. (Ordway.) Contains only $5H_2O$. (Roozeboom.)

$+7H_2O$. Melts in crystal H_2O at 32.5°.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+7H_2O$ at t°.

t°	Mols Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
20	11.35	32	13.55	30	15.12
27.4	12.15	32.5	14.99	25	15.54

(Roozeboom.)

$+12H_2O$. Less deliquescent than Fe_2Cl_6 or $Fe_2Cl_6+5H_2O$.

100 mols. H_2O dissolve mols. Fe_2Cl_6 from $Fe_2Cl_6+12H_2O$ at t°.

t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6	t°	Mols. Fe_2Cl_6
—55	2.75	30	5.93	27.4	11.20
—41	2.81	35	6.78	20	12.15
—27	2.98	36.5	7.93	10	12.83
0	4.13	37	8.33	8	13.70
10	4.54	36	9.29	....	...
20	5.10	30	10.45	....	...

(Roozeboom.)

Sol. in alcohol. Ether dissolves out Fe_2Cl_6.

Melts in crystal H_2O at 37° (Roozeboom); at 35.5° (Ordway).

Ferric hydrogen chloride, $FeCl_3$, $HCl+2H_2O$.

Decomp. by H_2O. (Sabatier, Bull. Soc. (2) **197.**)

More sol. in H_2O than $FeCl_3$. (Engel, C. R. **104.** 1708.)

For solubility, see $FeCl_3+HCl$, under ferric chloride.

$+6H_2O$. (Roozeboom and Schreinemakers.)

For solubility, see $FeCl_3+HCl$, under ferric chloride.

Ferrous lithium chloride, $FeCl_2$, $LiCl+3H_2O$.

(Chassevant, A. ch. (6) **30.** 17.)

Ferric magnesium chloride, $FeCl_3$, $MgCl_2+H_2O$.

Deliquescent. (Neumann, B. **18.** 2890.)

Ferrous mercuric chloride, $FeCl_2$, $HgCl_2+4H_2O$.

Deliquescent. (v. Bonsdorff.)

Ferric nitrosyl chloride, $FeCl_3$, $NOCl$.

Very deliquescent. (Weber, Pogg. **118.** 477.)

Ferric phosphoric chloride, $FeCl_3$, PCl_5.

Decomp. by H_2O. (Baudrimont, A. ch. (4) **2.** 15.)

Iron (ferrous) potassium chloride, $FeCl_2$, $2KCl+2H_2O$.

Sol. in H_2O. (Berzelius.)

Ferric potassium chloride, $FeCl_3$, $2KCl+H_2O$.

A little H_2O dissolves out $FeCl_3$. (Fritzsche J. pr. **18.** 483.)

Sol. in H_2O. (Walden, Z. anorg. 1894, **71.** 332.)

Ferric rubidium chloride, $FeCl_3$, 3RbCl.

Easily sol. in H_2O. Insol. in HCl+Aq. (Godeffroy, Arch. Pharm. (3) **9.** 343.)

$FeCl_3$, $2RbCl+H_2O$. Decomp. by H_2O. (Neumann, A. **244.** 329.)

Sol. in H_2O. (Walden, Z. anorg. 1894, **7.** 332.)

Ferric sulphur chloride, $FeCl_3$, SCl_4.

Very sensitive toward heat and moisture. (Ruff, B. 1904, **37.** 4518.)

Ferric thallium chloride, $FeCl_3$, 3TlCl.

Decomp. by H_2O. Can be crystallised from HCl+Aq. (Wöhler, A. **144.** 250.)

Ferrous chloride ammonia, $3FeCl_2$, $2NH_3$.

Decomp. by H_2O. (Rogstadius, J. pr. **86.** 310.)

$FeCl_2$, $6NH_3$. Loses $4NH_3$ at 100°. (Miller, Am. Ch. J. 1895, **17.** 577.)

$FeCl_2$, $2NH_3$. Decomp. in the air (Miller).

Ferric chloride ammonia, $FeCl_3$, NH_3.

Slowly deliquescent. Sol. in H_2O with evolution of heat. (Rose, Pogg, **24.** 302.)

$FeCl_3$, $6NH_3$. Not deliquescent; not sol. in H_2O; sol. in HCl with decomp. (Miller, Am. Ch. J. 1895, **17.** 577.)

Loses NH_3 to give $FeCl_3$, $5NH_3$, and $FeCl_3$, $4NH_3$.

Ferric chloride cyanhydric acid, $FeCl_3$, 2HCN.

Deliquescent. (Klein, A. **74.** 85.)

Ferrous chloride nitric oxide, $FeCl_2$, NO.

Sol. in H_2O without evolution of gas. (Thomas, C. R. 1895, **121.** 204.)

$+2H_2O$. Sol. in cold H_2O without decomp. (Thomas, C. R. 1895, **120.** 448.)

$2FeCl_2$, NO. Very hydroscopic. (Thomas, C. R. 1895, **121.** 129.)

$10FeCl_2$, NO. Very hygroscopic. (Thomas C. R. 1895, **121.** 128.)

Ferric chloride nitric oxide, Fe_2Cl_6, NO.

Very hygroscopic. Loses NO when exposed to the air.

$2Fe_2Cl_6$, NO. Very hygroscopic. In contact with H_2O gives off NO. (Thomas, C. R. 1895, **120.** 447.)

Iron (ferrous) fluoride, FeF_2.

Sl. sol. in H_2O; insol. in alcohol and ether. Partly sol. in hot HCl+Aq; slowly sol. in cold, easily in hot HNO_3; decomp. by H_2SO_4. (Poulenc, C. R. **115.** 941.)

$+8H_2O$. Difficultly sol. in H_2O; more easily if it contains HF. (Berzelius.)

Ferroferric fluoride, FeF_3, FeF_2+7H_2O.

Sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 268.)

Ferric fluoride, FeF_3.

Sl. sol. in H_2O; insol. in alcohol or ether. Sl. attacked by HNO_3, HCl, or H_2SO_4+Aq. (Poulenc, C. R. **115.** 941.)

$+4\frac{1}{2}H_2O$. More sol. in hot than cold H_2O. Insol. in alcohol. (Scheurer-Kestner, A. ch. (3) **68.** 472.)

Ferric nickel fluoride, FeF_3, NiF_2+7H_2O.

Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 268.)

Ferrous potassium fluoride, FeF_2, $KF+2H_2O$.

(Wagner, B. **19.** 896.)

FeF_2, 2KF. Sl. sol. in H_2O. (Berzelius.)

Ferric potassium fluoride, FeF_3, 2KF.

Somewhat sol. in H_2O, especially if hot. (Berzelius.)

$+H_2O$. (Christensen, J. pr. (2) **35.** 164.)

FeF_3, 3KF. Properties as above. (Berzelius.)

Ferric sodium fluoride, FeF_3, $2NaF+\frac{1}{2}H_2O$.

Rather easily sol. in H_2O. Solution decomp. on heating. Very sol. in $FeCl_3$+Aq. (Nicklès, J. Pharm. (4) **10.** 14.)

FeF_3, 3NaF. (Wagner, B. **19.** 896.)

Ferric thallous fluoride, $2FeF_3$, 3TlF.

Sol. in hot H_2O, less sol. in cold. Sl. sol. in HF. (Ephraim, Z. anorg. 1909, **61.** 239.)

Ferrous titanium fluoride.

See **Fluotitanate, ferrous.**

Ferric zinc fluoride, FeF_3, ZnF_2+7H_2O.

Sl. sol. in dil. HF+Aq. (Weinland, Z. anorg. 1899, **22.** 269.)

Ferrous hydroxide, FeO_2H_2.

Sol. in 150,000 pts. H_2O. (Bineau, C. R. **41.** 509.)

Insol. in KOH, or NaOH+Aq. Sol. in NH_4 salts+Aq. Sl. sol. in $NaC_2H_3O_2$+Aq. (Mercer.)

Not pptd. in presence of Na citrate. Insol. in boiling cane sugar+Aq, but sl. sol. when KOH has been added. Not pptd. in presence of much $H_2C_4H_4O_6$. (Rose.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine.

100 ccm. of the solution contain 1.0 g. FeO. (Müller, Z. anorg. 1905, **43.** 322.)

Iron (ferric) hydroxides, Fe_2O_3, xH_2O.

Many indefinite compounds of Fe_2O_3 and H_2O are known, and uncertainty exists as to their composition.

According to van Bemmelen (R. t. c. **7.** 106) there are probably no true definite compounds of Fe_2O_3 and H_2O.

According to Tommasi (B. **12.** 1924, 2334), there are two series of Fe hydroxides, α, red hydroxides, and β, yellow hydroxides.

α *Hydroxides.* $Fe_2O_6H_6$ (unstable), Fe_2O_3, $2H_2O$ (loses H_2O at 50°), and Fe_2O_3, H_2O (loses H_2O at 92°).

Sol. in dil. acids and in Fe_2Cl_6+Aq, and pptd. from the latter solution by Na_2SO_4, or H_2SO_4+Aq.

β *Hydroxides.* $Fe_2O_6H_6$ (stable below 70°), Fe_2O_3, $2H_2O$ (loses H_2O at 105°), Fe_2O_3, H_2O (loses H_2O at 150°).

Sl. sol. in acids, and insol. in Fe_2Cl_6+Aq. (Tommasi.)

The following more or less uncertain data are given.

$2Fe_2O_3$, H_2O. Sol. in HCl+Aq. Very sl. sol. in HNO_3+Aq. (Davies, Chem. Soc. (2) **4.** 69.)

Min. *Turgite.*

Fe_2O_3, H_2O. Insol. in cold acids, difficultly sol. in warm HCl and H_2SO_4+Aq, and especially in warm HNO_3+Aq. (Schiff, A. **114.** 199.)

Min. *Göthite.*

$2Fe_2O_3$, $3H_2O$. Sl. sol. in tartaric, citric, or acetic acids, but easily sol. in HCl+Aq. (Wittstein.)

Scarcely attacked by conc. HNO_3, or HCl+Aq. Sol. in acetic acid or dil. HNO_3, or HCl+Aq, from which solution it is pptd. by trace of alkali salts. (St. Gilles.)

Min. *Limonite.*

$3Fe_2O_3$, $5H_2O$. (Muck.)

Fe_2O_3, $2H_2O$. Easily sol. in HCl+Aq.

Min. *Xanthosiderite.*

Fe_2O_3, $3H_2O$. Sl. sol. in acetic acid of 1.03 sp. gr., but easily sol. if of 1.076 sp. gr. Sol. in mineral acids. (Limberger, J. B. **1853.** 70.)

Pptd. Fe_2O_3, $xH_2O = Fe_2O_6H_6$(?). Insol. in H_2O, or in solutions of the alkalies or NH_4 salts. When recently pptd. is easily sol. in acids. (Fresenius.)

Sl. sol. in NH_4OH, and NH_4 salts+Aq. (Odling.)

Apparently insol. in NH_4Cl, or $(NH_4)_2CO_3$+Aq. (Brett, **1837.**)

Sl. sol. in conc., but insol. in dil. KOH+Aq. (Chodnew, J. pr. **28.** 221.)

Sl. sol. in very conc. KOH+Aq free from CO_2. (Völcker, A. **59.** 34.)

Not at all sol. in pure conc. KOH+Aq, solubility noticed by previous observers being caused by the presence of silicic acid. (Sandrock.)

Sl. sol. in conc. alkali carbonates+Aq.

When freshly pptd., it is not acted upon by conc. K_2CO_3+Aq. (Grotthaus.)

Readily sol. in conc. $(NH_4)_2CO_3$+Aq, but pptd. by addition of H_2O.

Sol. in excess of $(NH_4)_2CO_3$+Aq when pptd. by that reagent. (Wohler.)

Sol. in solutions of the alkali bicarbonates. (Berzelius.)

Sol. in aqueous solutions of water-glass. (Ordway.)

Immediately dissolved by H_2SO_3+Aq.

Sol. in NH_4F+Aq. (Helmholt Z. anorg. **3.** 124.)

Sol. in conc. $Al_2(SO_4)_3$+Aq. (Schneider, B. **23.** 1352.)

Sl. sol. in a solution of $MgCO_3$(?). (Bischof).

Insol. in ethylamine, or amylamine+Aq. (Wurtz, A. ch. (3) **30.** 472.)

Sol. in boiling solution of $Bi(NO_3)_3$, with pptn. of Bi_2O_3. (Persoz.)

Sol. in Cr_2Cl_6+Aq; after 3 months 15 mols. $Fe_2O_6H_6$ were dissolved by 1 mol. Cr_2Cl_6. (Béchamp, A. ch. (3) **57.** 296.)

Insol. in fumaric acid, even when freshly pptd.

When recently pptd., it is easily sol. in $KHC_4H_4O_6$+Aq, but after drying it is difficultly sol. therein.

When moist easily sol. in $H_2C_4H_4O_6$+Aq, but after drying is scarcely sol. therein when cold, and only sl. sol. when hot. (Werther.)

Easily sol. in acetic, citric, and other acids. (Wittstein.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine.

100 ccm. of the solution contain 0.8 g. Fe_2O_3. (Müller, Z. anorg. 1905, **43.** 322.)

Easily sol. in aqueous solution of sucrates of Ca, Ba, Sr, K, Na. (Hunton, **1837.**)

Unacted upon by cane sugar+Aq. (Gladstone.)

Sl. sol. in cane sugar+Aq, from which it is pptd. by $(NH_4)_2S$+Aq, but not by NH_4OH, or $K_4FeC_6N_6$+Aq. (Peschier.)

Solubility of $Fe_2O_6H_6$ in sugar solutions. 1 l. of sugar solution of given strength dissolves mg. of $Fe_2O_6H_6$.

% Sugar	Mg. $Fe_2O_6H_6$		
	at 17.4°	at 45°	at 75°
10	3.4	3.4	6.1
30	2.3	2.7	3.8
50	2.3	1.9	3.4

(Stolle, Z. Ver. Zuckerind. 1900, **50.** 340.)

Not pptd. from solutions by alkalies or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc.

Not pptd. by NH_4OH from solutions containing $Na_4P_2O_7$. (Rose, Pogg. **76.** 19.)

Not pptd. by NH_4OH in presence of Na citrate. (Spiller.)

Soluble. (*a*) *By dialysis.* Solutions containing 1% can be concentrated somewhat, whereupon they gelatinise. They also gelatinise by cold, or addition of traces of H_2SO_4, alkalies, alkali carbonates or sulphates, or neutral salts, not, however, by HCl, HNO_3, alcohol, or sugar. (Graham, A. **121.** 46.)

When a dil. solution of a solid organic acid, or an alkali, or salt is added to a dialysed solution of $Fe_2O_6H_6$, a coagulum sol. in H_2O is formed, but if the solutions are conc. the separating coagulum is no longer sol. in H_2O. (Athenstädt, C. C. **1871.** 822.)

(*b*) *Pean St. Gilles' hydroxide, or meta-iron hydroxide.* Sol. in H_2O. Pptd. from solution by traces of H_2SO_4, HCl, HNO_3+Aq, and alkalies; the ppt. is insol. in cold acids, but sol. in pure H_2O. (Pean St. Gilles, A. ch. (3) **46.** 47.)

See also table by Krecke in the article on ferric chloride.

Iron (Ferroferric) hydroxide, Fe_3O_4, H_2O (?).

Sol. in acids.

Fe_3O_4, $4H_2O$. (Lefort.)

Ferrous iodide, FeI_2.

Very deliquescent. Sol. in H_2O. Solution decomp. on evaporating.

$+4H_2O$. Very deliquescent; sl. sol. in H_2O; sol. in ether. (Jackson, Am. Ch. J. 1900, **24.** 19.)

$+5H_2O$. Deliquescent. Sol. in alcohol. Sol. in sugar+Aq, and solution is much more stable than aqueous solution. Easily sol. in glycerine.

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

$+6H_2O$, and $+9H_2O$. Very sol.; pptd. from cooled aq. solution. (Volkmann, C. C. **1894,** II. 611.)

Ferric iodide, FeI_3.

Has not been isolated. Solution of I in FeI_2+Aq in the molecular ratio of I : FeI_2 probably contains FeI_3.

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Ferrous mercuric iodide, FeI_2, $2HgI_2+6H_2O$.

As the corresponding Mg salt. (Duboin, C. R. 1907, **145.** 714.)

Ferrous iodide ammonia, FeI_2, $6NH_3$.

Decomp. by H_2O. (Jackson, Am. Ch. J. 1900, **24.** 27.)

Ferrous mercuric iodide.

Very deliquescent. Decomp. by H_2O; sol. in $HC_2H_3O_2$ or alcohol.

Iron molybdenide, $FeMo_2$.

Attacked by HCl+Aq with difficultly Sol. in hot conc. H_2SO_4. (Steinacker.)

Iron nitride.

Easily decomp. by H_2O when finely powdered. (Rossel, C. R. 1895, **121.** 942.)

Fe_2N. Easily sol. in HNO_3, HCl, or H_2SO_4 +Aq. Very slowly decomp. by H_2O. (Stahlschmidt, Pogg. **125.** 37.)

Sol. in HCl with decomp.; decomp. by steam and by H_2S at 200°. (Fowler, C. N. 1894, **68.** 152.)

Fe_5N_2. Probably the same as the above compound. (Rogstadius, J. pr. **86.** 307.)

Iron nitrososulphantimonate, $Fe_4S(NO)_6Sb_2S_5$.

(Low, C. C. **1865.** 948.)

Does not exist, but was impure sodium ferro*tetra*nitrososulphide. (Pawel, B. **15.** 2600.)

Iron nitrososulphides.

See **Ferro*tetra*nitrososulphydric acid** *and* **Ferro*hepta*nitrososulphide, ammonium.**

$Fe_3S_5H_2(NO)_4$. (Roussin, C. R. **46.** 224.)

$Fe_3S_3(NO)_4+2H_2O$. (Porczinsky, A. **125.** 302.)

$Fe_6S_5(NO)_{19}+4H_2O$. (Rosenberg, B. **3.** 312.)

The compound to which the above formula were given was impure, according to Pawel (B. **12.** 1407 and 1949; **15.** 2600), and contained more or less Na or NH_4. Pawel considers the substance as NH_4 salt of ferro*hepta*nitrososulphydric acid, which see.

$Fe_3S_2N_5O_6+1\frac{1}{2}H_2O$. Sol. in H_2O, alcohol, ether, $CHCl_3$, acetone and ethyl acetate. Insol. in benzene and light petroleum. (Marie, C. R. 1896, **122.** 138.)

Iron sodium nitrososulphide, $3Na_2S$, Fe_2S_3, 2NO.

(Roussin.)

$Na_8Fe_8S_9(NO)_{18}$. (Rosenberg.)

Correct formula is $Na_2S_2(NO)_4Fe_2$, sodium ferro*tetra*nitrososulphide.

Iron nitrososulphocarbonate, $Fe_4S(NO)_6CS_2$+ $3H_2O$.

(Low, C. C. **1865.** 948.)

Correct formula is $NaS_3(NO)_7Fe_4+2H_2O$, sodium ferro*hepta*nitrososulphide. (Pawel, B. **15.** 2600.)

Ferrous oxide, FeO.

Insol. in H_2O. Sol. in acids.

Easily sol. in HCl, and HNO_3+Aq; nearly insol. in H_2SO_4, even when heated. (Tissandier, C. R. **74.** 531.)

Ferric oxide, Fe_2O_3.

Attacked by acids with difficulty, the more so the higher it has been heated. HCl+Aq is the best solvent, in which it is more quickly sol. by long digestion at a gentle heat than by boiling. (Fresenius.)

Most easily sol. in 16 pts. of a mixture of 8 pts. H_2SO_4 and 3 pts. H_2O. (Mitscherlich, J. pr. **81.** 110.)

Solubility of Fe_2O_3 in HF+Aq at 25°.

	Time	G. Fe_2O_3 in 10 ccm. of the solution
N-HF	4½ hrs.	0.1581
	21¾ "	0.2235
	45¾ "	0.2279
0.5N-HF	2¾ "	0.0579
	8½ "	0.0884
	23½ "	0.1045
	56½ "	0.1162
0.25N-HF	2¼ "	0.0180
	8¼ "	0.0345
	24¾ "	0.0475
	142½ "	0.0534
equal amts. N-HF+N-HCl	2¾ "	0.1011
	8½ "	0.1611
	23¾ "	0.1976
	96 "	0.2223
	264 "	0.2297

(Deussen, Z. anorg. 1905, **44.** 414.)

Solubility of Fe_2O_3 in HCl+Aq at 25°.

	Time	G. Fe_2O_3 in 10 ccm. of the solution
N-HCl	4¾ hrs.	0.0409
	21½ "	0.1230
	45½ "	0.2125
0.5N-HCl	2¾ "	0.0126
	8½ "	0.0188
	23½ "	0.0382
	56½ "	0.0672
0.25N-HCl	2¼ "	0.0040
	8½ "	0.0054
	24¾ "	0.0120
	142½ "	0.0306
equal vol. N-HCl+N-NaF	2¾ "	0.0444
	8½ "	0.0640
	23¾ "	0.0743
	72¼ "	0.0757
	215 "	0.0766

(Deussen, l. c.)

Solubility of Fe_2O_3 in N-oxalic acid at 25°.

Time	G. Fe_2O_3 in 10 ccm. of the solution
1¾ hrs.	0.0310
6¾ "	0.0790
22 "	0.1960
94 "	0.2326

(Deussen.)

Absolutely insol. in Br_2+Aq. (Balard.)
Insol. in hot NH_4Cl+Aq. (Rose.)
Insol. in KOH+Aq. (Chodnew, J. pr. **28.** 222.)

Slowly sol. in an aq. solution of calcium hydrogen carbonate. The velocity of the reaction may be much increased by the addition of small amounts of alkali sulphate or $CaSO_4$. (Rohland, Z. anal. 1909, **48.** 629.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Solubility in (calcium sucrate+sugar)+Aq. 1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 6.26 g. Fe_2O_3; 296.5 g. sugar and 24.2 g. CaO dissolves 4.71 g. Fe_2O_3; 174.4 g. sugar and 14.1 g. CaO dissolves 3.08 g. Fe_2O_3. (Bodenbender, J. B. **1865.** 600.)

Solubility of Fe_2O_3 in sugar solutions. 1 l. of sugar solution of given strength dissolves mg. Fe_2O_3.

% Sugar	mg. Fe_2O_3	
	at 17.5°	at 45°
10	1.4	2.0
30	1.4	...
50	0.8	1.1

(Stolle, Z. Ver. Zuckerind, 1900, **50.** 340.)

Calcined.

Solubility of calcined Fe_2O_3 in acids at 25°.

Acid	Time	g. Fe_2O_3 in 10 ccm. of the solution
N-HF	4½ hrs.	0.0889
	43½ "	0.2035
	129½ "	0.2194
N-HCl	4½ "	0.0224
	43½ "	0.1000
	139½ "	0.1910

(Deussen, Z. anorg. 1905, **44.** 413.)

See also **Ferric hydroxide.**

Min. *Hematite.* Rather easily sol. in HCl +Aq, but not readily sol. in other acids.

***Meta*iron oxide.**

See **Ferric hydroxides.**

Ferroferric oxide, 6FeO, Fe_2O_3.

FeO, $Fe_2O_3=Fe_3O_4$. With insufficient HCl +Aq for complete solution, FeO is dissolved and Fe_2O_3 left. (Berzelius.)

Insol. in HNO_3+Aq at the ordinary temperature. (Millon.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Solubility of Fe_3O_4 in sugar solutions. 1 l. of sugar solution of given strength dissolves mg. Fe_3O_4.

% Sugar	mg. Fe_3O_4		
	at 17.5°	at 45°	at 75°
10	10.3	10.3	12.4
30	12.4	10.3	12.4
50	14.5	10.3	14.5

(Stolle, Z. Ver. Zuckerind. 1900, **50.** 340.)

Min. *Magnetite.* Insol. in HNO_3, but sol. in hot HCl+Aq.

Iron *sesqui*oxide zinc oxide, Fe_2O_3, ZnO.

See **Ferrite, zinc.**

Ferric oxybromide.

Basic ferric bromides containing three equivalents, or less, of base to one of acid may be obtained dissolved in H_2O. (Ordway, Am. J. Sci. (2) **26.** 202.)

The most basic soluble compound obtained by three months' digestion of $Fe_2O_6H_6$ with Fe_2Br_6+Aq, is Fe_2Br_6, $14Fe_2O_3$. (Béchamp.)

Ferric oxychlorides.

(*a*) *Soluble.* $Fe_2O_6H_6$ dissolves in Fe_2Cl_6+Aq. By digesting until the acid reaction of the chloride has disappeared a solution of Fe_2Cl_6, $2Fe_2O_3$ is obtained. (Pettenkofer, Repert. (2) **41.** 289.)

By digesting for several days in the cold, Fe_2Cl_6,$5Fe_2O_3$ is obtained, and still more basic compounds by further addition of $Fe_2O_6H_6$. When the solution contains Fe_2Cl_6, $12Fe_2O_3$ it gelatinises, but still dissolves completely in H_2O. The most basic soluble compound is Fe_2Cl_6, $20Fe_2O_3$. (Béchamp, A. ch. (3) **57.** 296.)

If the digestion is carried on several weeks, a solution containing Fe_2Cl_6, $23Fe_2O_3$ is obtained; this can be boiled and diluted without pptn., but $Fe_2O_6H_6$ is precipitated by the addition of very many salts. (Ordway, Sill. Am. J. (2) **26.** 197.)

Solutions containing 10 or less molecules Fe_2O_3 to 1 mol. Fe_2Cl_6 can be dried without the oxychloride becoming insoluble. (Ordway.)

The above solutions do not become cloudy by boiling or diluting. (Phillips.)

A very dil. solution of Fe_2Cl_6, $10Fe_2O_3$ remains clear after protracted boiling, and may be boiled without decomp. even when Fe_2Cl_6, $20Fe_2O_3$ is present. (Béchamp.)

HNO_3, and HCl+Aq form precipitates in the above solutions, which are sol. on addition of more H_2O. H_2SO_4+Aq forms a precipitate insol. in H_2O. (Béchamp.)

Fe_2Cl_6, $9Fe_2O_3$ is easily sol. in H_2O, weak alcohol, and glycerine; but solutions are pptd. by small amts. of H_2SO_4, M_2SO_4, citric or tartaric acids, or a few drops of HCl, or HNO_3+Aq. (Jeannel, C. R. **46.** 799.)

Solutions containing 5 mols. Fe_2O_3 to 1 mol. Fe_2Cl_6 are completely precipitated by K_2SO_4, Na_2SO_4, $MgSO_4$, KNO_3, $NaNO_3$, $Zn(NO_3)_2$, KCl, NaCl, NH_4Cl, $CaCl_2$, $MgCl_2$, $ZnCl_2$, KBr, or KSCN. (Béchamp.)

$Ba(NO_3)_2$ does not precipitate solutions of less than 18–20 Fe_2O_3 to 1 Fe_2Cl_6.

$Pb(NO_3)_2$ or $Pb(C_2H_3O_2)_2$ do not precipitate solutions containing the compound Fe_2Cl_6, $12Fe_2O_3$, but a mixture of the two salts causes complete precipitation.

Solution has been obtained containing 116 Fe_2O_3 to 1 $FeCl_6$, probably owing to a formation of soluble colloidal Fe_2O_3. (Magnier de la Source, C. R. **90.** 1352.)

Solubility determinations in the system Fe_2O_3, HCl and H_2O, show that at 25° no definite basic chloride is formed, but that the stable solid phase is one of a series of solid solutions containing Fe_2O_3, HCl and H_2O. (Cameron, J. phys. Chem. 1907, **11.** 694.)

(β) *Insoluble.* Fe_2Cl_6, $6Fe_2O_3$+$9H_2O$.

(1) By exposing $FeCl_2$+Aq to air. Insol. in H_2O; sl. sol. in HCl+Aq. (Wittstein.)

(2) From $FeCl_2$+Aq and HNO_3. Insol. in H_2O, and sl. sol. in HCl+Aq. (Béchamp.)

$2Fe_2Cl_6$, $25Fe_2O_3$+$41H_2O$. Insol. in H_2O. (Béchamp.)

Fe_2Cl_6, $2Fe_2O_3$+$3H_2O$. Decomp. by H_2O with residue of Fe_2O_3; sl. sol. in dil. acids. (Rousseau, C. R. **110.** 1032.)

Fe_2Cl_6, $3Fe_2O_3$. As above. (Rousseau, C. R. **113.** 542.)

Ferric oxyfluoride, $3Fe_2O_3$, $2FeF_3$+$4H_2O$.

Ppt. (Scheurer-Kestner.)

Ferric oxysulphide, Fe_2O_3, $3Fe_2S_3$.

(Rammelsberg.)

Iron phosphide, FeP.

Very slowly (Freese), not (Hvoslef, A. **100.** 99) sol. in hot HCl+Aq. Still more insol. in dil. H_2SO_4+Aq. (Freese.)

Slowly sol. in HNO_3+Aq, and easily sol. in aqua regia. (Struve.)

Insol. in ammonum citrate+Aq; sl. sol. in HCl. (Dennis, J. Am. Chem. Soc. 1894, **16.** 483.)

Fe_2P. Slowly but completely sol. in HCl, or dil. H_2SO_4+Aq. Sol. in hot conc. H_2SO_4, in HNO_3, and in aqua regia. (Freese, Pogg. **132.** 225.)

Insol. in all acids except in a mixture of HNO_3 and HF. (Maronneau, C. R. 1900, **130.** 657.)

Fe_3P_4. Very slowly sol. in hot conc. HCl+Aq. 0.1 g. dissolves by 4 days' heating with HCl+Aq; 0.3 g. dissolves in hot conc. H_2SO_4 in 1½ hours; 0.4 g. in 2 hours in HNO_3+Aq. Quite easily sol. in aqua regia on warming. (Freese.)

Fe_2P_3. Insol. in HCl, HNO_3 and aqua regia. Sol. in potassium hypobromite solu-

tion. (Granger, Bull. Soc. 1896, (3) **15.** 1086.)

Fe_4P_3. Very slowly sol. in boiling HCl+Aq. Easily sol. in HNO_3, or aqua regia. (Struve, J. B. **1860.** 77.)

Mixture. (Freese, Pogg. **132.** 225.)

Almost insol. in aqua regia. Sol. in fused alkali. (Granger.)

Fe_3P. Nearly insol. in dil. acids; rapidly sol. in HNO_3 or aqua regia; decomp. by conc. HCl, or KOH+Aq. (Schneider, J. B. **1886.** 2026.)

Of the nine iron phosphides described the constitution has been established for only two, Fe_3P and Fe_2P.

Fe_3P. Sol. in conc. HCl.

Fe_2P. Sol. in hot aqua regia. Insol. in other acids. (Le Chatelier, C. R. 1909, **149.** 709.)

Iron selenide, Fe_2Se.

Not attacked by HNO_3 or acetic acid. Sl. attacked by conc. HCl. Readily attacked by aqua regia. Sol. in HF. (Vigouroux, C. R. 1905, **141.** 829.)

$FeSe+xH_2O$. Sol. in HCl, HNO_3, or $HC_2H_3O_2$+Aq. Insol. in alkalies, or $(NH_4)_2S$+Aq. (Reeb, J. Pharm. (4) **9.** 173.)

Fe_2Se_3. Sol. in dil. HCl, or HNO_3+Aq with evolution of H_2Se. Sol. in conc. HNO_3+Aq. (Little, A. **112.** 211.)

Fe_3Se_4. Decomp. by fuming HNO_3. (Fonzes-Diacon, C. R. 1900, **130.** 1711).

Fe_7Se_8. Decomp. by fuming HNO_3. (Fonzes-Diacon, C. R. 1900, **130.** 1711.)

$FeSe_2$. Insol. in conc. HCl; decomp. by fuming HNO_3. (Fonzes-Diacon, C. R. 1900, **130.** 1711.)

Iron silicide, Fe_4Si.

Difficultly sol. in HCl+Aq; easily sol. even in dil. HF+Aq. (Hahn, A. **129.** 57.)

Fe_2Si. Not easily sol. in conc. HCl and HNO_3 but readily sol. in HF. (Moissan, C. R. 1895, **121.** 623.)

$Fe_{10}Si_9$. Sol. in hot HCl+Aq only when most finely powdered. (Hahn.)

$FeSi_2$. Not attacked by conc. HF or H_2SO_4. (Hahn.)

Sol. in cold HF. (de Chalmot, Am. Ch. J. 1897, **19.** 123.)

Existence questioned by Jouve, (Bull. Soc. 1901, **25.** 290–293).

Fe_3Si_2. Sol. in HF and in fused KNO_3 and $KNaCO_3$. (de Chalmot, J. Am. Chem. Soc. 1895, **17.** 924.)

Iron ***semi*****sulphide,** Fe_2S.

Sol. in dil. acids with decomposition. (Arfvedson, Pogg. **1.** 72.)

Ferrous sulphide, FeS.

Decomp. by dil. acids, with evolution of H_2S and without separation of S, except with HNO_3+Aq.

$+xH_2O$. Sl. sol. in H_2O, especially if hot. (Berzelius.)

1 l. H_2O dissolves 70.1×10^{-6} moles FeS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** **294.**)

Very violently decomp., even by dil. acids. Sol. in H_2SO_3+Aq. Insol. in H_2S, or $(NH_4)_2S$+Aq. Sl. sol. in Na_2S, or K_2S+Aq. Sol. in Na_2S or K_2S +Aq. (de Koninck, Z. angew. Ch. **1891.** 204.)

Insol. in NH_4NO_3, or NH_4Cl+Aq. (Brett.)

Not completely pptd. in presence of Na citrate. (Spiller.)

Contrary to assertion of Persoz, it can be nearly completely pptd. in presence of $Na_4P_2O_7$ by $(NH_4)_2S$+Aq. (Rose, Pogg. **76.** 18.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. **16.** 2015.)

Sol. in KCN+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Solubility of FeS in sugar solutions. 1 l. sugar of given strength dissolves mg. FeS.

% Sugar	mg. FeS		
	at 17.5°	at 45°	at 75°
10	3.8	3.8	5.3
30	7.1	9.1	7.2
50	9.9	19.8	9.1

(Stolle, Z. Ver. Zuckerind. 1900, **50.** 300.)

Colloidal.—A very dilute solution has been obtained which coagulated very readily. (Winssinger, Bull. Soc. (2) **49.** 452.)

Ferric sulphide, Fe_2S_3.

Decomp. by dil. HCl, or H_2SO_4+Aq with evolution of H_2S, leaving a residue of FeS_2.

$+1\frac{1}{2}H_2O$. Sol. in NH_4OH+Aq, also in alcoholic ammonia. Sl. sol. in $(NH_4)_2S$+very dil. $Na_2S_2O_3$+Aq. (Phipson, C. N. **30.** 139.)

Iron ***di*****sulphide,** FeS_2.

Insol. in dil. HCl, or H_2SO_3+Aq. Decomp. by HNO_3 or aqua regia with separation of S. Insol. in a 10% solution of alkali sulphide.

Min. *Pyrite, Marcasite.* Sol. in a mixture of Na_2S and NaOH+Aq, Na_2S+Aq, or mixture of Na_2S and NaSH+Aq; insol. in cold NaSH+Aq. Marcasite is more easily sol. in above than pyrite. (Becker, Sill. Am. J. (3) **33.** 199.)

Ferroferric sulphide, Fe_8S_9 or Fe_7S_8.

Min. *Pyrrhotite.* Sol. in dil. acids with a residue of S. Extremely slowly sol. in a 10% solution of alkali sulphides. (Terreil, C. R. **69.** 1360).

Iron (ferrous) nickel sulphide, $2FeS, NiS$.
Min. *Pentlandite.*

Ferrous phosphorus sulphide, FeS, P_2S.
(Berzelius.)
$2FeS, P_2S_3$. Slowly decomp. by H_2O. Insol. in boiling HCl+Aq; decomp. by aqua regia. (Berzelius, A. **46.** 256.)

Iron potassium sulphide (potassium sulphoferrite), $K_2Fe_2S_4=K_2S, Fe_2S_3$.
Insol. in cold or hot H_2O. Violently attacked by dil. acids. Not decomp. by boiling with alkalies, alkali carbonates, or sulphides+Aq. Decomp. by KCN, or $Na_2S_2O_3$+Aq. (Preis, J. pr. **107.** 16.)
$K_2S, 2FeS$. (Schneider, Pogg. **136.** 460.)

Iron silver sulphide (silver sulphoferrite), Ag_2S, Fe_2S_3.
Not attacked by dil. HCl+Aq; decomp. by conc. HCl+Aq. (Schneider.)
$2Ag_2S, FeS_2$. (Schneider, Pogg. **138.** 305.)
$Ag_2S, 3FeS, FeS_2$. Min. *Sternbergite.* Decomp. by aqua regia.

Iron sodium sulphide (sodium sulphoferrite), $Na_2Fe_2S_4+4H_2O$.
Insol. in H_2O. Decomp. by very dil. acids. (Schneider, Pogg. **138.** 302.)

Iron sulphophosphide, Fe_2PS_3.
Attacked by acids at 100°. Decomp. by boiling NaOH+Aq. (Ferrand, A. ch. 1899, (7) **17.** 410.)

Ferrous telluride, FeTe.
Insol. in H_2O; sol. in acids. (Fabre, C. R. **105.** 277.)

Kermes.
See **Antimony** *tri***sulphide.**

"Knallplatin" compounds.
See **Fulminoplatinum compounds.**

Krypton, Kr.

Absorption by H_2O at t°.

t°	Coefficient of absorption det. by two series of experiments	
0	0.1249	0.1166
10	0.0965	0.0877
20	0.0788	0.0670
30	0.0762	0.0597
40	0.0740	0.0561
50	0.0823	0.0610

(Antropoff, Roy. Soc. Proc. 1910, **83.** A. 480.)

Lanthanic acid.

Barium *meta***lanthanate,** $Ba(H_9La_5O_{15})_2$.
(Baskerville, J. Am. Chem. Soc. 1904, **26.** 79.)

Lithium *meta***lanthanate,** $LiH_9La_5O_{15}+2H_2O$.
(Baskerville.)

Potassium *meta***lanthanate,** $KH_9La_5O_{15}+15H_2O$.
Decomp. by H_2O. (Baskerville.)

Sodium *meta***lanthanate,** $NaH_9La_5O_{15}+4H_2O$.
Almost insol. in H_2O, but decomp. by it. (Baskerville.)

*Di***sodium** *tetra***lanthanate,** $Na_2La_4O_7$.
Insol. in H_2O. (Baskerville.)

Lanthanicotungstic acid.

Ammonium lanthanicotungstate, $2(NH_4)_2O, La_2O_3, 16WO_3+16H_2O$.
Ppt. Insol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1904, **26.** 1481.)

Barium lanthanicotungstate, $5BaO, La_2O_3, 16WO_3+16H_2O$.
Ppt. (E. F. Smith.)

Silver lanthanicotungstate, $5Ag_2O, La_2O_3, 16WO_3+4H_2O$.
Very insol. in H_2O. (E. F. Smith.)

Lanthanum, La.
Slowly decomp. cold, rapidly hot H_2O. Not attacked by cold conc. H_2SO_4, but energetically by cold conc. HNO_3+Aq. Sol. in dil. acids. (Hillebrand and Norton, Pogg. **155.** 633.)

Lanthanum bromide, $LaBr_3+7H_2O$.
Easily sol. in H_2O. Not very sol. in absolute alcohol. Insol. in ether. (Cleve, Sv. V. A. H. Bih. **2.** No. 7.)

Lanthanum nickel bromide, $2LaBr_3, 3NiBr_2+18H_2O$.
Deliquescent. (Frerichs and Smith, A. **191.** 355.)

Lanthanum zinc bromide, $2LaBr_3, 3ZnBr_2+36H_2O$.
Very deliquescent. (F. and S.)

Lanthanum carbide, LaC_2.
Decomp. by H_2O and dil. acids. (Pettersson, B. 1895, **28.** 2422.)
Sol. in conc. H_2SO_4 and dil. acids; insol. in conc. HNO_3.

Sol. in fused oxidizing agents; decomp. by H_2O at ordinary temps. (Moissan, C. R. 1896, **123**. 149.)

Lanthanum chloride, $LaCl_3$.

Anhydrous. Deliquescent. (Hermann.)
Insol. in acetone. (Naumann, B. 1904, **37**. 329.)
$+7\frac{1}{2}H_2O$. Not deliquescent. (Zschiesche.) Easily sol. in alcohol. (Hermann.)

Lanthanum mercuric chloride, $2LaCl_3$, $HgCl_2$ $+{}^8/_3H_2O$.

Not deliquescent. Very sol. in H_2O. (Marignac, Ann. Min. (5) **15**. 272.)

Lanthanum stannic chloride.

See **Chlorostannate, lanthanum.**

Lanthanum fluoride, LaF_3+-H_2O.

Precipitate. Sl. sol. in HCl+Aq. (Cleve.)

Lanthanum hydrogen fluoride, $2LaF_3$, 3HF.

Precipitate. (Frerichs and Smith, A. **191**. 355.)
Does not exist. (Cleve, B. **11**. 910.)

Lanthanum hydride, La_2H_3.

Decomp. by dil. acids. (Winkler, B. **24**. 1966.)
LaH_3. Decomp. by H_2O. Sol. in acids with evolution of H_2. Decomp. by alkalis. (Muthmann, A. 1902, **325**. 266.)

Lanthanum hydroxide, $La_2O_6H_6$.

Insol. in H_2O; easily sol. in acids; insol. in KOH, or NaOH+Aq.
Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, **26**. 49.)

Lanthanum zinc iodide, $2LaI_3$, $3ZnI_2+27H_2O$.

Very sol. in H_2O. (Frerichs and Smith, A. **191**. 358.)

Lanthanum nitride, LaN.

Decomp. by H_2O with evolution of NH_3. Sol. in mineral acids. Decomp. by alkali. (Muthmann, A. 1902, **325**. 275.)

Lanthanum oxide, La_2O_3.

Easily sol., even when ignited, in mineral, and acetic acids. (Hermann.)
Sol. in boiling conc. NH_4Cl+Aq. (Mosander.)
Sol. in cold conc. NH_4NO_3+Aq. (Damour and Deville.)
Insol. in $(NH_4)_2CO_3$+Aq. (Mosander.)
Insol. in acetone. (Naumann, B. 1904, **37**. 4329.)

Lanthanum *per*oxide, La_4O_9.

Sol. in HCl, H_2SO_4, HNO_3, and $HC_2H_3O_2$+Aq with decomp. (Cleve, Bull. Soc. (2) **43**. 359.)
$La_2O_5+xH_2O$. Unstable. Sol. in dil. H_2SO_4+Aq with decomp. (Melikoff, Z. anorg. 1899, **21**. 71.)

Lanthanum oxybromide, LaOBr.

Ppt. (Frerichs and Smith.)

Lanthanum oxychloride, $3La_2O_3$, $2LaCl_3$.

Insol. in H_2O. Difficultly and slowly sol. in HCl, or HNO_3+Aq. (Hermann.)
LaOCl. Boiling H_2O dissolves only traces. (Frerichs and Smith.)

Lanthanum sulphide, La_2S_3.

Decomp. by H_2O and acids. (Didier.)

Lanthanum *di*sulphide, LaS_2.

Decomp. by heat. (Biltz, Z. anorg. 1911, **71**. 435.)

Lead, Pb.

Lead, in contact with H_2O and air free from CO_2, gives a solution of PbO which turns litmus blue and turmeric red, and is turned brown with H_2S.

H_2O which has been boiled does not dissolve Pb if there is no access of air. When shaken up with air it dissolves 0.01 to 0.008% PbO in 2 hours. Pure spring water, containing 1¾ grains salts in 2 pounds H_2O and no CO_2, when conducted though a lead pipe 150 feet long, dissolves so much lead that it turns brown with H_2S. (Yorke, Phil. Mag. J. **5**. 82.)

CO_2 or small amts. of salts prevent the solution of Pb. 1 vol. H_2O with ¾ vol. CO_2 dissolves only a trace of Pb. Spring H_2O, containing in 10 pounds 1.21 grains NaCl and $CaCl_2$, and 6.4 grains $CaCO_3$ dissolved in CO_2, does not dissolve lead. (Yorke.)

If the amt. of salts in solution equals $\frac{1}{5000}$ the amt. of H_2O, and especially if they are carbonates, very slight amts. of Pb are dissolved. (Christison, Phil. Mag. J. **21**. 158.)

$CaCO_3$ dissolved in CO_2 water decreases the solubility of Pb more than any other salt.

Distilled H_2O, quietly standing in a closed flask with lead and air free from CO_2, deposits white flocks of PbO_2H_2, and dissolves $\frac{1}{70000}$ pt. PbO. The solution has an alkaline reaction. (v. Bonsdorff, Pogg. **41**. 305.)

Water of 3° hardness does not take up enough Pb to become injurious. (Clarke, J. B. **1856**. 608.)

Soluble carbonates increase the solubility of Pb in H_2O (Nevins, C. C. **1851**. 608); especially $(NH_4)_2CO_3$. (Böttger.)

Presence of H_2SO_4 decreases the solubility of Pb. (Horsford, Chem. Gaz. **1849**. 247.)

H_2O containing K_2SO_4 takes up only a trace of Pb. (Wetzlar, Schw. J. **54**. 324.)

Presence of sulphates diminishes (Christison), does not diminish (Graham, Miller, and Hoffmann), the action of H_2O on Pb.

$CaSO_4$ protects Pb, but it is attacked by much $MgSO_4$. (Nevins.)

NaCl+Aq dissolves only a trace of Pb.

$\frac{1}{4000}$ pt. of a chloride in H_2O is not sufficient to prevent the solubility of Pb in H_2O. (Christison.)

Presence of chlorides increases the solubility. (Graham, Miller, and Hoffmann; Nevins.)

H_2O containing KNO_3 does not corrode Pb.

Nitrates hinder the action of H_2O. (v. Bonsdorff.) Nitrates increase the action of H_2O. (Graham, Miller, and Hoffman.) Nitrates have no influence. (Kersting.)

10 lbs. of H_2O dissolved the following amts. from Pb pipes in 24 hours: if distilled H_2O+1% Na_2CO_3, 0.38 grain Pb; if Duna water, 0.19 grain Pb; if canal water, 0.15 grain Pb; if distilled H_2O+1% NH_4NO_3, 0.15 grain Pb; if hard well water, 0.04 grain Pb; if distilled H_2O+1% KNO_3, 0.01 grain Pb. (Kersting, Dingl. **169**. 183.)

200 l. Manchester drinking water dissolved 2.094 g. from 1 sq. metre Pb in 8 weeks; 9 l. well water dissolved 1.477 g. from 1 sq. metre Pb in 8 weeks; 11 l. distilled H_2O containing

are dissolved 110.003 g. from 1 sq. metre Pb in 8 weeks; distilled H_2O free from air dissolved 1.829 g. from 1 sq. metre Pb in 8 weeks; sea water dissolved 0.038 g. from 1 sq. metre Pb in 8 weeks. (Calvert and Johnson, C. N. **16.** 171.)

A lead pipe taken up in Paris, which had been exposed to action of ordinary H_2O for 200 years, was found perfectly smooth and uncorroded. (Belgrand, C. R. **77.** 1055.)

Pb is attacked by all waters, hard or soft; even highly calcareous water dissolves some lead. (Mayençon and Bergeret, C. R. **78.** 484.)

Pure distilled H_2O does not act on Pb, but extremely small quantities of NH_3, HNO_3, etc. cause an action; but for this action on Pb the presence of air and CO_2 is also required. (Stallman, Dingl. **180.** 366.)

100 ccm. distilled H_2O dissolved 3 mg. from 11.8 sq. cm. lead in one week when air without CO_2 was passed through the solution. 8 mg. were dissolved when the air contained CO_2. (Wagner, Dingl. **221.** 260.)

Action of dil. salt solutions on lead. In 500 ccm. of the solutions containing salt, bright sheets of lead of 5600 sq. metres' surface were so suspended that the liquid reached all parts of the metal without hindrance, and the amts. dissolved determined after 24, 48, and 72 hours of action.

Salt	Grammes salt per litre	Dissolved Pb in mg. per litre		
		after 24	48	72 hrs.
NH_4NO_3	0.020	13.0	...	25
"	0.040	15.0	...	32
"	0.080	15.0	...	...
KNO_3+ $NaNO_3$	0.020 0.050	2.0	2.0	...
KNO_3+ Na_2SO_4	0.040 0.212	0.8	1.0	...
KNO_3+ K_2CO_3	0.045 0.308	....	...	0.3
KNO_3+ K_2SO_4	0.070 0.504	....	...	0.5
$CaSO_4$	0.252	0.4	...	0.8
	0.408	0.4	1.0	...
K_2CO_3	0.310	....	...	0.2
"	0.516	....	...	0.2
$CaCl_2$	0.250	0.5	0.5	0.5
"	0.510	0.3	...	0.4
Na_2SO_4	0.200	....	...	0.8
"	0.400	....	...	0.5
NH_4NO_3+ $CaCl_2$	0.020 0.060	....	...	1.8
NH_4NO_3+ K_2CO_3+ Na_2SO_4	0.020 0.100 0.200	....	...	0.4
Na_2SO_4+ K_2CO_3+ $CaCl_2$	0.200 0.040 0.100	....	...	0.1
Water from L. Katrine		1.0	1.0	1.5
Distilled water . .		2.0	2.0	3.0

(Muir, C. N. **25.** 294.)

Action of salt solutions on 11.8 sq. cm. Pb in one week while air either with or without CO_2 was passed through the solution.

Solubility of Pb in salt solutions.

100 ccm. solutions containing the given amts. salts dissolve Pb in mg.:—

Salt	g. salt in 100 ccm.	mg. Pb dissolved	
		without CO_2	with CO_2
KCl	0.5	21	12
NaCl	0.5	21	12
NH_4Cl	1.0	12	5
$MgCl_2$	0.83	20	35
K_2SO_4	1.0	0	0
KNO_3	1.0	14	20
Na_2CO_3	1.0	0	..
NaOH	0.923	430	..
CaO_2H_2	Saturated	137	..

(Wagner, Dingl. **221.** 260.)

Solubility of Pb in salt solutions.

25 sq. cm. were acted upon by a solution containing 0.2 g. salt in a litre for 21 days.

Three series of experiments were carried on. I. In corked flasks. II. In beakers covered with porous paper; diameter of mouth of beaker = 11.5 cm. III. In basins covered with porous paper; diameter of mouth of basin = 14.5 cm. IV. In corked flasks with constant current of air. V. In beakers half filled and covered with porous paper, the lead being suspended so that equal amts. of surface were above and beneath the liquid.

The amts. in mgs. of Pb dissolved were as follows:—

Salt used	I.	II.	III.	IV.	V.
NH_4NO_3 .	1.8	4.0	16.0	...	...
KNO_3 . .	1.6	0.5	6.0	1.5	...
$CaCl_2$ . .	3.0	2.8	5.5	3.5	3.5
$(NH_4)_2SO_4$.	0.7	1.3	16.0	5.0	2.5
K_2CO_3 . .	0.3	0.3	0.7	0.6	0.3
Dist. H_2O .	1.5	0.8	4.2	2.0	...

(Muir, Chem. Soc. **36.** 660.)

H_2O sat. with CO_2 dissolves 0.012 g. Pb to a litre in 3 days. (Marais, C. R. **77.** 1529.)

Action of H_2O charged with CO_2 under 760 mm. pressure on Pb. 3 mg. of Pb were dissolved per litre in 24 hours, and the amt. was not increased by further action. The addition of 100 mg. K_2CO_3+20 mg. NH_4NO_3 to a litre prevented all action.

Action of H_2O charged with CO_2 under 6 atmos. pressure on Pb.

14.8 mg. were dissolved per l. in 24 hours, and 24 mg. per l. in 48 hours.

Action of various salt solutions added to above solution of CO_2 were as follows:—

	mg. salt per l.	mg. Pb dissolved	
		after 24 hrs.	after 48 hrs.
K_2CO_3 . . .	80	13.2	32.0
K_2CO_3 . . .	160	....	6.0
$CaCl_2$ . . .	160	32.0	44.0
NH_4NO_3 . .	16	5.0	....
NH_4NO_3 . .	40	10.0	35.0
Distilled H_2O .	...	14.8	24.0

(Muir, C. N. **33**. 125.)

The corrosion of Pb by ordinary distilled H_2O depends upon the presence of CO_2 and O. If the dissolved CO_2 is double the amt. of the dissolved O, the action is most energetic. When CO_2 is wholly absent and O present, the action is very slight, and when the H_2O contains $1\frac{1}{2}$ or more vol. % CO_2 with normal amt. of oxygen, there is no visible corrosion. Pure distilled H_2O containing neither O nor CO_2 has no action on Pb. In the above cases the greater part of the Pb remains in the form of a white ppt. or crust on the Pb, but in the case where O and CO_2 are both present in the ratio of 1 : 2, very small amts. of Pb go into solution in a few days; the amt., however, diminishes on standing. As the amt. of CO_2 increases, the amt. of Pb dissolved in the H_2O also increases.

NH_4OH alone does not protect Pb from corrosion, but when in combination with CO_2 the action is much diminished.

CaO_2H_2, and NaOH+Aq attack Pb much more actively in absence of CO_2 and presence of air. In absence of dissolved O neither CaO_2H_2 nor NaOH attacks Pb.

Na_2CO_3+Aq in absence of CO_2 attacks Pb slightly, but $NaHCO_3$+Aq has not the slightest action.

$CaH_2(CO_3)_2$+Aq also has not the slightest action on Pb, and the presence of $CaCO_3$ and CO_2 wholly prevents H_2O attacking Pb.

$CaSO_4$+Aq in presence of air forms a crust on Pb, but no Pb is found in solution, but if air is excluded there is no visible action. Presence of CO_2 causes a strong corrosive action.

H_2O containing $CaSO_4$ and $CaH_2(CO_3)_2$ does not attack Pb.

The above reactions are not in the least altered by the presence of moderate amts. of nitrates, chlorides, or ammonium, or organic compounds; but ammonium salts in excess have a strong solvent action on Pb. (Muller, J. pr. (2) **36**. 317.)

See also an extended report of the action of H_2O on Pb made to the Water Committee of Huddersfield, England, in 1886, by Messrs. Crookes, Odling, and Tidy.

Very extended researches are published by Cornelley and Frew (Jour. Soc. Chem. Ind. **7**. 15), of which only the general conclusions can be given here.

The action of slaked lime, limestone, sand calcium silicate, mortar, etc., was tested. The results were as follows:—

1. In nearly all cases the corrosion is greater with free exposure to the air than when air is excluded. The difference is especially great in those cases where the greatest action on the lead takes place. Aluminum hydroxide and blue clay form exceptions, and exert a greater corrosive action when air is excluded. In the case of $CaCO_3$, old mortar, $CaSiO_3$, or a mixture of $CaCO_3$ and CaO_2H_2, the exclusion or presence of air makes no appreciable difference.

KNO_3+Aq shows a peculiar behaviour. In the presence of air it acts nearly as much on the Pb as pure H_2O, but when air is excluded it exerts nearly as much retarding action as $CaSiO_3$.

2. In the presence of air the action of H_2O on Pb is considerably increased by the presence of NH_4NO_3 or CaO_2H_4; with exclusion of air, by $CaSO_4$, also by a mixture of CaO_2H_2 and sand. All the other investigated substances, even KNO_3, hinder the action of H_2O on Pb either with or without exclusion of air.

3. CaO_2H_2+Aq exerts in all cases a much greater corrosive action than pure H_2O, and although this action is diminished by sand yet fresh mortar very quickly destroys lead pipes when in contact therewith. Old mortar, on the other hand, and also $CaSiO_3$ and $CaCO_3$, have a protective action.

4. The fact is very important that sand, $CaCO_3$, old mortar, $CaSiO_3$, and a mixture of sand and $CaCO_3$ afford considerable protection to lead against H_2O. A mixture of limestone and sandstone has more effect than the two substances separately.

5. $CaSiO_3$ totally prevents the corrosive action of KNO_3 and NH_4NO_3, so that the lead is not attacked by solutions of those salts any more than by H_2O containing $CaSiO_3$ alone. Sand, and a mixture of sand and $CaCO_3$ have a similar effect, but not to such a degree.

6. The protective influence of $CaCO_3$ does not appear to depend on the presence of CO_2 and the formation of $CaH_2(CO_3)_2$.

7. $MgCO_3$ prevents the corrosion of Pb as much as $CaSiO_3$. (Carnelley and Frew, Jour. Soc. Chem. Ind. **7**. 15.)

Pb in contact with Zn or Fe is protected thereby from the solvent action of H_2O, and in fact the action is nearly null. Sn, on the other hand, increases the action. This is of importance in regard to the use of tin-coated lead pipes.

The presence of Ca salts does not influence the action of the H_2O on Pb, hard or soft H_2O *provided it contains* CO_2 having a strong corrosive action. Removal of air from H_2O diminishes the solvent action. Simple filtration will remove all Pb from H_2O if suitable filters are used. (Flögel, J. B. **1888**. 2645.)

Pure distilled H_2O has strong corrosive action on Pb, which is very much weakened by addition of a solution of $CaCO_3$ in carbonic acid water, but the presence of sulphates increase the action. Pb is not appreciably attacked by H_2O in presence of chlorides alone, but very strongly when $CaSO_4$ is also present. H_2O containing CO_2 also corrodes Pb. The conclusion was drawn that the absence of action of H_2O on Pb in lead pipes is due to the presence of traces of $CaH_2(CO_3)_2$. (Barbaglia and Gucci, C. C. **1888.** 934.)

Solubility in H_2O containing various solids in solution.

Water used	Pts. of lead per 100,000			
	1	2	3	4
Water alone, unfiltered	8.19	12.98	8.19	4.09
Water alone, filtered	3.00	4.09	2.07	2.32
Water containing 0.049 g. NaCl per l., unfiltered	1.36	2.73	0.68	4.04
" " " " " " filtered	0.68	1.50	0.67	1.36
Water containing 0.49 g. Na_2SO_4 per l., unfiltered	3.41	6.83	2.05	1.84
" " " " " " filtered	2.05	3.41	1.64	1.77
$CaHCO_3$+Aq containing 0.04 g. CaO as carbonate per l.	2.45	3.14	2.63	5.70
$CaHCO_3$+Aq with NaCl	2.05	3.41	2.35	3.40
$CaHCO_3$+Aq with Na_2SO_4	2.18	3.32	2.05	3.16
$CaSO_4$+Aq containing 0.095 g. CaO as sulphate per l.	6.83	6.83	3.41	1.35
$CaSO_4$+Aq with NaCl	5.46	6.57	3.51	1.50
$CaSO_4$+Aq with Na_2SO_4	4.78	5.87	3.69	1.77

Column 1 gives the numbers for distilled water free from air; column 2 for distilled water aerated by agitation with air; column 3 for water continuously aerated by passing 1 litre of air through it per hour; column 4 for distilled water through which 1 litre of air and 400 cc. of CO_2 were passed per hour throughout the experiment. (Antony and Benelli, Gazz. ch. it. 1896, **26,** (2) 97 and 352.)

Almost insol. in cold HCl+Aq, and only sl. attacked when boiling. Completely sol. in HNO_3+Aq if not too conc., but presence of H_2SO_4 or HCl diminishes the solvent power to a great extent. (Rose.)

Granulated Pb is sl. sol. in conc. HCl+Aq; addition of $PtCl_4$ makes the action very energetic. Dil. HCl+Aq may also be used with $PtCl_4$. (Millon, C. R. **21.** 49.)

HCl+Aq of 1.2 sp. gr., with Pb, gives off H at ord. temp., more abundantly when heated. Evolution of H is hastened by placing Cu in contact with the Pb. (Stolba, J. pr. **94.** 113.)

Quickly decomp. by hot HCl+Aq, slowly by cold. (Sharples, C. N. **50.** 126.)

Scarcely acted upon by boiling conc. HCl+Aq.

Sol. in aqua regia.

HNO_3+Aq is the best solvent, but Pb is as good as insol. in a mixture of HNO_3 and H_2SO_4. (Berzelius.)

Not acted upon by very conc. HNO_3+Aq.

Pb is only sl. attacked by HNO_3+Aq of any strength below 15°. Above 15° it is most rapidly attacked by a rather weak acid. (Montemartini, Gazz. ch. it. **22.** 397.)

Action of H_2SO_4 on Pb.

H_2SO_4 of 1.842 sp. gr. dissolves 201 g. from 1 sq. metre pure lead at ordinary temp. (time?), and H_2SO_4 of 1.705 sp. gr. dissolves only 59 g.

Slight impurities in the lead lessen this solubility. (Calvert and Johnson, Chem. Soc. (2) **1.** 66.)

Strongly attacked by 99.8% H_2SO_4 at ord. temp. with exclusion of air. (Lunge, Dingl. **261.** 131.)

When 0.2 g. pure Pb was heated with 50 ccm. H_2SO_4 of 66° B. there was no appreciable action below 175°. At 230–250° all the Pb was suddenly converted into $PbSO_4$, which dissolved. (Bauer, B. **8.** 210.)

Lead is slowly attacked by pure cold conc. H_2SO_4+Aq (99.78% H_2SO_4). Lead vessels which held the H_2SO_4 were gradually destroyed by long standing. (Napier and Tatlock, C. N. **42.** 314.)

H_2SO_4+Aq (20%) does not evolve H under the same circumstances. (Stolba.)

Sol. in $HC_2H_3O_2$+Aq when in contact with the air.

Strong NH_4OH+Aq does not dissolve litharge; but lead immersed in NH_4OH+Aq 3 days gives an ammonia solution containing 0.0139% lead. (Endemann, Am. Ch. J. 1897, **19.** 892.)

Somewhat sol. in NaCl+Aq. (Reichelt, Dingl. **172.** 155.)

NaCl+Aq attacks Pb at high temp. (Lunge, *l. c.*)

Action of $KClO_3$. $KClO_3$+Aq (6.3% $KClO_3$) oxidised 64.31 g. Pb from 1 sq. metre surface by boiling 7 hours; $KClO_3$+Aq (25% $KClO_3$) oxidised 151.12 g. under same conditions; and $Ca(ClO_3)_2$, $CaCl_2$+Aq (20° Baume)

tions; and $Ca(ClO_3)_2$, $CaCl_2$+Aq (20° Baume), obtained by passing Cl_2 through CaO_2H_2+Aq, oxidised 437.70 g. (Lunge and Deggeler, Jour. Soc. Chem. Ind. **4.** 31.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Sol. in a solution of K in liquid NH_3. (Kraus, J. Am. Chem. Soc. 1907, **29.** 1562.)

½ ccm. oleic acid dissolves 0.0592 g. Pb in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Solubility of Pb in petroleum.

If b.-pt. is under 230°, only slightest trace is dissolved in 4 months; if 230–300°, 0.0026% in 4 months; if over 300°, 0.0244% in 4 months in 4 months; if over 300°, 0.0244% in 4 months.

Solubility of Pb in commercial oil of turpentine and resin oil.

	Temp.	% Pb dissolved	
		in 8 days	in 14 days
Fresh oil of turpentine .	15–20°	sl. trace	0.0722
Old oil of turpentine . .	15–20	0.0522	0.1435
Fresh oil of turpentine .	100	0.265	0.715
Old oil of turpentine . .	100	0.982	1.851
Fresh oil of turpentine .	130–150	0.938	2.045
Old oil of turpentine . .	130–150	1.738	4.083
Fresh resin oil	15–20	trace	0.024
Old "	15–20	0.073	0.185
Fresh "	100	0.380	0.880
Old "	100	1.190	2.711
Fresh "	130–150	1.050	2.065
Old "	130–150	2.208	4.740

(Engler and Kneis, Dingl. **263.** 193.)

Pb is strongly attacked by oil of turpentine. (Am. Chem. **4.** 289.)

The fatty oils dissolve Pb in considerable amt. (Macadam, J. B. **1878.** 1169.)

Not attacked by sugar+Aq. (Klein and Berg, C. R. **102.** 1176.)

Lead potassium amide.

See **Potassium ammonoplumbite.**

Lead azoimide, basic, PbO, PbN_6.

Insol. in H_2O. (Wöhler, B. 1913, **46.** 2054.)

Lead azoimide, PbN_6.

Insol. in cold H_2O; much less sol. in boiling H_2O than $PbCl_2$. 1 l. H_2O dissolves about ½ g. PbN_6. Easily sol. in warm $HC_2H_3O_2$+Aq. Insol. in conc. NH_4OH+Aq. (Curtius, B. **24.** 3344.)

Lead bromide, $PbBr_2$.

Sl. sol. in cold, more easily in hot H_2O, or in H_2O containing HCl, HNO_3, or $HC_2H_3O_2$ (Löwig.)

1 l. H_2O dissolves 6 g. $PbBr_2$ at 10°; addition of HBr causes a ppt. which redissolves on further addition of HBr. 1000 pts. of a liquid containing 720 pts. HBr dissolve 550 g. $PbBr_2$. This solubility increases by heating. (Ditte, C. R. **92.** 718.)

1 l. H_2O dissolves 26.28 millimols. $PbBr_2$ at 25.2°. (von Ende. Z. anorg. 1901, **26.** 159).

Solubility in 100 g. H_2O at t°.

t°	G. $PbBr_2$
0	0.4554
15	0.7305
25	0 9744
35	1.3220
45	1.7457
55	2.1376
65	2.5736
80	3.3430
95	4.3613
* 100	4.7510

* By extrapolation.

(Lichty, J. Am. Chem. Soc. 1903, **25.** 474.)

Sl. sol. in H_2O.

8.34×10^{-1} gram. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. ch. 1903, **46.** 603.)

Solubility of $PbBr_2$ in HNO_3+Aq at 25.2°.
S = solubility in millimols per litre.

HNO_3 normal	S
0.001	39.11
0.01	39.87
0.051	42.56
0.04 KNO_3+ 0.01 HNO_3	42.77

(von Ende, Z. anorg. 1901, **26.** 162.)

Slowly sol. in cold, easily in warm NH_4Cl, or NH_4NO_3+Aq. (Wittstein.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in H_2O containing $Pb(NO_3)_2$. (von Ende, Z. anorg. 1901, **26.** 159.)

Insol. in benzene. (Franchimont, B. **16.** 387.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate (Naumann, B. 1910, **43.** 314.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+3H_2O$. (Ditte, *l. c.*)

Lead hydrogen bromide, $5PbBr_2$, $2HBr+10H_2O$.

Sol. in HBr+Aq. (Ditte, C. R. **92.** 718.)

Lead magnesium bromide, $PbBr_2$, $2MgBr_2+16H_2O$.

Very deliquescent. Decomp. immediately by H_2O or alcohol. (Otto and Drewes, Arch. Pharm. **229.** 585.)

Lead potassium bromide (potassium bromoplumbite, $PbBr_2$, $KBr+H_2O$.

(Remsen and Herty, Am. Ch. J. **14.** 124.)
$+H_2O$. (Wells, Sill. Am. J. **145.** 129.)
$PbBr_2$, 2KBr. Sol. in a little H_2O without decomp., but decomp. by an excess with separation of $PbBr_2$. (Lowig.)
$+H_2O$. (Wells, Sill. Am. J. **145.** 129.)
$2PbBr_2$, KBr. (Wells.)

Lead potassium *per***bromide,** $K_3Pb_2Br_8+4H_2O$.

Decomp. by H_2O and alcohol. (Wells, Z. anorg. **4.** 340.)

Lead rubidium bromide, $PbBr_2$, $2RbBr+\frac{1}{2}H_2O$.

(Wells, Sill. Am. J. **146.** 34.)
$2PbBr_2$, RbBr. (Wells.)

Lead sodium bromide.

Decomp. by H_2O. (Lowig.)

Lead bromochloride, $PbBrCl=PbBr_2$, $PbCl_2$.

Can be recrystallised from H_2O without decomp. (Iles, C. N. **43.** 216.)
$3PbCl_2$, $PbBr_2$. Sol. in H_2O with decomp. Sol. in HCl and in HBr. Insol. in cold alcohol; sl. sol. in boiling alcohol. (Thomas, C. R. 1899, **128.** 1235.)

Lead bromoiodide, $PbBrI=PbBr_2$, PbI_2.

Decomp. by H_2O. Cryst. from a solution of PbI_2 in HBr. (Grissom and Thorp, Am. Ch. J. **10.** 229.)
$3PbBr_2$, PbI_2. Decomp. by H_2O. (Thomas C. R. 1899, **128.** 1236.)
$6PbBr_2$, PbI_2. (G. and T.)

Lead bromosulphide, $PbBr_2$, PbS.

Properties as chlorosulphide. (Parmentier.)

Lead chloride, $PbCl_2$.

Slowly sol. in 135 pts. H_2O at 12.5°, and in a much smaller quantity of hot H_2O. (Bischof.)
Sol. in 30 pts. cold, and 22 pts. hot H_2O. (Wittstein.)
Sol. in 30 pts. H_2O at 18.75°. (Abl.)
100 pts. H_2O dissolve 4.59 pts. $PbCl_2$ at 15.5°. (Ure's Dict.)

100 pts. H_2O dissolve 0.9712 pt. $PbCl_2$ at 20°. (Formánek, C. C. **1887.** 270.)
100 pts. H_2O dissolve 0.946 pt. $PbCl_2$ at 17.7°. (Bell, Chem. Soc. (2) **6.** 355.)
Sol. in 105.2 pts. H_2O at 16.5°. (Bell, C. N. **16.** 69.)

100 pts. H_2O dissolve 0.8 pt. $PbCl_2$ at 0°; 1.18 pts. at 20°; 1.7 pts. at 40°; 2.1 pts. at 55°; 3.1 pts. at 80°. (Ditte, C. R. **92.** 718.)
1 l. H_2O dissolves 38.80 millimols. $PbCl_2$ at 25.2°. (von Ende, Z. anorg. 1901, **26.** 148.)
9.61 x 10^{-1} gram are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. ch. 1903, **46.** 603.)

Solubility in H_2O.
100 g. H_2O dissolve g. $PbCl_2$ at t°.

t°	G. $PbCl_2$
0	0.6728
15	0.9090
25	1.0842
35	1.3244
45	1.5673
55	1.8263
65	2.1265
80	2.6224
95	3.1654
* 100	3.3420

* By extrapolation.
(Lichty, J. Am. Chem. Soc. 1903, **25.** 474.)

33.6 millimols. Pb are dissolved in 1 liter H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)
1 l. H_2O dissolves 77.76 milliequivalents $PbCl_2$ at 25°. Sp. gr. of the solution 25°/4° = 1.0069. (Harkins and Winninghoff, J. Am. Chem. Soc. 1911, **33.** 1816.)
0.0388 mol. mg. $PbCl_2$ are sol. in 1 l. H_2O. (Kernot and Pomilio, Soc. R. Napoli, **1912,** (3), XVII, 353.)
A colloidal modification is sol. in hot water to give cryst. modification. (Van de Veide, Ch. Z. 1893, **17.** 1908.)
Solubility in H_2O is not much increased by the addition of acids. (Fresenius.)
Sol. in conc. HCl+Aq, from which it is pptd. by H_2O, but less sol. in dil. HCl+Aq than in H_2O. (Berzelius.)
Sol. in 1636 pts. H_2O containing HCl. (Bischof.)
Sat. solution of $PbCl_2$ in HCl+Aq of 1.116 sp. gr. contains 2.566% $PbCl_2$ at 16.5°.

Solubility in HCl+Aq. 100 pts. liquid containing pts. HCl of 1.1162 sp. gr. in 100 pts. H_2O dissolve pts. $PbCl_2$ at 17.7°.

Pts. HCl	Pts. $PbCl_2$	Pts. HCl	Pts. $PbCl_2$	Pts. HCl	Pts. $PbCl_2$
1	0.347	8	0.099	50	0.356
2	0.201	9	0.096	60	0.559
3	0.165	10	0.093	70	0.933
4	0.145	15	0.090	80	1.498
5	0.131	20	0.111	90	2.117
6	0.107	30	0.151	100	2.900
7	0.100	40	0.216	..	...

(Bell, Chem. Soc. **21.** 350.)

Solubility of $PbCl_2$ in HCl.

Amt. HCl in 100 pts. H_2O	Amount $PbCl_2$ dissolved in 1000 pts. of liquid				
	At 0°	At 20°	At 40°	At 55°	At 80°
0.0	8.0	11.8	17.0	21.0	31.0
5.6	2.8	3.0	4.6	6.5	12.4
10.0	1.2	1.4	3.2	5.5	12.0
18.0	2.4	4.8	7.2	9.8	19.8
21.9	4.7	6.2	10.4	12.9	23.8
31.5	11.9	14.1	19.0	24.0	38.0
46.0	29.8	30.0	....	....	....

(Ditte, C. R. **92.** 718.)

Solubility in HCl+Aq at 0°. $\frac{PbCl_2}{2}$ = ½mols.

$PbCl_2$ in mgs. in 10 ccm. solution; HCl = mols. HCl in ditto.

$\frac{PbCl_2}{2}$	HCl	$\frac{PbCl_2}{2}$	HCl
0.42	0.	0.072	5.8
0.22	0.35	0.088	11.7
0.135	0.675	0.100	29.5
0.11	1.125	0.209	46.7
0.105	1.6	0.95	73.5
0.099	2.3	1.5	89.0
0.090	3.4	1.9	96.0
0.08	4.5	3.01	111.5

It is seen that very little HCl+Aq is sufficient to diminish solubility very considerably, and, that on further addition of HCl+Aq, the solubility is nearly constant, and increases finally very much when large amts. of HCl+Aq are present. (Engel, A. ch. (6) **17.** 359.)

Solubility of $PbCl_2$ in HCl+Aq at 25°.

G. HCl per l.	G. $PbCl_2$ per l.	G. HCl per l.	G. $PbCl_2$ per l.
0	10.79	3	5.0
0.5	9.0	6	3.1
1.	7.6	10	1.8
2.	6.0		

(Noyes, Z. phys. Ch. 1892, **9.** 623.)

Solubility of $PbCl_2$ in HCl+Aq at 25.20°.
S = solubility in millimols per litre.

HCl normal	S	HCl normal	S
0.0000	38.80	0.3714	6.35
0.0009	38.66	0.5142	5.37
0.0022	38.20	0.7386	4.73
0.0030	37.94	1.026	4.41
0.0045	37.35	1.538	4.61
0.0091	35.80	2.051	5.18
0.0114	34.99	2.564	6.25
0.0151	33.75	3.085	7.78
0.0226	31.46	3.718	8.16
0.0302	29.32	5.0	19.38
0.0452	25.46	7.5	65.86
0.0910	17.12	10.0	141.35
0.1850	10.12	12.05	164.3

(von Ende, Z. anorg. 1901, **26.** 148.)

Solubility of $PbCl_2$ in HCl at 18°.

HCl Normality	G. $PbCl_2$ per l.
0	9.34
0.0001	9.305
0.0002	9.300
0.0005	9.243
0.00102	9.200
0.0102	8.504

(Pleissner, Arb. Kais. Gesundamt. 1907, **26.** 384.)

Sol. in hot, insol. in cold conc. H_2SO_4. (Hayes.)

Sol. in dil. HNO_3+Aq, from which it is pptd. by HCl+Aq. (Gladstone.)

Easily and completely decomp. by hot HNO_3+Aq. (Wurtz.)

Solubility of $PbCl_2$ in HNO_3+Aq at 25.2°.
S = solubility in millimols per litre.

HNO_3 normal	S
0.001	38.87
0.01	39.71
0.051	42.92
0.04 KNO_3+ 0.01 HNO_3	43.36

(von Ende, Z. anorg. 1901, **26.** 162.)

Solubility of $PbCl_2$ in NH_4Cl+Aq at 25.20°.
S = solubility in millimols per litre.

NH_4Cl normal	S
0.25	9.47
0.50	7.11
1.0	4.35

(von Ende, Z. anorg. 1901, **26.** 152.)

Solubility of $PbCl_2$+NH_4Cl at 22°.

G. equiv. per l. H_2O NH_4Cl	G. equiv. per 100 cc. H_2O $PbCl_2$	G. equiv. per l. H_2O NH_4Cl	G. equiv. per 100 cc. H_2O $PbCl_2$
0.0	7.49×10^{-3}	1.0	0.758×10^{-3}
0.1	3.10	1.2	0.707
0.2	1.916	1.5	0.671
0.3	1.508	2.0	0.695
0.4	1.348	2.5	0.812
0.5	1.263	3.0	0.968
0.55	1.189	4.0	1.502
0.6	1.092	5.0	2.338
0.65	1.012	6.0	3.580
0.7	0.956	7.0	5.628
0.8	0.837	7.29*	6.46
0.9	0.793		

* Saturated.

(Brönsted, Cong. Appl. Chem. 1909, Sec. X, 110.)

Solubility in NH_4Cl+Aq at t°.

t°	G. $PbCl_2$ in 100 g. of the solution	G. NH_4Cl in 100 g. of the solution	Solid phase
17°	0.89	0.0	$PbCl_2$
	0.21	0.96	
	0.16	1.43	
	0.14	2.40	
	0.076	3.48	eutectic-pt.
	0.078	4.23	$2PbCl_2, NH_4Cl$
	0.078	4.93	
	0.098	12.36	
	0.34	22.33	
	0.64	26.49	eutectic-pt.
	0.52	26.68	NH_4Cl
	0.33	26.91	
	0.30	27.03	
	0.0	27.14	
50°	1.69	0.0	$PbCl_2$
	1.08	0.51	
	0.67	1.45	
	0.58	2.45	
	0.48	4.86	eutectic pt.
	0.49	12.45	$2PbCl_2, NH_4Cl$
	0.71	19.42	
	1.76	27.16	
	3.31	31.90	
	3.96	33.56	eutectic pt.
	2.65	33.62	NH_4Cl
	1.62	33.88	
	0.32	34.14	
	0.0	34.25	
100°	3.10	0.0	$PbCl_2$
	2.02	1.32	
	1.85	5.33	
	1.80	6.01	
	1.76	8.59	eutectic pt.
	1.98	13.19	$2PbCl_2, NH_4Cl$
	4.54	26.08	
	8.32	32.64	
	11.40	36.29	
	12.67	37.62	eutectic pt.
	12.50	38.14	$PbCl_2, 2NH_4Cl$
	11.60	38.32	
	10.70	38.66	
	9.88	40.22	
	9.26	41.90	eutectic pt.
	4.21	42.91	NH_4Cl
	3.06	43.20	
	1.61	43.42	
	0.0	43.51	

These results show that the double salt $PbCl_2, 2NH_4Cl$ can only exist in aqueous solution at temperature above 70°.

(Demassieux, C. R. 1913, **156.** 894.)

Much more sol. in $HgCl_2$+Aq than in H_2O.

Grammes $HgCl_2$ in 100 ccm.	Grammes $PbCl_2$ dissolved	After subtracting amt. dissolved by H_2O alone	Calculated no. of grammes for 100 g. $HgCl_2$
0	0.9712	....	...
4	1.8972	0.9350	23.37
2	1.4874	0.5208	26.04
1	1.2272	0.2600	26.00
0.5	1.0808	0.1134	22.68
0.25	1.0192	0.0500	20.00
0.125	0.9926	0.0226	18.08

(Formánek, C. C. **1887.** 270.)

Solubility of $PbCl_2$ in $Pb(NO_3)_2$+Aq at 20°.

G. equiv. per l.	
$Pb(NO_3)_2$	$PbCl_2$
0.0	0.0777
0.2	0.0832

(Noyes, Z. phys. Ch. 1892, **9.** 623.)

Solubility in $Pb(NO_3)_2$+Aq at 25°.

C = concentration of $Pb(NO_3)_2$ in $Pb(NO_3)_2$+Aq expressed in milliequivalents per l.

d_1 = Sp. gr. of $Pb(NO_3)_2$+Aq at 25°.

S = Solubility of $PbCl_2$ in $Pb(NO_3)_2$+Aq expressed in milliequivalents per l.

d_2 = Sp. gr. 25°/4° of $PbCl_2$+$Pb(NO_3)_2$+Aq.

C	d_1	S	d_2
20.020	1.0008	76.75	1.0095
50.063	1.0045	76.64	1.0139
99.660	1.0119	77.98	1.0210

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, **33.** 1816.)

Solubility of $PbCl_2$ in $Pb(NO_3)_2$+Aq at 25°.

G. $Pb(NO_3)_2$ per l.	% $PbCl_2$
0	1.09
3.31	1.10
6.62	1.05
33.12	1.11
82.80	1.29

(Armstrong and Eyre, Proc. Roy. Soc. 1913, (A) **88.** 234.)

Solubility of $PbCl_2$ in KCl+Aq at 25.20°.
S = Solubility in millimols per litre.

KCl normal	S	KCl normal	S
0.0000	38.80	0.0999	16.90
0.001	38.32	0.5006	7.40
0.0025	37.85	0.7018	7.38
0.0049	37.02	0.9991	4.90
0.0049	37.02	0.9991	4.90
0.0099	35.28	1.5018	4.83
0.0200	32.16	2.0024	5.56
0.0599	22.62	3.0036	9.74

(von Ende, Z. anorg. **1901, 26. 151.**)

Solubility of $PbCl_2$+KCl in H_2O at 20°.
Values = g. equivalents.

In 1000 g. solution		In 1000 g. H_2O		Solid phase
$PbCl_2$	KCl	$PbCl_2$	KCl	
...	...	28.0	4.57	$PbCl_2$, KCl. $^1/_3H_2O$+KCl
17.80	3.18	23.42	4.18	$PbCl_2$, KCl. $^1/_3H_2O$
16.56	3.05	21.50	3.96	"
15.50	2.91	19.85	3.73	"
14.76	2.77	18.66	3.50	"
13.96	2.66	17.48	3.33	"
13.16	2.47	16.17	3.03	"
13.08	2.45	16.06	3.01	"
12.94	2.40	15.80	2.93	"
12.96	2.36	14.92	2.87	$2PbCl_2$, KCl
12.86	2.35	15.63	2.86	"
12.44	2.30	15.03	2.78	"
11.84	2.29	14.30	2.77	"
11.38	2.24	13.70	2.70	"
10.60	2.20	12.72	2.64	"
11.98	2.29	14.35	2.62	"
10.46	2.14	12.47	2.55	"
10.22	2.10	12.13	2.49	"
9.82	2.04	11.60	2.41	"
9.34	1.965	10.96	2.31	"
8.94	1.884	10.42	2.20	"
7.86	1.575	8.92	1.79	"
7.72	1.526	8.72	1.744	"
7.66	1.404	8.56	1.570	"
7.46	1.324	8.29	1.472	"
7.36	1.224	8.11	1.348	"
7.38	1.223	8.13	1.347	"
7.30	1.127	7.98	1.231	"
7.34	1.122	8.01	1.225	"
7.36	1.059	8.00	1.152	"
7.48	1.022	8.10	1.107	"
7.52	0.988	8.13	1.068	"
7.70	0.930	8.28	1.000	"
7.82	0.880	8.38	0.943	"
8.24	0.821	8.79	0.875	"
8.42	0.783	8.96	0.833	"
8.84	0.719	9.36	0.761	"
9.54	0.639	10.03	0.672	"
10.68	0.575	11.18	0.602	"
12.32	0.523	12.85	0.545	"
12.38	0.503	12.88	0.523	$PbCl_2$
12.36	0.483	12.85	0.502	"
12.56	0.475	13.04	0.497	"
12.48	0.458	12.95	0.475	"
12.24	0.375	13.65	0.387	"
14.52	0.299	14.88	0.306	"
19.00	0.195	19.33	0.199	"

(Brönsted, Z. phys. Ch. 1912, **80.** 208.)

$PbCl_2$ is sol. in 120 pts. pure H_2O, but on adding 5% NaCl 437 pts. are required to effect solution. When $PbCl_2$ is digested with conc. NaCl+Aq, 1 pt. dissolves in 129 pts. of the liquid.

A study of the equilibrium between lead chloride and sodium chloride in aqueous solution at 13°, 50° and 100° shows that at none of these temp. do these chlorides form a double salt. (Demassieux, C. R. 1914, **158.** 702.)

Solubility in salts+Aq at 25°.

Salt used	Concentration of the salt. Equivalents per liter	Solubility of $PbCl_2$ Equivalents per liter
None	0	0.07770
HCl	0.05	0.04786
"	0.1	0.03243
"	0.2	0.01927
KCl	0.05	0.0482
"	0.1	0.0341
"	0.2	0.0219
$MgCl_2$	0.05	0.0503
"	0.1	0.0350
$CaCl_2$	0.05	0.0503
"	0.1	0.0355
"	0.2	0.0219
$MnCl_2$	0.05	0.0501
"	0.1	0.0349
"	0.2	0.0217
$ZnCl_2$	0.2	0.0220
$CdCl_2$	0.05	0.0601
"	0.1	0.0481
"	0.2	0.0355

(Noyes, Z. phys. Ch. 1892, **9.** 623.)

Sol. in KOH+Aq. (Rose.)

Less sol. in dil. salt solutions than in H_2O, especially $CaCl_2$+Aq; sol. in 534 pts. H_2O containing $CaCl_2$. (Bischof.)

More sol. in $Na_2S_2O_3$+Aq than in H_2O, but not as sol. as AgCl. (Herschell, **1819.**)

More sol. in $NaC_2H_3O_2$+Aq than in H_2O. (Anthon.)

Easily sol. in NH_4NO_3+Aq.

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in conc. alcohol. (Wittstein.) Insol. in 94% alcohol; very sl. sol. in cold or hot 76% alcohol.

Solubility in alcohol at 25°.

Alcohol = g. mol. alcohol in 1 l. of solvent.

$PbCl_2$ = g. mol. $PbCl_2$ in 1 l. of solution.

Alcohol	4	2	1	$^1/_2$	$^1/_4$
$PbCl_2$	0.0172	0.0257	0.0298	0.0330	0.0338

Alcohol	$^1/_8$	0
$PbCl_2$	0.0367	0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) **17.** 353.)

Insol. in benzene. (Franchimont, B. **16.** 387.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B.

1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in methylal. (Eidmann, C. C. **1899,** II, 1014.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Glycerine dissolves 1.995% $PbCl_2$.

1 pt. glycerine+1 pt. H_2O dissolves 1.32% $PbCl_2$.

1 pt. glycerine+3 pts. H_2O dissolves 1.0365 % $PbCl_2$.

Glycerine containing 87.5% H_2O dissolves 0.91% $PbCl_2$. (Piesse, B. **7.** 599.)

Solubility of $PbCl_2$ in mannite+Aq at 25°.

Mannite = g. mol. mannite in 1 l. of solvent.

$PbCl_2$ = g. mol. $PbCl_2$ in 1 l. of solution.

Mannite	1/2	1/4	1/8	1/16	1/32
$PbCl_2$	0.0408	0.0403	0.0394	0.0384	0.0385

Mannite	1/64	0
$PbCl_2$	0.0377	0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) **17.** 353.)

Min. *Cotunnite.*

Lead ***tetra*****chloride,** $PbCl_4$.

Sol. in H_2O with subsequent decomp. (Rivot, Beudant, and Daguin, Ann. Min. (5) **4.** 239.)

Obtained in a pure state by Friedrich. Sol. in a little cold H_2O, but is decomp. by warming or diluting. Miscible with conc. HCl+Aq; not attacked by conc. H_2SO_4 even on warming. (Friedrich, W. A. B. **102, 2b.** 534.)

Lead ***tetra*****chloride** ***with*** **MCl.**

See **Chloroplumbate, M.**

Lead magnesium chloride, $PbCl_2$, $2MgCl_2+13H_2O$.

Deliquescent. Decomp. by H_2O. (Otto and Drewes, Arch. Pharm. **228.** 495.)

Lead potassium chloride (potassium chloroplumbite), $PbCl_2$, KCl.

(Remsen and Herty, Am. Ch. J. **14.** 125.)

Contains 1/3 H_2O. (Wells, Sill. Am. J. 145. 130.)

See also Demassieux, $PbCl_2$+KCl under $PbCl_2$.

$2PbCl_2$, KCl. (Wells.)

See also Demassieux as above.

Lead rhodium chloride.

See **Chlororhodite, lead.**

Lead rubidium chloride, $PbCl_2$, $2RbCl+\frac{1}{2}H_2O$.

(Wells, Sill. Am. J. **146.** 34.)

2 $PbCl_2$, RbCl. (Wells.)

Lead sodium chloride.

Decomp. by H_2O.

Lead sodium ***tetra*****chloride,** $2PbCl_4$, 9NaCl.

Very sol. in H_2O. (Sobrero and Selmi, A. ch. (3) **29.** 165.)

See also **Chloroplumbate, lead.**

Lead thallous chloride, $PbCl_2$, 3TlCl.

Sl. sol. in cold, more in hot H_2O. (Noyes, Z. phys. Ch. **9.** 622.)

$PbCl_2$, TlCl. Ppt. (Ephraim, Z. anorg. 1909, **61.** 245.)

Lead chloride ammonia, $2PbCl_2$, $3NH_3$.

(Rose, Pogg. **20.** 157.)

Lead ***tetra*****chloride ammonia,** $PbCl_4$, $4NH_3$.

Pptd. from chloroform solution. (Matthews, J. Am. Chem. Soc. 1898, **20.** 825.)

$PbCl_4$, $2NH_3$. Fumes in the air. Decomp. by H_2O. (Matthews.)

Lead chloride arsenate, $3Pb_3(AsO_4)_2$, $PbCl_2$.

See **Arsenate chloride, lead.**

Lead chloride borate, $Pb(BO_2)_2$, $PbCl_2+H_2O$.

See **Borate chloride, lead.**

Lead chloride carbonate.

See **Carbonate chloride, lead.**

Lead chloride chlorite.

See **Chlorite chloride, lead.**

Lead chloride ***with*** **fluoride** ***and*** **iodide.**

See **Lead chlorofluoride** and **Lead chloroiodide.**

Lead chloride phosphate.

See **Phosphate chloride, lead.**

Lead chloride phosphite, $PbCl_2$, $Pb_2P_2O_5$(?).

Ppt. (Berzelius.)

Does not exist. (Rose.)

Lead chloride sulphate.

See **Sulphate chloride, lead.**

Lead chloride sulphide, $PbCl_2$, 3PbS.

See **Lead chlorosulphide.**

Lead chlorofluoride, PbClF.

Sl. sol. in H_2O without decomp. Easily sol. in HNO_3+Aq. (Berzelius.)

Solubility in H_2O.

100 g. H_2O dissolve 0.0211 g. PbClF at 0°; 0.0370 g. at 25°; 0.1081 g. at 100°. (Starck, Z. anorg. Ch. 1911, **70.** 174.)

Solubility in HCl+Aq at 25°.

Solution of PbClF in HCl+Aq containing 0.0535 g. equiv. per l. contains 0.0758 g. PbClF in 100 cc. of solvent.

Solution of PbClF in HCl+Aq containing

0.1069 g. equiv. per l. contains 0.1006 g. PbClF in 100 cc. of solvent. (Starck.)

Solubility in acetic acid at 25°.

Solution of PbClF in $HC_2H_3O_2$ containing 0.0518 g. equiv. per l. contains 0.05129 g. PbClF in 100 cc. of solvent.

Solution of PbClF in $HC_2H_3O_2$ containing 0.1055 g. equiv. per l. contains 0.0561 g PbClF in 100 cc. of solvent. (Starck.)

Solubility in $PbCl_2$+Aq.

t°	G. equiv. per l. $PbCl_2$	G. PbClF in 100 cc. of solvent
18°	0.0100	0.0020
"	0.0195	0.0016
"	0.0495	0.0002
25°	0.00996	0.0030
"	0.0196	0.0008
"	0.0392	0.0005

(Starck.)

Lead chloroiodide, $2PbCl_2$, PbI_2.

Sol. in hot NH_4Cl+Aq. (Poggiale, J. pr. **35.** 329.)

$PbCl_2$, PbI_2. Sol. in hot HCl+Aq. (Engelhardt.)

Sol. in H_2O. (Thomas, C. R. 1898, **126.** 1351.)

Lead chloroselenide.

Decomp. by boiling H_2O and by conc. KOH+Aq. (Fonzes-Diacon, C. R. 1900, **130.** 1133.)

Lead chlorosulphide, $PbCl_2$, 3PbS.

Partially decomp. by hot H_2O. Not attacked by dil., but decomp. by conc. HCl+Aq. (Hünefeld, J. pr. **7.** 27.)

PbS, $PbCl_2$. Decomp. by H_2O, acids, or alkalies. (Parmentier, C. R. **114.** 298.)

$ClPbS_2PbS_2PbS_2PbCl$. Ppt. (Hofmann, B. 1904, **37.** 250.)

Lead fluoride, PbF_2.

Very sl. sol. in H_2O, and not more in HF+Aq. (Berzelius, Pogg. **1.** 31.)

5.5 millimols are sol. in 1000 ccm. H_2O. (Jaeger, Z. anorg. 1901, **27.** 38.)

1 l. H_2O dissolves 640 mg. at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

641 mg. in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

More sol. in HNO_3, or HCl+Aq. Sl. sol. in KF+Aq. (Herty, Am. Ch. J. **14.** 107.)

Sl. sol. in dil. HF+Aq;. insol. in strong HF+Aq.

0.01302 g. atoms Pb are sol. in 1000 cc. HF. (Jaeger, Z. anorg. 1901, **27.** 37.)

Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Insol. in liquid NH_3. (Gore, Am. J. Ch. 1898, **20.** 828.)

Insol. in ethylacetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Lead potassium fluoride, 3KF, HF, PbF_4.

Decomp. H_2O, stable in dry air. (Brauner, Z. anorg. 1894, **7.** 7.)

Lead silicon fluoride.

See **Fluosilicate, lead.**

Lead tantalum fluoride.

See **Fluotantalate, lead.**

Lead titanium fluoride.

See **Fluotitanate, lead.**

Lead fluoride sulphate.

See **Sulphate fluoride, lead.**

Lead hydroxide, PbO_2H_2.

Not appreciably sol. in H_2O. (Jaeger, Z. anorg. 1901, **27.** 38.)

1 l. H_2O dissolves 0.155 g. PbO_2H_2 at 20° and 100°. (Sehnal, C. R. 1909, **148.** 1396.)

Solubility in NaOH+Aq.

G. Na in 20 ccm.	G. Pb in 20 ccm.
0.2024	0.1012
0.3196	0.1736
0.5866	0.3532
0.9476	0.4071
1.7802	0.5170

(Rubenbauer, Z. anorg. 1902, **30.** 336.)

Solubility of PbO_2H_2 in NaOH+Aq at 25°.

G. mol. per l.		Solid Phase
Na	Pb	
0.274	0.0181	PbO_2H_2
0.431	0.287	"
0.476	0.319	"
0.745	0.489	"
1.132	0.711	"
1.519	0.101	"

(Wood, Chem. Soc. 1910, **97.** 884.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

2PbO, PbO_2H_2 = 3PbO, H_2O. Sol. in 10,000 to 12,000 pts. H_2O. (Yorke.) Sol. in 7000 pts. H_2O. (v. Bonsdorff, Pogg. **41.** 307.)

0.45 millimol. Pb are sol. in 1 liter H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

Sol. in acids. Insol. in NH_4OH+Aq. Sol. in NaOH, or KOH+Aq. Sol. in hot NH_4Cl+Aq, and repptd. by NH_4OH+Aq.

Solubility in KOH+Aq, according to Ditte (C. R. **94.** 130). When KOH+Aq is gradu-

ally added to lead hydroxide suspended in H_2O, the lead hydroxide is at first dissolved proportional to the amount of KOH, until the strength reaches 200 g. KOH to 1 litre H_2O. The solubility then diminishes and increases again until 400 g. KOH are dissolved in 1 litre H_2O. The amorphous lead hydroxide is then converted into crystalline $2PbO(PbO_2H_2)$. By further addition of KOH the solubility is suddenly decreased, and then increases again. (Ditte.)

Sol. in triethyl toluenyl ammonium hydrate+Aq.

Sol. in sorbine+Aq. (Pelouze.)

Sol. in acetates+Aq. (Mercer.)

Sol. in Ca, Ba, Sr, K, or Na sucrate+Aq.

Not pptd. in presence of Na citrate+Aq. (Spiller.)

See also under **Lead**, *and* **Lead oxide.**

Lead *per***hydroxide,** PbO_2, H_2O.

See **Lead** *per***oxide.**

Lead imide, PbNH.

Decomp. by H_2O and dilute acids. (Franklin, Z. anorg. 1905, **46.** 27.)

Lead iodide, PbI_2.

Sol. in 187 pts. boiling H_2O. (Berthemot.)

Sol. in 1235 pts. H_2O at ord. temp., and 194 pts. at 100°. (Denot, J. pr. **1.** 425.)

Sol. in 2400 pts. H_2O at 18.75°. (Abl.)

Sat. PbI_2+Aq at 20° contains 0.0017 pt.; at 27°, 0.002 pt.; at 100°, 0.0039 pt. PbI_2. (Lassaigne, J. chim. med. **7.** 364.)

1 l. H_2O dissolves 0.6 g. PbI_2 at 10°. (Ditte, C. R. **92.** 718.)

1 l. H_2O dissolves 1.58 millimols PbI_2 at 25.2°. (Von Ende, Z. anorg. 1901, **26.** 159.)

0.47×10^{-1} gram are dissolved in 1 litre of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Solubility in 100 g. H_2O at t°.

t°	G. PbI_2.
0	0.0442
15	0.0613
25	0.0764
35	0.1042
45	0.1453
55	0.1755
65	0.2183
80	0.3023
95	0.3960
* 100	0.4360

* By extrapolation.

(Lichty, J. Am. Chem. Soc. 1903, **25.** 474.)

0.0013 g. mol. PbI_2 are dissolved in 1 l. H_2O at 20°. (Fedotieff, Z. anorg. 1911, **73.** 178.)

Not more sol. in $HC_2H_3O_2$+Aq than in H_2O, contrary to Henry. (Denot, *l. c.*)

Pptd. from aqueous solution by little HI+Aq, but redissolved by the addition of more. (Ditte, C. R. **92.** 718.)

Insol. in cold, sol. in hot HCl+Aq with decomp.

Solubility of PbI_2 in HNO_3+Aq at 25.2°.

S = Solubility in millimols. per litre.

HNO_3 normal	S
0.001	38.87
0.01	39.06
0.051	39.45
0.04 KNO_3+ 0.01 HNO_3	39.45

(von Ende, Z. anorg. 1901, **26.** 162.)

Sol. in KOH+Aq.

Sol. in conc. KI, NaI, BaI_2, SrI_2, CaI_2, and MgI_2+Aq, from which it is pptd. by H_2O. (Berthemot.)

Very sol. in KI+Aq, 2 mols. PbI_2 being dissolved for 1 mol. KI. (Boullay.)

Sol. in NH_4I+Aq. Easily sol. in $Na_2S_2O_3$+Aq. (Werner, C. N. **53.** 51.)

Not pptd. in presence of Na citrate. (Spiller.)

Solubility in sat. I_2+Aq at 20° = 0.00216 g. mol. per l. Solid phase PbI_2+I_2. (Fedotieff, Z. anorg. 1911, **73.** 178.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sl. sol. in alcohol. (Henry.) Decomp. by boiling ether. (Vogel.)

100 g. formic acid dissolve 0.25 g. at 19.8°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

0.02 pts. are sol. in 100 pts. acetone at 59°.

0.02 pts. are sol. in 100 pts. amyl alcohol at 133.5.

0.50 pts. are sol. in 100 pts. aniline at 13°.

1.10 pts. are sol. in 100 pts. aniline at 184°. (Laszczynski, B. 1894, **27.** 2287.)

Solubility of PbI_2 in pyridine at t°.

t°	G. PbI_2 per 100 g. pyridine	Solid phase
—37	0.166	PbI_2, C_5H_5N
—20	0.175	"
— 9	0.186	"
0	0.200	"
+ 3	0.215	"
6	0.225	PbI_2, C_5H_5N+PbI_2, $2C_5H_5N$
15	0.208	PbI_2, $2C_5H_5N$
35	0.188	"
57	0.190	"
77	0.228	"
92	0.290	"
98	0.340	"
105	0.370	"
108	0.410	"
112	0.445	"

(Heise, J. phys. Ch. 1912, **16**, 273.)

Lead hydrogen iodide, $PbH_2I_4=PbI_2$, 2HI.

Cold H_2O dissolves out HI. Sol. in hot H_2O, from which crystallizes PbI_2. (Guyot, J. chim. med. **12.** 247.)

$+10H_2O$. Decomp. by H_2O. (Berthelot, C. R. **91.** 1024.)

Lead lithium iodide, PbI_2, $LiI+5H_2O$.

Loses 1 mol. H_2O at 95° and loses another mol. H_2O at 100°. (Bogorodski, C. C. **1894,** II. 515.)

PbI_2, $2LiI+6H_2O$. Sl. sol. in H_2O. (Mosnier, C. R. 1895, **120.** 446.)

Lead magnesium iodide, PbI_2, $2MgI_2$.

Decomp. by H_2O and by alcohol. (Mosnier, A. ch. 1897, (7) **12.** 402.)

$+16H_2O$. Very hygroscopic. Decomp. immediately by H_2O. (Otto and Drewes, Arch. Pharm. **229.** 180.)

Lead nickel iodide, $PbNi_2I_6+3H_2O$.

Decomp. by H_2O. (Mosnier, A. ch. 1897, (7) **12.** 411.)

Lead potassium iodide (Potassium iodoplumbite), PbI_2, KI.

Permanent. Completely decomp. by H_2O. Unacted upon by cold, but completely decomp. by hot alcohol. (Boullay, A. ch. (2) **34.** 366.)

$+2H_2O$. The only salt that could be obtained by Remsen and Herty (Am. Ch. J. **14.** 110.)

PbI_2, 2KI. Sl. sol. in boiling chloroform; easily sol. in strong KI+Aq, insol. in alcohol. (Brooks, C. N. 1898, **77.** 191.)

$+2H_2O$. Decomp. by H_2O. (Berthelot, A. ch. (5) **29.** 289.)

Does not exist. (R. and H.)

$+4H_2O$. (Ditte, C. R. **92.** 134.) Does not exist. (R. and H.)

PbI_2, 4KI. Decomp. by H_2O; insol. in alcohol. (Boullay.) Does not exist. (R. and H.)

$3PbI_2$, $4KI+6H_2O$. (Berthelot, *l. c.*) Does not exist. (R. and H.)

Lead potassium *per*iodide, $K_3Pb_2I_8+4H_2O$.

Decomp. by H_2O or alcohol. (Wells, Z. anorg. **4.** 346.)

Lead rubidium iodide, PbI_2, $RbI+2H_2O$.

(Wells, Sill. Am. J. **146.** 34.)

Lead silver iodide, PbI_2, 2AgI.

(Ruff and Geisel, B. 1905, **38.** 2663.)

Lead silver iodide ammonia, PbI_2, 2AgI, $5NH_3$.

(Ruff and Geisel, B. 1905, **38.** 2663.)

Lead sodium iodide, PbI_2, NaI.

Decomp. by H_2O. (Poggiale, C. R. **20.** 1180.)

$+xH_2O$. (Remsen and Herty, Am. Ch. J. **14.** 124.)

PbI_2, $2NaI+6H_2O$. Sl. sol. in H_2O. (Moisnier, C. R. 1895, **120.** 445.)

Lead iodide ammonia, PbI_2, $2NH_3$.

Decomp. by H_2O. (Rammelsberg, Pogg. **48.** 166.)

Lead iodide carbonate.

See **Carbonate iodide, lead.**

Lead iodosulphide, PbS, $4PbI_2$.

Decomp. by light, heat, acids and alkalies. (Lenher, J. Am. Chem. Soc. 1895, **17.** 512.)

Sol. in conc. HI; insol. in dil. HI+Aq. (Lenher, J. Am. Chem. Soc. 1901, **23.** 681.)

$IPbS_2PbS_2PbI$. Ppt. (Hofmann, B. 1904, **37.** 251.)

Lead *sub*oxide, Pb_2O.

Decomp. by H_2O into PbO_2H_2.

Decomp. by dil. H_2SO_4, HCl, HNO_3, $HC_2H_3O_2$+Aq, or alkalies, into PbO, which dissolves, and Pb, which dissolves or not, according to the reagent. Sol. in dil. $Pb(NO_3)_2$+Aq.

Lead *mon*oxide (Litharge), PbO.

Sol. in 7000 pts. H_2O. (Horsford.)

Pure PbO is insol. in H_2O. (Brandecke, Repert. **53.** 155; Siebold, Repert, **53.** 174; Herbergen, Repert. **55.** 55.) Sl. sol. in H_2O. (Yorke, Phil. Mag. (3) **5.** 82.)

0.31 millimoles Pb are dissolved in 1 liter H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

1.71×10^{-2} g. are dissolved in 1 litre of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Easily sol. in acids.

Sol. in KOH, or NaOH+Aq; also in CaO_2H_2+Aq.

Sol. in boiling $Cu(NO_3)_2$+Aq with pptn. of Aq.

Sol. in $CaCl_2$, and $SrCl_2$+Aq. (André, C. R. **104.** 359.)

Sol. in $MgCl_2$+Aq. (Voigt, Ch. Ztg. **13.** 695.)

Sol. in boiling $Cu(NO_3)_2$+Aq with pptn. of CuO.

Partially sol. in $Cd(NO_3)_2$, and $Mn(NO_3)_2$ +Aq with pptn. of CdO and MnO respectively.

Not acted upon by Mg, Ag, Co, Ni, or Ce nitrates + Aq. (Persoz.)

Very sol. in $Pb(C_2H_3O_2)_2$+Aq. (Rochleder.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Eidmann, C. C. **1899**, II, 1014.)

When finely pulverised, sol. in cane sugar +Aq, but less than Pb_3O_4. (Peschier.)

Sl. sol. in glycerine. Readily sol. in glucose +Aq. (Persoz.)

Sol. in volatile oils. (Schweitzer.)

Yellow modification.

Solubility in H_2O at 22°.

	Solubility in g.-equiv. per litre
1. Yellow PbO, obtained by boiling lead hydroxide with 10% NaOH	1.03×10^{-4}
2. Yellow PbO, obtained by heating 1 at 630°	1.05×10^{-4}
3. Yellow PbO, obtained by heating at 740° red PbO, formed by boiling lead hydroxide with conc. NaOH	1.00×10^{-4}
4. Yellow PbO obtained by heating pure, commercial, yellow-brown PbO at 620°.	1.09×10^{-4}

(Ruer, Z. anorg. 1906, **50.** 273.)

Red modification. Obtained by boiling lead hydroxide with conc. NaOH+Aq.

Solubility in H_2O at 22° = 0.56×10^{-4} g. equiv. per l. (Ruer, Z. anorg. 1906, **50.** 273.)

Yellow-brown modification. Solubility in H_2O at 22° = 1.10×10^{-4} g. equiv. per litre. (Ruer, Z. anorg. 1906, **50.** 273.)

See also **Lead.**

Min. *Massicot.*

Lead oxide (Red lead), Pb_3O_4.

Insol. in H_2O.

Converted by acids into PbO_2 and salts of *mono*oxide.

Sol. in a large amt. of glacial acetic acid. (Berzelius.) Insol. in acetic acid. (Schonbein, J. pr. **74.** 325.)

Solution in $HC_2H_3O_2$+Aq may decompose or not according to concentration of acid. When treated with an excess of $HC_2H_3O_2$+Aq of 8° B, Pb_3O_4 is quickly dissolved, but the solution soon deposits PbO_2; this decomposition is facilitated by dilution. But if Pb_3O_4 is treated with a large excess of glacial $HC_2H_3O_2$, it dissolves, and the solution is permanent if atmospheric air is excluded, and temp. does not rise above 40°. (Jacquelain, J. pr. **53.** 152.)

Insol in acetone. (Eidmann, C. C. **1899**, II, 1014; Naumann, B. 1904, **37.** 4329.)

Easily sol. in cane sugar+Aq. (Peschier.)

Min. *Minium.*

Lead *sesqui*oxide, Pb_2O_3.

Insol. in H_2O or in KOH+Aq.

Decomp. by strong acids into PbO_2 and corresponding salt of *mono*oxide.

Lead *per*oxide, PbO_2.

Insol. in H_2O. Sol. in acids, also in conc. alkali hydroxides+Aq. The solutions in acids are very unstable, except when concentrated and kept at a low temperature.

Decomp. by cold HCl, HCN, HBr, and HI+ Aq. Not attacked by other acids when cold, but decomp. thereby when hot. Insol. in moderately conc. HNO_3, H_2SO_4, or $HC_2H_3O_2$+Aq.

There are two forms of PbO_2, the amorphous and the crystalline.

1 l. of very conc. H_2SO_4 dissolves 10 millimols. crystalline PbO_2.

Solubility of amorphous PbO_2 in H_2SO_4+Aq at 22°.

99.5 millimols. PbO_2 are dissolved in 1 l. of acid containing 1720 g. H_2SO_4.

4 millimols. PbO_2 are dissolved in 1 l. of acid containing 1097 g. H_2SO_4.

v = moles H_2SO_4 per mole of H_2O.

c = millimols. PbO_2 dissolved in 1 litre.

v	c	v	c
0.32	0.82	0.20	8.10^{-3}
0.30	0.4	0.15	5.10^{-4}
0.25	7.10^{-2}	0.10	1.10^{-5}

(Dolezalek and Finckli, Z. anorg. 1906, **51.** 323–5.)

Decomp. by NH_4OH+Aq. Sol. in conc. KOH, or NaOH+Aq.

Sol. with decomp. in $Hg_2(NO_3)_2$+Aq. (Levol.)

Insol. in acetone. (Eidmann, C. C. **1899**, II, 1014; Naumann, B. 1904, **37.** 2943.)

Min. *Plattnerite.*

Lead manganese *per*oxide, PbO_2, $4MnO_2$.

Ppt. (Gibbs and Parkmann, Sill. Am. J. (2) **39.** 58.)

Lead oxybromide, $PbBr_2$, PbO.

Insol. in H_2O.

+1, 1½, and $3H_2O$. (André, C. R. **96.** 1502.)

6PbO, $PbBr_2+2H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 436.)

Lead oxychloride, $2PbCl_2$, $PbO+2H_2O$.

(André, C. R. **96.** 435.)

$PbCl_2$, PbO. Absolutely insol. in hot or cold H_2O. (André, A. ch. (6) **3.** 108.)

Min. *Matlockite.*

$+H_2O$. Sol. in hot NaOH+Aq. (André.)

0.38 millimols. Pb are dissolved in 1 litre H_2O at 18°. (Pleissner, C. C. **1907,** II. 1055.)

$PbCl_2$, 2PbO. Insol. in H_2O. Sol. in dil. KOH+Aq (about 110 g. in 1 l.) (Ditte, C. R. **94.** 1180.)

Min. *Mendipite.* Easily sol. in HNO_3+Aq.

$+2H_2O$. (André, A. ch. (6) **3.** 111.)

$PbCl_2$, 3PbO. Insol. in H_2O. (Döbereiner.)

$+\frac{1}{2}H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 435.)

$+2H_2O$. 0.10 millimols. Pb are dissolved in 1 litre H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

$+3H_2O$. Ppt. (André, C. R. **104.** 359.)

$+4H_2O$. Nearly insol. in H_2O. Sl. sol. in NaOH+Aq. (Vauquelin.)

$PbCl_2$, 5PbO. (Döbereiner.)

6PbO, $PbCl_2+2H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 434.)

$PbCl_2$, 7PbO. *Cassel-yellow.*

Lead strontium oxychloride, 2PbO, $SrCl_2+5H_2O$.

(André, C. R. **104.** 359.)

Lead oxychloride, iodide, $PbCl_2$, PbI_2, 4PbO.

Min. *Schwartzenbergite.* Sol. in dil. HNO_3+Aq.

Lead oxyiodide, PbI_2, PbO.

Insol. in boiling H_2O or KI+Aq. (Brandes, A. **10.** 269.)

$+\frac{1}{2}H_2O$. (Ditte, C. R. **92.** 145.)

$+H_2O$.

PbI_2, 2PbO. Insol. in H_2O. (Denot, J. Pharm. **20.** 1.)

$+H_2O$.

PbI_2, $3PbO+2H_2O$. Ppt. (Kühn, C. C. **1847.** 593.)

PbI_2, 5PbO. Insol. in H_2O. (Denot.)

$+7H_2O$. (Ditte, C. R. **92.** 145.)

6PbO, PbI_2+2H_2O. Ppt. (Strömholm, Z. anorg. 1904, **38.** 437.)

9PbO, PbI_2+2H_2O. (Strömholm, Z. anorg. 1904, **38.** 437.)

Lead oxy*per*iodide, PbO, PbI_2I_3.

Decomp. by boiling H_2O. Sol. in dil. $HC_2H_3O_2$+Aq. (Gröger, W. A. B. **100, 2b.** 415.)

Lead phosphide, PbP_5.

Decomp. by H_2O and dil. acids. (Bossuet, C. R. 1913, **157.** 721.)

Lead phosphoselenide, PbSe, P_2Se.

Insol. in H_2O or HCl+Aq. Sol. in HNO_3+Aq.

Insol. in cold, slowly decomp. by hot alkalies+Aq. (Hahn, J. pr. (2) **93.** 436.)

2PbSe, P_2Se_3. Insol. in H_2O, HCl, or HNO_3+Aq. Slowly sol. in red fuming HNO_3. (Hahn.)

2PbSe, P_2Se_5. Decomp. by fuming HNO_3. (Hahn.)

Lead selenide, PbSe.

Cold HNO_3+Aq dissolves Pb with separation of Se, which dissolves on warming. (Little, A. **112.** 212.)

Min. *Clausthalite.* Sol. in HNO_3+Aq with separation of Se, when warmed.

Lead mercury selenide, (Pb, Hg)Se.

Min. *Lehrbachite.*

Lead sulphide, PbS.

Very sl. sol. in H_2O.

1 l. H_2O dissolves 3.6×10^{-5} moles. PbS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

1 l. H_2O dissolves 3×10^{-4} g. PbS at 25°. (Hevesy, Z. anorg. 1913, **82.** 328.)

Insol. in dilute acids; alkalies, and alkali sulphides+Aq. Decomp. with solution in moderately dil. HNO_3+Aq. With conc. HNO_3 or aqua regia, $PbSO_4$ is formed. Sol. in hot conc. HCl+Aq.

1 l. H_2O sat. with H_2S dissolves 1.5×10^{-4} g. PbS at 25°. (Hevesy, Z. anorg. 1913, **82.** 328.)

Insol. in NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Somewhat sol. in H_2S+Aq when heated therewith in a sealed tube. (Senarmont, A. ch. (3) **32.** 168.)

Insol. in potassium thiocarbonate +Aq. (Rosenbladt, Z. anal. **26.** 15.)

Sol. in $Na_2S_2O_3$+Aq. (Waller, J. Anal. Ch. **5.** 646.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Min. *Galena, Galenite.*

Lead *poly*sulphide, PbS_5.

Ppt.; insol. in alkali sulphides; decomp. by conc. HNO_3. (Bodroux, C. R. 1900, **130.** 1398.)

Lead platinum sulphide.

See **Sulphoplatinate, lead.**

Lead sulphide mercuric chloride, 3PbS, $4HgCl_2$.

Decomp. by H_2O. (Levallois, C. R. **96.** 1666.)

Lead sulphobromide, chloride, or iodide.
See **Lead bromosulphide,** etc.

Lead *di*sulpho*di*imide, PbN_2S_2, NH_3.
Ppt.
Very stable in the air or in a vacuum. Sol. in no solvent without decomp.
When rapidly heated it explodes very violently at 140°. (Ruff, B. 1904, **37.** 1581.)

Lead telluride, PbTe.
Insol. in H_2O. Sol. in cold HNO_3+Aq. (Rose, Pogg. **18.** 68.)
Min. *Altaite.* Easily sol. in HNO_3+Aq.

"Leucone."
Wöhler (A. **127.** 268) gives this substance the formula $H_{10}Si_8O_{10}$, but it is identical with silicoformic anhydride, $Si_2H_2O_3$, which see.

Lime.
Quicklime, CaO. See **Calcium oxide.**
Slaked lime, CaO_2H_2. *See* **Calcium hydroxide.**

Lithium, Li.
Decomposes H_2O.
Easily sol. in dil. acids. Slowly attacked by conc. H_2SO_4, rapidly by conc. HNO_3+Aq.
Insol. in hydrocarbons. Sol. in liquid NH_3, but not so easily as K.
Sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 820.)
1 gram atom dissolves:

at 0°	in 3.93	mol.	liquid	NH_3.
" —25°	" 3.93	"	"	"
" —50°	" 3.93	"	"	"
" —80°	" 3.93	"	"	"

(Ruff, B. 1906, **39.** 840.)

Sol. in ethylamine. Insol. in propylamine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, **29.** 1561.)

Lithium amalgam, $LiHg_5$.
$LiHg_5$ is obtained at all temp. up to 100°. Can be cryst. from Hg without decomp. at any temp. below 100°. (Kerp, Z. anorg. 1900, **25.** 68.)

Lithium amide, $LiNH_2$.
(Ruff, B. 1911, **44.** 505.)
Decomp. slowly in the air.
Slowly decomp. by cold, rapidly by hot H_2O.
Slowly decomp. by HCl.
Slowly decomp. by cold, rapidly by hot abs. alcohol. (Titherley, Chem. Soc. 1894, **65.** 518.)

***Tri*lithium amide,** Li_3NH_2.
Hydroscopic; decomp. by H_2O. (Dafert, M. 1910, **31.** 994.)

Lithium ammonia, Li, NH_3.
Decomp. by H_2O at ordinary temp.; sol. in liquid NH_3. (Moissan, C. R. 1898, **127.** 689.)
Li, $3NH_3$. (Moissan, C. R. 1901, **133.** 716.)

***Tri*lithium ammonium,** Li_3NH_3.
Very hydroscopic, decomp. by H_2O. (Dafert, M. 1910, **31.** 992.)

Lithium antimonide, Li_3Sb.
Decomp. by H_2O with evolution of H_2. Sol. in liquid NH_3. (Lebeau, C. R. 1902, **134.** 285.)

Lithium arsenide, Li_3As.
Decomp. by H_2O; decomp. violently by fuming HNO_3. (Lebeau, C. R. 1899, **129.** 50.)

Lithium azoimide, LiN_3.
Deliquescent. Stable in aq. solution.
36.12 pts. are sol. in 100 pts. H_2O at 10°.
62.07 " " " " 100 " H_2O " 15.5°.
66.41 " " " " 100 " H_2O " 16°.
20.26 " " " " 100 " abs. alcohol at 16°.
Insol. in ether. (Curtius, J. pr. 1898, (2) **58.** 277.)
+H_2O. Very hydroscopic; decomp. in the air. Very sol. in H_2O and alcohol. (Dennis, Z. anorg. 1898, **17.** 18.)

Lithium bromide, LiBr.
Deliquescent.
100 pts. H_2O dissolve at:

0°	34°	59°	82°	103°
143	196	222	244	270 pts. LiBr.

Sp. gr. of LiBr+Aq at 19.5° containing:

0	10	15	20	25	30% LiBr,
1.035	1.072	1.113	1.156	1.204	1.254

35	40	45	50	55% LiBr.
1.309	1.368	1.432	1.500	1.580

(Kremers, Pogg. **103.** 65; **104.** 133: Gerlach, Z. anal. **8.** 285.)

Temp. of maximum density of LiBr+Aq.	g.-mol. LiBr dissolved in 1000 g. H_2O.
1.921°	0.2941
0.881°	0.4383

(de Coppet, C. R. 1900, **131.** 178.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)
Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Solubility in glycol at 14.7° = 37.5%. (de Coninck, Belg. Acad. Bull. **1905,** 359.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)
Sol. in methyl acetate (Naumann, B. 1909, **42.** 3789); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+H_2O$. 100 g. H_2O dissolve 209 g. LiBr at 44°. (Bogorodski, C. C. **1894,** II. 514.)

$+2H_2O$. (Bogorodski.)

$+3H_2O$. 100 g. H_2O dissolve 80 g. LiBr at —30°, and 122 g. at —10°. (Bogorodski.)

Lithium molybdenyl bromide, LiBr, $MoOBr_3$ $+4H_2O$.

Very hygroscopic. (Weinland and Knöll, Z. anorg. 1905, **44.** 111.)

Lithium bromide ammonia.

LiBr, NH_3. Sol. in H_2O with decomp.
LiBr, $2NH_3$. " " " " "
LiBr, $3NH_3$. " " " " "
LiBr, $4NH_3$. " " " " "

(Bonnefoi, C. R. 1900, **130.** 1395.)

Lithium carbide, LiC_2.

Insol. in conc. acids.

Sol. in fused oxidizing agents; decomp. H_2O in the cold. (Moissan, C. R. 1896, **122.** 363.)

Lithium *sub***chloride,** Li_2Cl.

Decomp. by H_2O. (Guntz, C. R. 1895, **121.** 945.)

Lithium chloride, LiCl.

Very deliquescent. Most deliquescent salt known to Berzelius. Very sol. in H_2O. Sol. in 1.315 pts. H_2O at 15°. (Gerlach.)

100 pts. H_2O dissolve at:

0°	20°	65°	80°	69°	140°	160°	
63.7	80.7	104.2	115	129	139	145	pts. LiCl.

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. of LiCl+Aq at 15° containing:

1	5	10	15	20% LiCl,	
1.006	1.030	1.058	1.086	1.117	
25	30	35	40% LiCl.		
1.148	1.182	1.219	1.256		

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. of LiCl+Aq at 18° containing:

5	10	20	30	40% LiCl.
1.0274	1.0563	1.115	1.181	1.255

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of LiCl+Aq at 25°.

Concentration of LiCl+Aq.	Sp. gr.
1–normal	1.0243
1/2– "	1.0129
1/4– "	1.0062
1/8– "	1.0030

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Sp. gr. of LiCl+Aq.

g. LiCl in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
2.3923	1.001405
6.2360	1.003647
10.1993	1.005921

(Dijken, Z. phys. Ch. 1897, **24.** 109.)

Sp. gr. of LiCl+Aq at 0°.

% LiCl	4.26	12.18	22.2	32.5	41.4	43.2
Sp. gr.	1.026	1.073	1.133	1.203	1.267	1.282

(Lemoine, C. R. 1897, **125.** 603.)

Sp. gr. of LiCl+Aq at 20°.

Normality of LiCl+Aq	% LiCl	Sp. gr.
10.35	35.97	1.2230
7.17	26.40	1.1550
5.57	21.10	1.1215
2.98	11.83	1.0691
1.06	4.37	1.0232

(Forchheimer, Z. phys. Ch. 1900, **34.** 25.)

Sp. gr. 20°/4° of a normal solution of LiCl = 1.022375. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of dil. LiCl+Aq at 20.004°.
Conc. = g. equiv. LiCl per l. at 20.004°.
Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,002,5
0.0002	1.000,005,0
0.0005	1.000,012,6
0.0010	1.000,025,3
0.0020	1.000,050,5
0.0050	1.000,125,8
0.0100	1.000,251,0

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1688.)

B.-pt. of LiCl+Aq.

% LiCl	B.-pt.	% LiCl	B.-pt
3.38	101°	16.66	107°
6.54	102	19.35	109
13.04	105	21.8	111

(Skinner, Chem. Soc. **61.** 341.)

Sat. LiCl+Aq boils at 171°. (Kremers.)

B.-pt. of LiCl+Aq. P=pts. LiCl to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	3.5	124°	48.5	147°	87.5
102	7	125	50	148	90
103	10	126	51.5	149	92.5
104	12.5	127	53	150	95
105	15	128	54.5	151	97.5
106	17.5	129	56	152	100
107	20	130	57.5	153	102.5
108	22	131	59	154	105
109	24	132	60.5	155	107.5
110	26	133	62	156	110.5
111	28	134	63.5	157	113.5
112	30	135	65	158	116.5
113	32	136	66.5	158.5	117.96
114	33.5	137	68	159	119.5
115	35	138	69.75	160	122.5
116	36.5	139	71.5	161	125.5
117	38	140	73.25	162	128.5
118	39.5	141	75	163	131.5
119	41	142	77	164	135
120	42.5	143	79	165	138.5
121	44	144	81	166	142.5
122	45.5	145	83	167	146.5
123	47	146	85	168	151

(Gerlach, Z. anal. **26.** 437.)

Solubility of LiCl in HCl+Aq at 0°.

Mg. mol. per 10 cc. of solution		G. per 10 cc. of solution		Sp. gr. of solution
LiCl	HCl	LiCl	HCl	
120	0.0	51.0	0.0	1.255
97.5	22.5	41.4	8.2	1.243
67.0	66.0	28.5	24.1	1.249
58.0	81.0	24.6	29.5	1.251

(Engel, A. ch. (6) **13.** 385.)

See also LiCl+H_2O.

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in absolute alcohol, ether, and alcohol-ether.

B.-pt. of alcoholic solution of LiCl.

% LiCl	B.-pt.	% LiCl	B.-pt.
2.4	78.43°+0.70°	9.93	78.43°+ 5.55°
5.39	" +2.15	15.94	" +11.75
8.01	" +4.18	. .	. . . .

(Skinner.)

Solubility in alcohol+Aq decreases to 40% alcohol+60% H_2O. Curve shows minimum at 30% H_2O to 70% alcohol. The sat. pure H_2O and pure alcohol solutions cooled to 0° deposit LiCl, H_2O and LiCl, $4C_2H_6O$ respectively. (Pina de Rubies, C. A. **1914.** 743, 3006.)

Solubility in ethyl alcohol.

Temp.	1.06°	5.07°	13.0°	25.0°	40.6°	62.6°
% LiCl	14	14	13	14	15	18

(Lemoine, C. R. 1897, **125.** 605.)

100 g. ethyl alcohol dissolve at:

0°	5°	10°	15°	17°
14.42	15.04	16.77	18.79	20.31 g. LiCl.

The solid phase from 0°–17° is LiCl, $4C_2H_6O$

20°	30°	40°	50°	60°
24.28	25.10	25.38	24.40	23.46 g. LiCl.

The solid phase from 20°–60° is LiCl. (Turner and Bissett, Chem. Soc. 1913, **103** 1907.)

Solubility in ethyl alcohol+Aq at 25°.

100 g. of the solution contain		
G. C_2H_5OH	G. H_2O	G. LiCl
0	55.10	44.90
5.96	51.52	42.52
11.07	48.73	40.20
17.46	43.90	38.64
18.56	43.70	37.74
22.16	41.17	36.67
26.29	39.51	34.70
28.97	37.42	33.61
29.27	36.89	33.84
30.10	36.64	33.26
30.51	35.67	33.82
32.79	34.95	32.26
38.40	31.58	30.02
49.27	24.67	26.06
50.32	24.04	25.64
53.50	20.94	25.56
58.15	18.47	23.38
59.78	17.46	22.76
63.09	14.83	22.08
70.24	8.66	21.10
70 70	8.26	21.04
70.74	7.78	21.48
79.26	0	20.74

The solid phase in the mixtures which are richest in alcohol is LiCl; in the other mixtures the solid phase is LiCl+H_2O.

(Pina de Rubies, C. C. **1915, I.** 521.)

Sp. gr. of LiCl in ethyl alcohol (LiCl, $2C_2H_6O$).

% salt	Sp. gr. at 14°	Sp. gr. at 0°
0	0.797	0.809
5.2	0.839	0.851
10.1	0.871	0.881
14.6	0.903	0.903

(Lemoine, C. R. 1897, **125.** 605.)

Solubility in methyl alcohol at t°.

t°	% LiCl in sat. solution
1	26
23	27
50	30

(Lemoine, C. R. 1897, **125.** 604.)

Sp. gr. of LiCl in methyl alcohol (LiCl, $3CH_4O$).

% salt	5.2	14.5	22.1
Sp. gr. at 21.5°	0.836	0.910	0.974
Sp. gr. " 0°	0.854	0.926	0.988

(Lemoine, C. R. 1897, **125.** 604.)

15.86 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 276.)

Sol. in 15 pts. fusel oil. (Gooch, Am. Ch. J. **9.** 33.)

100 g. methyl alcohol dissolve 42.36 g. LiCl at 25°.

100 g. ethyl alcohol dissolve 25.83 g. LiCl at 25°.

100 g. propyl alcohol dissolve 16.22 g. LiCl at 25°.

100 g. isoamyl alcohol dissolve 9.03 g. LiCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, **103.** 1909.)

Solubility of fused LiCl in alcohols at 25°.

Solvent	% LiCl
Water	45.0
Ethyl alcohol	2.475
Propyl alcohol	3.720
Butyl alcohol	9.56
Amyl alcohol	8.26
Allyl alcohol	4.20
Glycerine	4.14
Phenol (at 53°C)	1.89

(Patten and Mott, J. phys. Chem. 1904, **8.** 158.)

100 pts. pyridine dissolve 7.78 pts. LiCl at 15°; 14.26 pts. LiCl at 100°. (Laszczynski, B. 1894, **27.** 2288.)

Soluble in anhydrous pyridine, 97% pyridine+Aq, 95% pyridine+Aq, and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, **42.** 3789); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Solubility in glycol at 15° = 11%. (de Coninck, Belg. Acad. Bull. **1905,** 359.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sol. in ethylamine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Solubility of LiCl in acetone.

Pts. sol. in 100 pts. acetone	t°
4.60	0
4.40	12
4.11	25
3.76	46
3.12	53
2.14	58

(Laszczynski, B. 1894, **27.** 2287.)

$+H_2O$. 13.536 millimols. are contained in 1 l. sat. solution at 25°. (Herz, Z. anorg. 1912, **73.** 274.)

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm.	Millimols LiCl in 10 ccm.
...	135.36
6.30	134.14
10.53	126.52
17.64	122.58

(Herz, Z. anorg. 1912, **73.** 274.)

$+2H_2O$. Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

$+3H_2O$. (Bogorodski, C. C. **1894, II.** 514.)

Lithium gold chloride.

See **Chloraurate, lithium.**

Lithium manganous chloride, LiCl, $MnCl_2+3H_2O$.

Decomp. by H_2O; stable only in excess of LiCl. (Chassevant, A. ch. (6) **30.** 10.)

Lithium mercuric chloride, 2LiCl, $HgCl_2$.

Very deliquescent and sol. in H_2O. (Harth, Z. anorg. 1897, **14.** 323.)

Lithium nickel chloride, LiCl, $NiCl_2+3H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Chassevant.)

Lithium thallic chloride, 3LiCl, $TlCl_3+8H_2O$.

Very deliquescent. Sol. in H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 404.)

Lithium stannic chloride.

See **Chlorostannate, lithium.**

Lithium uranous chloride, Li_2UCl_6.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Lithium uranium chloride, UCl_4, 2LiCl.

Very hydroscopic; sol. in H_2O with decomp. Sol. in acetic acid. Decomp. by alcohol. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Lithium zinc chloride, $LiCl, ZnCl_2+3H_2O$.

Extremely deliquescent. (Ephraim, Z. anorg. 1908, **59.** 68.)

$3LiCl, ZnCl_2+10H_2O$ (?). Not obtained in solid state. (Ephraim, Z. anorg. 1908, **59.** 69.)

Lithium chloride ammonia.

$LiCl, NH_3$.
$LiCl, 2NH_3$.
$LiCl, 3NH_3$.
$LiCl, 4NH_3$.

Above salts are all decomp. by H_2O. (Bonnefoi, C. R. 1898, **127.** 367–369.)

Lithium chloroiodide, $LiCl_4I+4H_2O$.

Deliquescent. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Lithium fluoride, LiF.

Very difficultly sol. in H_2O. (Berzelius, Pogg. **1.** 17.)

Two crystalline forms. Only very sl. sol. in H_2O. Very sl. decomp. by H_2O at red heat. (Poulenc, Bull. Soc. 1894, (3) **11.** 17.)

Sp. gr. of solution sat. at 18° = 1.003 and contains 0.27% LiF. (Mylius, B. 1897, **30.** 1718.)

Sol. in 800 pts. H_2O, and the presence of NH_4F and NH_3 decreases solubility to 1 : 3500. (Carnot, Bull. Soc. 1889, (3) **1.** 250.)

Two crystalline forms are very sl. sol. in HCl; easily sol. in HNO_3. (Poulenc, Bull. Soc. 1894, (3) **11.** 17.)

Two crystalline forms are insol. in 95% alcohol. (Poulenc.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Lithium hydrogen fluoride, $LiHF_2$.

Difficultly sol. in H_2O, but more easily than LiF. (Berzelius.)

Lithium silicon fluoride.

See **Fluosilicate, lithium.**

Lithium stannic fluoride.

See **Fluostannate, lithium.**

Lithium tantalum fluoride.

See **Fluotantalate, lithium.**

Lithium uranyl fluoride, $UO_2F_2, 4LiF$.

(Ditte.)

Lithium zirconium fluoride.

See **Fluozirconate, lithium.**

Lithium hydride, LiH.

Not deliquescent. Decomp. by H_2O. (Guntz, C. R. 1896, **123.** 997.)

Lithium hydrosulphide, LiSH (?).

Deliquescent. Sol. in H_2O and alcohol. (Berzelius, Pogg. **6.** 439.)

Lithium hydroxide, LiOH.

Not so deliquescent as NaOH, and apparently not more sol. in hot than cold H_2O. (Gmelin, Gilb. **62.** 399.)

Not deliquescent. (Arfvedson, A. ch. **10.** 82.)

The solubility of LiOH in H_2O can be expressed by $y=6.6750+0.00346t+0.0003t^2$, where y = the percentage of Li_2O in a saturated solution. (Dittmar, Jour. Soc. Chem. Ind. **7.** 730.)

Solubility of LiOH in H_2O at t°.

t°	G. per 100 g. Solution		G. LiOH per 100 g. H_2O
	Li_2O	LiOH	
0	6.67	10.64	12.7
10	6.74	10.80	12.7
20	6.86	10.99	12.8
25	6.95	11.14	12.9
30	7.05	11.27	12.9
40	7.29	11.68	13.0
50	7.56	12.12	13.3
60	7.96	12.76	13.8
80	8.87	14.21	15.3
100	10.02	16.05	17.5

(Seidell's Solubilities, 1st Ed. 174.)

A sat. aq. solution contains 7.09% LiOH. (Schreinemakers, C. C. **1905,** II. 1486.)

Sp. gr. of LiOH+Aq at 18° containing:

1.25	2.5	5	7.5% LiOH.
1.0132	1.0276	1.0547	1.0804

(Kohlrausch, W. Ann. **1879.** 1.)

Solubility in Li_3SbS_4+Aq at 30°.

% LiOH	% Li_3SbS_4	Solid Phase
11.4	0	$LiOH, H_2O$
9.1	8.3	"
2.3	29.9	"
2.1	48.3	"
2.1	52.1	$LiOH, H_2O+Li_3SbS_4, 10H_2O$
1.4	51.8	$Li_3SbS_4, 10H_2O$
0	51.3	"

(Donk, Chem. Weekbl. 1908, **5.** 529, 629, 767.)

Sl. sol. in alcohol; insol. in alcohol-ether. (Mayer.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Cryst. also with H_2O, and $\frac{1}{2}H_2O$. (Göttig, B. **20.** 2912.)

Lithium imide, Li_2NH.

Decomp. at high temp. Insol. in toluene, benzene, ether and ethyl acetate. Decomp. $CHCl_3$. (Ruff, B. 1911, **44.** 506.)

Lithium iodide, LiI.

Deliquescent.

Solubility in 100 pts. H_2O at:

0°	19°	40°	59°	75°	80°	99°	120°	
151	164	179	200	263	435	476	588	pts. LiI.

Sp. gr. of LiI+Aq at 19.5° containing:

5	10	15	20	25	30% LiI,
1.038	1.079	1.124	1.172	1.224	1.280
35	40	45	50	55	60% LiI.
1.344	1.414	1.489	1.575	1.670	1.777

(Kremers, Pogg. **104.** 133; **111.** 60: Gerlach, Z. anal. **8.** 295.)

Sp. gr. of LiI+Aq at 18° containing:

5	10	15	20	25% LiI.
1.0361	1.0756	1.1180	1.1643	1.2138

(Kohlrausch, W. Ann. **1879.** 1.)

Temp. of maximum density of LiI+Aq.	g.-mol. LiI dissolved in 1000 g. H_2O.
2.516°	0.1795
0.039°	0.4666

(de Coppet, C. R. 1900, **131.** 178.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

100 g. methyl alcohol dissolve 343.4 g. LiI at 25°.

100 g. ethyl alcohol dissolve 250.8 g. LiI at 25°.

100 g. propyl alcohol dissolve 47.52 g. LiI at 25°.

100 g. isoamyl alcohol dissolve 112.50 g. LiI at 25°.

In the case of propyl alcohol the solid phase at 25° is LiI, $4C_3H_8O$. (Turner and Bissett, Chem. Soc. 1913, **103.** 1909.)

Solubility in organic solvents at t°.

C=pts. by wt. of LiI in 100 ccm. of the sat. solution.

L=no. of liters which at the saturation temp. hold in solution 1 mol. LiI.

Solvent	t°	C	L
Furfurol	25°	45.86	0.292
Nitromethane	25°	2.519	5.32
"	0°	1.219	10.98

(Walden, Z. phys. Ch. 1906, **55.** 718.)

Solubility in glycol at 15.3°=28%. (de Coninck, Belg. Acad. Bull. **1905,** 359.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

$+H_2O$. Mpt. below 200°. (Bogorodsky, C. C. **1897,** II. 175.)

$+2H_2O$. Mpt. 86–88°. (Bogorodsky.)

$+3H_2O$. Mpt. 75°. (Bogorodsky.)

Sol. in absolute alcohol without decomp. (Thirsoff, Chem. Soc. 1894, **66.** (2) 234.)

The composition of the hydrates formed by LiI at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by LiI and of the conductivity and sp. gr. of LiI+Aq. (Jones, Am. Ch. J. 1905, **34.** 301.)

Lithium mercuric iodide, 2LiI, HgI_2+6H_2O.

Very deliquescent. Decomp. by H_2O. Very sol. without decomp. in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, ethyl oxalate, etc. Less sol. in nitrobenzene. Insol. in benzene and methyl iodide. (Duboin, C. R. 1905, **141.** 1017.)

$+8H_2O$. Decomp. by H_2O. Very sol. in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, etc. without decomp. Sl. sol. in nitrobenzene. Insol. in benzene and methyl iodide. (Duboin, l. c.)

$+9H_2O$. Hydroscopic. Sol. in alcohol and acetone without decomp. (Dobroserdoff, C. C. **1901,** I. 664.)

Lithium nitride, Li_3N.

Sol. in H_2O with decomp. (Ouvrard, C. R. **114.** 120.)

Very hydroscopic. (Dafert, M. 1910, **31.** 987.)

Lithium oxide, Li_2O.

Slowly sol. in H_2O to form LiOH.

See **Lithium hydroxide.**

Lithium *per*oxide, Li_2O_2.

(de Forcrand, C. R. 1900, **130.** 1467.)

Lithium hydrogen *per*oxide, Li_2O_2, $H_2O_2+3H_2O$.

Sol. in H_2O. Insol. in alcohol. (de Forcrand, C. R. 1900, **130.** 1466.)

Lithium selenide, Li_2Se.

Sol. in H_2O. (Fabre, C. R. **103.** 269.)

$+9H_2O$. Sol. in H_2O. (Fabre.)

Lithium silicide, Li_6Si_2.

Decomp. by H_2O and by dil. acids. Decomp. by aqueous solutions of alkalies with evolution of H_2. (Moissan, C. R. 1902, **134.** 1083.)

Lithium ***mono*****sulphide,** Li_2S.

More sol. in H_2O or alcohol than LiOH.

Luteochromium bromide, $Cr(NH_3)_6Br_3$.

Less sol. in H_2O than the chloride. (Jörgensen, J. pr. (2) **30.** 1.)

—— **bromoplatinate,** $[Cr(NH_3)_6]_2(PtBr_6)_3+4H_2O$.

Sl. sol. in H_2O. Insol. in alcohol. (Jörgensen.)

—— **chloride,** $Cr(NH_3)_6Cl_3+H_2O$.

Efflorescent, and very sol. in H_2O. (Jörgensen.)

—— **chloroplatinate.**

(*a*) $[Cr(NH_3)_6]_2(PtCl_6)_3+6H_2O$. Nearly completely insol. in H_2O. (Jörgensen.)

(*b*) $Cr(NH_3)_6Cl(PtCl_6)+2\frac{1}{2}H_2O$. Decomp. by H_2O into above; insol. in alcohol. (Jörgensen.)

(*c*) $[Cr(NH_3)_6]_2Cl_4(PtCl_6)+2H_2O$. Decomp. by H_2O into (*a*). (Jörgensen.)

—— **mercuric chloride,** $Cr(NH_3)_6Cl_3$, $HgCl_2$.

Decomp. by H_2O; sl. sol. in dil. HCl+Aq; insol. in alcohol.

$Cr(NH_3)_6Cl_3$, $3HgCl_2+2H_2O$. Decomp. by dil. HCl+Aq into above salt. (Jörgensen.)

—— **chromicyanide,** $Cr(NH_3)_6Cr(CN)_6$.

Precipitate.

—— **cobalticyanide,** $Cr(NH_3)_6Co(CN)_6$.

Nearly insol. in H_2O or in conc. HCl+Aq. (Jörgensen.)

—— **ferrocyanide,** $Cr(NH_3)_6Fe(CN)_6$.

Very sl. sol. in cold H_2O or dil. acids. (Jörgensen.)

—— **iodide,** $Cr(NH_3)_6I_3$.

Sl. sol. in H_2O. (Jörgensen, l. c.)

—— **iodosulphate,** $Cr(NH_3)_6SO_4I$.

Sol. in H_2O; nearly insol. in dil. NH_4OH+Aq or alcohol. (Jörgensen.)

—— **nitrate,** $Cr(NH_3)_6(NO_3)_3$.

Sol. in 35–40 pts. H_2O. Insol. in cold dil. HNO_3+Aq or alcohol. Can be crystallised out of H_2O containing a little HNO_3. (Jörgensen, J. pr. (2) **30.** 1.)

—— **nitrate chloroplatinate,** $Cr(NH_3)_6(NO_3)PtCl_6+H_2O$.

Insol. in H_2O. Sol. in dil. H_2SO_4+Aq. (Jörgensen.)

—— **nitratosulphate,** $Cr(NH_3)_6(NO_3)SO_4$.

Sol. in H_2O; insol. in alcohol. (Jörgensen.)

Luteochromium oxalate, $[Cr(NH_3)_6]_2(C_2O_4)_3+4H_2O$.

Nearly insol. in cold H_2O. (Jörgensen.)

—— ***ortho*****phosphate,** $Cr(NH_3)_6PO_4+4H_2O$.

Sl. sol. in H_2O; easily sol. in dil. acids. (Jörgensen.)

—— **sodium** ***pyro*****phosphate,** $Cr(NH_3)_6(NaP_2O_7)+11\frac{1}{2}H_2O$.

Nearly insol. in cold H_2O; wholly insol. in dil. NH_4OH+Aq. (Jörgensen.)

—— **sulphate,** $[Cr(NH_3)_6]_2(SO_4)_3+5H_2O$.

Quite sol. in H_2O; insol. in alcohol. (Jörgensen.)

—— **sulphate chloroplatinate,** $[Cr(NH_3)_6(SO_4)]_2PtCl_6$.

Nearly insol. in H_2O. (Jörgensen.)

Luteocobalt ***di*****amine chromium sulphocyanide.**

See **Diamine chromium luteocobalt sulphocyanide.**

Luteocobaltic bromide, $Co(NH_3)_6Br_3$.

Sol. in H_2O. Precipitated from saturated H_2O solution by dil. HBr+Aq. (Jörgensen, J. pr. (2) **35.** 417.)

—— **bromopermanganate,** $Co(NH_3)_6Br_2(MnO_4)$.

Easily sol. in H_2O. (Klobb, A. ch. (6) **12.** 5.)

—— **bromoplatinate,** $Co(NH_3)_6Br_3$, $PtBr_4+H_2O$.

Sl. sol. in H_2O; can be recrystallised from hot H_2O containing HBr. (Jörgensen.)

—— **bromosulphate,** $Co(NH_3)_6Br(SO_4)$.

Nearly insol. in H_2O. Very sl. sol. in dil. NH_4OH+Aq. (Jörgensen.)

—— **carbonate,** $[Co(NH_3)_6]_2(CO_3)_3+7H_2O$.

Efflorescent; easily sol. in H_2O.

$[Co(NH_3)_6]_2(CO_3)_3$, $H_2CO_3+5H_2O$. Less sol. in H_2O than the neutral salt. (Gibbs and Genth.)

—— **chloride,** $Co(NH_3)_6Cl_3$.

Sol. in 17.09 pts. H_2O at 10.5°; 16.81 pts. at 11.4°; 16.48 pts. at 12°; and more easily in hot H_2O. (F. Rose.)

100 pts. H_2O dissolve 4.26 pts. at 0°, and 12.74 pts. at 46.6°. (Kurnakoff, J. russ. Soc. **24.** 629.)

Not appreciably sol. in conc. HCl+Aq. (Jorgensen.)

Insol. in alcohol or solutions of the alkali chlorides. (Gibbs and Genth.)

Insol. in NH_4OH+Aq.

Aqueous solution is pptd. by alcohol, mineral acids, or alkali chlorides.

Luteocobaltic mercuric chloride, $Co(NH_3)_6Cl_3$, $HgCl_2+1\frac{1}{2}H_2O$.

Sol. in hot H_2O. (Krok, **1870.**)

By recrystallizing from hot H_2O containing HCl is converted into—

$Co(NH_3)_6Cl_3$, $3HgCl_2+H_2O$. Very sl. sol. in cold H_2O. (Jörgensen.)

$Co(NH_3)_6Cl_3$, $2HgCl_2+\frac{1}{2}H_2O$. Sol. in hot H_2O, from which it crystallizes on cooling. Insol. in cold conc. HCl+Aq, and is pptd. from H_2O solution by HCl or alcohol. (Carstanjen.)

Does not exist. (Jörgensen.)

$+3H_2O$. More easily sol. in cold H_2O and other solvents than the preceding comp. (Carstanjen, Berlin, **1861.**)

Does not exist. (Jörgensen.)

—— **stannous chloride,** $2Co(NH_3)_6Cl_3$, $3SnCl_2+10H_2O$.

$+8H_2O$.

—— **chloraurate,** $Co(NH_3)_6Cl_3$, $AuCl_3$.

Very sl. sol. in cold, more easily in hot H_2O containing HCl. (Gibbs and Genth, Sill. Am. J. (2) **23.** 330.)

—— **chloriodate,** $[Co(NH_3)_6Cl_2]_2I_4O_{11}+H_2O$.

—— **chloriridite,** $Co(NH_3)_6$, $IrCl_6$.

Insol. in boiling H_2O or dil. HCl+Aq. (Gibbs.)

—— **chloriridate,** $2Co(NH_3)_6Cl_3$, $3IrCl_4$.

Insol. in H_2O. (Gibbs.)

—— **chlorochromate,** $Co(NH_3)_6CrO_4Cl+3H_2O$.

Sol. in H_2O. (Klobb, Bull. Soc. 1901, (3) **25.** 1027.)

—— **chlorofluoride,** $Co(NH_3)_6Cl_2F$.

(Bohm, Z. anorg. 1905, **43.** 339.)

—— **chloropalladite,** $2Co(NH_3)_6Cl_3$, $3PdCl_2$.

Easily sol. in dil. HCl+Aq. (Gibbs, Sill. Am. J. (2) **37.** 58.)

—— **chloroperchlorate,** $Co(NH_3)_6Cl(ClO_4)_2$.

(Millosevich, Gazz. ch. it. 1901, **31.** (2) 285.)

—— **chloropermanganate,** $Co(NH_3)_6Cl_2(MnO_4)$.

Can be recrystallized from H_2O. (Klobb, C. R. **103.** 384.)

—— **chloropermanganate ammonium chloride,** $Co(NH_3)_6Cl_2(MnO_4)$, NH_4Cl.

Easily sol. in H_2O. (Klobb.)

Luteocobaltic chloropermanganate potassium chloride, $Co(NH_3)_6Cl_2(MnO_4)$, KCl.

Very easily sol. in H_2O, with decomp. into constituents; sol. in KCl+Aq. (Klobb.)

—— **chloropermanganate sodium chloride,** $Co(NH_3)_6Cl_2(MnO_4)$, NaCl.

Very sol. in H_2O. (Klobb.)

—— **chloroplatinate,** $2Co(NH_3)_6Cl_3$, $3PtCl_4+6H_2O$.

Can be recrystallized from much hot H_2O. (Gibbs and Genth.)

$+21H_2O$ (Gibbs and Genth.)

$Co(NH_3)_6Cl_3$, $PtCl_4+\frac{1}{2}H_2O$. Very sl. sol. in cold, decomp. by hot H_2O into—

$2Co(NH_3)_6Cl_3$, $PtCl_4+2H_2O$. By recrystallizing from hot H_2O containing HCl this salt is converted into the above salt. (Jörgensen.)

—— **chlororhodite.**

Nearly insol. in boiling H_2O or dil. acids. Sol. in conc. HCl+Aq. (Gibbs, Sill. Am. J. (2) **37.** 57.)

—— **chlororuthenate,** $2Co(NH_3)_6Cl_3$, $3RuCl_4$.

Sol. in dil. acids. (Gibbs.)

—— **chloroselenate,** $Co(NH_3)_6ClSeO_4+3H_2O$.

Decomp. by H_2O. (Klobb, Bull. Soc. 1901, (3) **25.** 1029.)

—— **chlorosulphate,** $Co(NH_3)_6Cl(SO_4)$.

Sol. in H_2O.

$+3H_2O$. Only sl. sol. in cold H_2O. (Klobb, Bull. Soc. 1901, (3) **25.** 1025.)

—— **ammonium chlorosulphate,** $[Co(NH_3)_6]_4Cl_2(SO_4)_5$, $3(NH_4)_2SO_4+6H_2O$.

Decomp. by H_2O. (Klobb, Bull. Soc. 1901, (3) **25.** 1027.)

—— **chlorosulphate chloroplatinate,** $2Co(NH_3)_6Cl(SO_4)$, $PtCl_4$.

Very sl. sol. in cold pure H_2O. Can be recrystallized out of H_2O containing HCl. (Krok.)

—— **chlorosulphate mercuric chloride,** $Co(NH_3)_6Cl(SO_4)$, $HgCl_2$.

Scarcely sol. in pure H_2O, but can be crystallized from warm acidified H_2O. (Krok.)

—— **chlorosulphite,** $Co(NH_3)_6(SO_3)Cl+3H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2637.)

—— **chromate,** $[Co(NH_3)_6]_2(CrO_4)_3+5H_2O$.

Ppt. Sol. in hot H_2O.

$[Co(NH_3)_6]_2(Cr_2O_7)_3+5H_2O$. Moderately sol. in hot H_2O.

Luteocobaltic chromicyanide, $Co(NH_3)_6Cr(CN)_6$.

Ppt. (Braun.)

—— **cobalticyanide,** $Co(NH_3)_6Co(CN)_6$.

Ppt.

—— **dithionate, basic,** $4[Co(NH_3)_6(S_2O_6)(OH)]$, $Co_2(S_2O_6)_2O$.

Sol. in H_2O and dil. alcohol.

—— **ferricyanide,** $Co(NH_3)_6Fe(CN)_6 + \frac{1}{2}H_2O$.

Insol. in H_2O. (Braun.)

—— **fluoride,** $Co(NH_3)_6F_3$.

Sl. sol. in cold H_2O. Nearly insol. in acids. (Böhm, Z. anorg. 1905, **43.** 340.)

—— **hydrogen fluoride,** $Co(NH_3)_6H_3F_6$.

Sl. sol. in H_2O. Decomp. by hot H_2O. (Miolati and Rossi, Real. Ac. Linc. 1896, (5) **5.** II, 185.)

—— **hydrogen boron fluoride,** $Co(NH_3)_6F_3$, $3BF_3$, HF.

Cryst. from H_2O acidified with HF. Miolati and Rossi.)

—— **molybdenyl fluoride,** $Co(NH_3)_6F_3$, $2\ MoO_2F_2$.

Cryst. from H_2O containing HF. (Miolati and Rossi.)

—— **silicon fluoride,** $Co(NH_3)_6F_3$, $2SiF_4$. (Miolati and Rossi.)

—— **titanium hydrogen fluoride,** $2Co(NH_3)_6F_3$, $3TiF_4$, 2HF. (Miolati and Rossi.)

—— **tungstyl fluoride,** $Co(NH_3)_6F_3$, $2WO_2F_2$. (Miolati and Rossi.)

—— **uranyl fluoride.** $Co(NH_3)_6F_3$, UO_2F_2.

Can be cryst. from H_2O containing HF. (Miolati and Rossi.)

—— **vanadyl fluoride,** $2Co(NH_3)_6F_3$, $5VO_2F$, 7HF.

Ppt. (Miolati and Rossi.)

—— **fluoride nitrate,** $Co(NH_3)_6F(NO_3)_2$.

(Bohm, Z. anorg. 1905, **43.** 336.)

—— **hydroxide,** $Co(NH_3)_6(OH)_3$.

Known only in aqueous solution.

Luteocobaltic mercuric hydroxychloride, $CoN_6H_{14}(HgCl)_3(HgOH)Cl_3$.

Ppt. Easily decomp. (Vortmann and Morgulis, B. **22.** 2644.)

$CoN_6H_{14}(HgOH)_4Cl_3$. Ppt. (V. and M.)

$CoN_6H_{16}(HgOH)_2Cl_3$. Ppt. (V. and M.)

—— **iodide,** $Co(NH_3)_6I_3$.

Insol. in cold, but moderately sol. in hot H_2O.

According to Jörgensen, contains HNO_3 and has the formula $Co_2(NH_3)_{12}I_4(NO_3)_2$.

—— **iodosulphate,** $Co(NH_3)_6I(SO_4)$.

Can be recrystallized from hot H_2O. Sl. sol. in warm, nearly insol. in cold H_2O. (Krok, B. **4.** 711.)

—— **mercuriodide,** $Co_2N_{12}H_{38}(HgI)_3I_6$.

Ppt. (Vortmann and Borsbach.)

$CoN_6H_{16}(HgI)_2I_3$. Ppt. (V. and B.)

—— **mercuriodide, basic,** $CoN_6H_{16}(HgOH)_2I_2(OH)$.

Insol. in H_2O. Sl. sol. in H_2O. (Vortmann and Borsbach, B. **23.** 2804.)

—— **nitrate,** $Co(NH_3)_6(NO_3)_3$.

Sol. in H_2O. Can be recrystallised from boiling H_2O. Sol. in about 60 pts. H_2O. Insol. in conc. HNO_3+Aq. (Jörgensen, J. pr. (2), **35.** 417.)

Almost insol. in acids. (Rogojski, A. ch. (3), **41.** 454.)

Insol. in NH_4OH, HCl, and HNO_3+Aq; decomp. by H_2SO_4+Aq. (Gibbs and Genth.)

$Co(NH_3)_6(NO_3)_3$, HNO_3. Decomp. by H_2O or dil. alcohol. (Jörgensen, J. pr. (2), **44.** 63.)

—— **nitrate chloroplatinate,** $Co(NH_3)_6(NO_3)Cl_2$, $PtCl_4 + H_2O$.

Not decomp. by H_2O. (Jörgensen.)

—— **nitratosulphate,** $Co(NH_3)_6(NO_3)(SO_4)$.

Sol. in H_2O. (Jörgensen.)

—— **nitrite cobaltic nitrite,** $Co_2(NH_3)_{12}(NO_2)_6$, $Co_2(NO_2)_6 = Co(NH_3)_6(NO_2)_6Co$.

Nearly insol. in H_2O. (Jörgensen.)

Much less sol. in H_2O than the corresponding roseo salt. (Gibbs.)

—— **diamine cobaltic nitrite,** $Co(NH_3)_6[Co(NH_3)_2(NO_2)_4]_3$.

Ppt. (Gibbs.)

$= Co(NH_3)_6[(NO_2)_2(NH_3)_2Co(NO_2)_2]_3$.

Nearly insol. in cold, sl. sol. in boiling H_2O. (Jörgensen, Z. anorg. **5.** 179.)

—— **oxalate,** $[Co(NH_3)_6]_2(C_2O_4)_3 + 4H_2O$.

Insol. in hot or cold H_2O. Easily sol. in $H_2C_2O_4$+Aq.

Luteocobaltic oxalate chloraurate, $2Co(NH_3)_6(C_2O_4)Cl, AuCl_3+4H_2O$.
Easily sol. in hot H_2O. (Gibbs.)

—— **perchlorate,** $Co(NH_3)_6(ClO_4)_3$.
(Millosevich, Gazz. ch. it. 1901, **31,** (2), 285.)

—— **permanganate,** $[Co(NH_3)_6]_2(MnO_4)_3$.
Nearly insol. in H_2O. 100 pts. H_2O at 0° dissolve only 0.072 pt. salt. Moderately sol. in hot H_2O. (Klobb, A. ch, (6) **12.** 5.)

—— **persulphate sulphate,** $[Co(NH_3)_6]_2S_2O_8(SO_4)_2$.
Much less sol. in H_2O than the sulphate. Sol. in 641 pts. H_2O at 18.8° and in 632 pts. at 20°. Not easily sol. even in boiling H_2O. (Jörgensen, Z. anorg. 1898, **17.** 459.)

—— *ortho***phosphate,** $Co(NH_3)_6(PO_4)+4H_2O$.
Sl. sol. in cold H_2O. Easily sol. in dil. acids. (Jörgensen.)
$[Co(NH_3)_6]_3(PO_4)(PO_4H)_3+5\frac{1}{2}H_2O$ (?). Ppt. (Braun.)
$[Co(NH_3)_6]_2(PO_4H)_3+4H_2O$. Ppt. Easily sol. in very dil. HCl+Aq. (Jörgensen.)

—— *meta***phosphate.**
Ppt.

—— *pyro***phosphate,** $[Co(NH_3)_6]_2P_4O_{13}+6H_2O$.
(Gibbs, Am. Acad. Proc. **11.** 29); or $Co_2(NH_3)_{12}P_4O_{13}(ONa)_2$ (Vortmann, B. **11.** 2181); or $Co(NH_3)_6(P_2O_7Na)+11\frac{1}{2}H_2O$. (Jörgensen, J. pr. (2) **35.** 438.)
Very nearly insol. in H_2O. With H_2O at 80° it is decomp. into—
$[Co(NH_3)_6]_4(P_2O\ )_3+20H_2O$. Less easily sol. than the preceding salt.

—— *pyro***phosphate, acid,** $Co(NH_3)_6(P_2O_7H)$.
Wholly insol. in H_2O. Somewhat sol. in dil. $HC_2H_3O_2$+Aq. Easily sol. in HCl+Aq (Jörgensen.)

—— **sodium** *pyro***phosphate,** $Co(NH_3)_6(P_2O_7Na)+11\frac{1}{2}H_2O$.
Ppt. Not wholly insol. in cold H_2O. Decomp. by hot H_2O. Less sol. in NH_4OH+Aq than in H_2O. (Jörgensen.)
$[Co(NH_3)_6]_4(P_2O_7)_3$, $2Co(NH_3)_6(NaP_2O_7)+39\ H_2O$. As above. (Jörgensen.)

—— **selenate,** $[Co(NH_6)]_2(SeO_4)_3+5H_2O$.
Very sol. in H_2O. (Klobb, Bull. Soc. 1901, (3) **25.** 1028.)

—— **hydrogen selenate,** $[Co(NH_3)_6]H(SeO_4)_2+2\frac{1}{2}H_2O$.
Not decomp. by H_2O. (Klobb.)

Luteocobaltic ammonium selenate, $[Co(NH_3)_6]_2(SeO_4)_3$, $(NH_4)_2SeO_4+4H_2O$.
Very sol. in H_2O.
$[Co(NH_6]_2(SeO_4)_3$, $(NH_4)_2SeO_4+8H_2O$. Very sol. in H_2O. (Klobb.)

—— **sulphocyanide,** $Co(NH_3)_6(SCN)_3$.
Decomp. by hot H_2O. (Miolati, Z. anorg. 1900, **23.** 241.)

—— **mercuric sulphocyanide,** $Co(NH_3)_6(SCN)_3$, $2Hg(SCN)_2$.
Decomp. by H_2O.
Cryst. from dil. NH_4SCN+Aq. (Miolati.)

—— **platinum sulphocyanide,** $[Pt(SCN)_4]_3[Co(NH_3)_6(SCN_3)]_2$.
Decomp. by hot H_2O. (Miolati.)

—— **silver sulphocyanide,** $Co(NH_3)_6(SCN)_3$, $2AgSCN$.
Decomp. by hot H_2O. (Miolati.)

—— **sulphate,** $[Co(NH_3)_6]_2(SO_4)_3+5H_2O$.
Sl. sol. in cold, more easily in hot H_2O.
$+6H_2O$. (Krok, B. **4.** 711.)

—— **hydrogen sulphate,** $Co(NH_3)_6H(SO_4)_2$.
Decomp. by alcohol to sulphate. (Jörgensen, Z. anorg. 1898, **17.** 458.)

$4[(Co6NH_3)_2(SO_4)_3]$, $5H_2SO_4+10H_2O$. Very sol. in H_2O with decomp. into the normal sulphate.
When pulverized it seems to dissociate slowly in contact with abs. alcohol. (Klobb, Bull. Soc. 1901, (3) **25.** 1025.)

—— **ammonium sulphate,** $[Co_6(NH_3)_6]_2(SO_4)_3$, $(NH_4)_2SO_4+8H_2O$.
Sol. in H_2O with decomp. (Klobb.)

—— **cerium sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $Ce_2(SO_4)_3+1\frac{1}{2}H_2O$.
Very sl. sol. in cold, and practically insol. in boiling H_2O. Sol. in acids. (Gibbs, Am. Ch. J. **15.** 560.)
$[Co(NH_3)_6]_2(SO_4)_3$, $3Ce(SO_4)_2+H_2O$. As above. (Wing, Sill. Am. J. (2) **49.** 363.)

—— **lanthanum sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $La_2(SO_4)_3+H_2O$.
Sl. sol. in H_2O. (Wing.)

—— **thallic sulphate,** $[Co(NH_3)_6]_2(SO_4)_3$, $Tl_2O(SO_4)_2+5H_2O$.
Decomp. by cold H_2O. (Gibbs.)

—— **sulphate bromaurate,** $Co(NH_3)_6(SO_4)(AuBr_4)$.
Very sl. sol. in H_2O with apparent decomp. Insol. in alcohol. (Jörgensen.)

Luteocobaltic sulphate chloraurate, $Co(NH_3)_6(SO_4)AuCl_4$.

Sl. sol. in H_2O. (Jörgensen.)

—— **cobaltic sulphite,** $[Co(NH_3)_6]_2(SO_3)_3$, $Co_2(SO_3)_3+H_2O$ = **dichrocobaltic sulphite,** $[Co(NH_3)_3]_2(SO_3)_3+2H_2O$, which see.

$[Co(NH_3)_6]_2(SO_3)_3$, $2Co_2(SO_3)_3+15H_2O$ = **diamine cobaltic sulphite,** $[Co(NH_3)_2]_2(SO_3)_2+5H_2O$, which see.

Luteorhodium bromide, $Rh(NH_3)_6Br_3$.

Less sol. in H_2O than the chloride. (Jorgensen, J. pr. (2) **44.** 51.)

—— **chloride,** $Rh(NH_3)_6Cl_3$.

Sol. in 7 to 8 pts. H_2O at 8°. (J.)

$+H_2O$. Extremely efflorescent. (J.)

—— **rhodium chloride,** $Rh(NH_3)_6Cl_3$, $RhCl_3$.

Sol. in H_2O. (Jörgensen, Z. anorg. **5.** 174.)

— **chloroplatinate,** $2Rh(NH_3)_6Cl_3$, $3PtCl_4+6H_2O$.

Insol. in H_2O. Sol. in warm HCl+Aq. (J.)

$Rh(NH_3)_6Cl_3$, $PtCl_4+\frac{1}{2}H_2O$. Decomp. by H_2O into chloride and above salt. (J.)

—— **nitrate,** $Rh(NH_3)_6(NO_3)_3$.

Sol. in 48 to 49 pts. H_2O at ord. temp. HNO_3+Aq diluted with 5 vols. H_2O ppts. the salt completely from aqueous solution. (Jörgensen, J. pr. (2) **44.** 51.)

$Rh(NH_3)_6(NO_3)_3$, HNO_3. Decomp. by H_2O or dil. alcohol. (Jörgensen, J. pr. (2), **44.** 63.)

—— *ortho***phosphate,** $Rh(NH_3)_6PO_4+4H_2O$.

Sl. sol. in cold H_2O. (J.)

—— **sodium** *pyro***phosphate,** $[Rh(NH_3)_6]_2(P_2O_7)_3Na_2+23H_2O$.

Nearly wholly insol. in H_2O. Wholly insol. in NH_4OH+Aq. (J.)

—— **sulphate,** $[Rh(NH_3)_6]_2(SO_4)_3+5H_2O$.

Sol. in 43 pts. H_2O at 20°. (J.)

Magnesium, Mg.

Does not decomp. H_2O at ord. temp., but decomp. slowly at 100°. H_2O containing acids dissolves Mg easily. Sol. in cold dil. $HC_2H_3O_2$+Aq. Difficultly sol. in cold H_2SO_4+Aq. (Bunsen.) Cold nitrosulphuric acid does not attack. (Bunsen.) Cold NH_4OH+Aq, KOH+Aq, or $NaOH$+Aq do not attack. (Maak, Phippson.) Sol. in NH_4Cl or $(NH_4)_2CO_3$+Aq. (Wöhler.)

Very rapidly sol. in $K_2S_2O_8$+Aq and $(NH_4)_2S_2O_8$+Aq with violent evolution of gas. (Levi, Gazz. ch. it. 1908, **38.** (1), 583.)

Attacked by aqueous solution of KCl, NH_4Cl, $NaCl$, $LiCl$, $CuCl_2$, $CdCl_2$, $CoCl_2$, $PbCl_2$, $HgCl_2$, $FeCl_3$, $CrCl_3$, $PtCl_4$, $AuCl_3$, $CuSO_4$, $ZnSO_4$, $FeSO_4$ and $MnSO_4$.

Sl. attacked by hot 30% $CaCl_2$+Aq, not by 30% $MgCl_2$+Aq, $BaCl_2$+Aq and $SrCl_2$+Aq. (Tommasi, Bull. Soc. 1899, (3), **21.** 886.)

Not attacked by NH_4F+Aq, very slowly by solutions of $BaCl_2$, $CaCl_2$, KCl, $K_3Fe(CN)_6$, $NaNO_3$, $Na_2S_2O_3$ and Na_2HPO_4. Solutions of $NaC_2H_3O_2$, $Na_2B_4O_7$, alum and chrome alum attack vigorously. Solutions of $(NH_4)_2CO_3$, NH_4Cl, $(NH_4)_2C_2O_4$, $(NH_4)_2S$ and Na_2CO_3 attack even more vigorously. (Mouraour, C. R. 1900, **130.** 140.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Somewhat sol. in liquid NH_3, if a clean metallic surface is in contact with the pure solvent. (Kraus, J. Am. Chem. Soc, 1907, **29.** 1561.)

½ccm. oleic acid dissolves 0.0104 g. Mg in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Magnesium arsenide, Mg_3As_2.

Decomp. on air. (Parkinson, Chem. Soc. **5.** 127.)

Magnesium azoimide, $Mg(N_3)_2$.

Decomp. by hot H_2O. (Curtius, J. pr. 1898, (2) **58.** 292.)

Magnesium boride, Mg_9B_2.

Sol. in HCl+Aq. (Winkler, B. **23.** 774.)

Magnesium bromide, $MgBr_2$.

Deliquescent. Very sol. in H_2O with evolution of heat.

Sat. $MgBr_2$+Aq contains at:

—18°	+17°	48°	62°	97°	
52	58	60.9	62.5	65.8%	$MgBr_2$.

(Étard, A. ch. 1894, (7), **2.** 541.)

See also $MgBr_2+6H_2O$.

Sp. gr. of $MgBr_2$+Aq at 19.5° containing:

5	10	15	20	25	% $MgBr_2$,
1.043	1.087	1.137	1.191	1.247	
30	35	40	45	50	% $MgBr_2$.
1.31	1.377	1.451	1.535	1.625	

(Kremers, Pogg. **108.** 118, calculated by Gerlach, Z. anal. **8.** 285.)

$MgBr_2$+Aq is sl. decomp. by evaporation.

Solubility of $MgBr_2$ in alcohols.

$MgBr_2$ forms with methyl alcohol a complex, $MgBr_2$, $6CH_3OH$.

Solubility of $MgBr_2$, $6CH_3OH$ in CH_3OH at t°.

t°	% by weight of $MgBr_2$, $6CH_3OH$	t°	% by weight of $MgBr_2$, $6CH_3OH$
0	42.6	130	63.6
20	44.6	140	66.8
40	46.7	150	70.2
60	48.9	160	74.0
80	51.4	170	78.5
100	55.5	180	84.5
110	58.0	185	88.0
120	60.7	190 mpt.	100

(Menschutkin, Z. anorg. 1907, **52.** 11.)

$MgBr_2$ forms with ethyl alcohol a complex, $MgBr_2$, $6C_2H_5OH$.

Solubility of $MgBr_2$, $6C_2H_5OH$ in C_2H_5OH at t°.

t°	% by weight of $MgBr_2$, $6C_2H_5OH$	t°	% by weight of $MgBr_2$, $6C_2H_5OH$
0	17.2	80	73.8
10	24.9	85	76.2
20	32.7	90	78.7
30	40.3	95	82.3
40	47.8	100	86.7
50	55.1	103	90.0
60	62.2	106	94.4
70	68.8	108.5 mpt.	100
75	71.4		

(Menschutkin.)

$MgBr_2$ forms with propyl alcohol a complex, $MgBr_2$, $6C_3H_7OH$.

Solubility of $MgBr_2$, $6C_3H_7OH$ in C_3H_7OH at t°.

t°	% by weight of $MgBr_2$, $6C_3H_7OH$	t°	% by weight of $MgBr_2$, $6C_3H_7OH$
0	77.9	43	93.0
10	81.5	46	94.3
20	85.1	48	95.8
30	89.5	50	97.8
40	92.0	52 mpt.	100

(Menschutkin.)

$MgBr_2$ forms with isobutylalcohol a complex, $MgBr_2$, $6(iso)C_4H_9OH$.

Solubility of $MgBr_2$, $6(iso)C_4H_9OH$ in C_4H_9OH at t°.

t°	% by weight of $MgBr_2$, $6isoC_4H_9OH$	t°	% by weight of $MgBr_2$, $6isoC_4H_9OH$
0	55.8	60	82.4
10	60.5	65	84.2
20	65.2	71	88.0
30	69.8	75	92.0
40	74.3	77	94.6
50	78.5	80 mpt.	100

(Menschutkin.)

$MgBr_2$ forms with isoamylalcohol a complex, $MgBr_2$, $6(iso)C_5H_{11}OH$.

Solubility of $MgBr_2$, $6(iso)C_5H_{11}OH$ in $C_5H_{11}OH$ at t°.

t°	% by weight of $MgBr_2$, $6isoC_5H_{11}HO$	t°	% by weight of $MgBr_2$, $6isoC_5H_{11}OH$
0	70.2	38	88.7
10	75.6	40	90.0
20	80.2	42	92.0
30	84.5	44	94.2
35	86.7	46 mpt.	100

(Menschutkin.)

Solubility in ether at t°.

t°	% $MgBr_2$	% $MgBr_2$, $2C_4H_{10}O$
−8	0.6	1.08
0	0.8	1.44
+10	1.27	2.3
14	1.64	2.95
16	1.93	3.48
18	2.3	4.14
20	2.7	4.86
22 mpt.	3.22	5.80

(Menschutkin, Z. anorg. **1906**, 49, 36.)

Solubility of $MgBr_2$, $2C_4H_{10}O$ in ether at t°. "Lower solution" = the melted $MgBr_2$, $2C_4H_{10}O$ which does not mix with the ether above.

t°	Composition of lower solution		Composition of the upper layer	
	% $MgBr_2$	% $MgBr_2$, $2C_4H_{10}O$	% $MgBr_2$	% $MgBr_2$, $2C_4H_{10}O$
−10	42.0	75.7	1.8	3.2
0	41.0	73.9	2.3	4.1
+10	40.1	72.2	2.8	5.0
20	39.3	70.8	3.3	5.9
30	38.7	69.8	3.8	6.8
40	38.2	68.8	4.3	7.7
50	37.8	68.0	4.7	8.5
60	37.6	67.7	5.1	9.2
70	37.6	67.7	5.4	9.7
80	37.8	68.0	5.6	10.0
90	38.1	68.6	5.7	10.2

(Menschutkin.)

Solubility of $MgBr_2$ in formic acid.

$MgBr_2$ forms with formic acid a complex, $MgBr_2$, 6HCOOH.

Solubility of $MgBr_2$, 6HCOOH in HCOOH at t°.

t°	% by wt. $MgBr_2$, 6HCOOH
0	49.8
20	57.5
40	65.1
60	73.1
70	78.1
80	86.0
86	95.0
88 mpt.	100

(Menschutkin, Z. anorg. 1907, **54.** 90.)

Solubility of $MgBr_2$ in acetic acid.

$MgBr_2$ forms with acetic acid a complex, $MgBr_2$, $6CH_3COOH$.

Solubility of $MgBr_2$, $6CH_3COOH$ in CH_3COOH at t°.

t°	% by wt. $MgBr_2$, $6CH_3COOH$
17	0.3
30	1.5
50	4.5
60	7.9
70	16.2
80	38.5
85	49.5
90	57.7
100	71.8
105	80.0
110	89.5
112 mpt.	100.0

(Menschutkin.)

Solubility of $MgBr_2$ in acetic anhydride.

$MgBr_2$ forms with acetic anhydride a complex, $MgBr_2$, $6(CH_3CO)_2O$.

Solubility of $MgBr_2$, $6(CH_3CO)_2O$ in $(CH_3CO)_2O$ at t°.

t°	% by wt. $MgBr_2$, $6(CH_3CO)_2O$
0	26.4
30	30.0
60	37.7
90	44.5
120	57.8
130	69.8
135	85.0
136–137 mpt.	100

(Menschutkin, Z. anorg. 1909, **61.** 112.)

Solubility of $MgBr_2$ in acetone.

$MgBr_2$ forms with acetone a complex, $MgBr_2$, $3CH_3COCH_3$.

Solubility of $MgBr_2$, $3CH_3COCH_3$ in CH_3COCH_3 at t°.

t°	% by wt. $MgBr_2$, $3CH_3COCH_3$
0	0.2
30	0.8
60	1.45
70	2.0
72	3.7
73	5.5
74	14.0
75	50.0
76	71.6
80	83.3
84	89.8
88	95.2
92 mpt.	100

(Menschutkin, Z. anorg. 1907, **53.** 30.)

Solubility of $MgBr_2$ in acetamide.

$MgBr_2$ forms with acetanide a complex, $MgBr_2$, $6CH_3CONH_2$.

Solubility of $MgBr_2$, $6CH_3CONH_2$ in CH_3CONH_2 at t°.

t°	% by wt. $MgBr_2$, $6CH_3CONH_2$
50.5	56.0
70	57.8
90	60.5
110	65.0
130	71.5
150	80.0
160	85.5
165	90.0
169 mpt.	100.0

(Menschutkin, Z. anorg. 1909, **61.** 106.)

Solubility of $MgBr_2$ in acetanilide.

$MgBr_2$ forms with acetanilide a complex, $MgBr_2$, $6CH_3CONHC_6H_5$.

Solubility of $MgBr_2$, $6CH_3CONHC_6H_5$ in $CH_3CONHC_6H_5$ at t°.

t°	% by wt. $MgBr_2$, $6CH_3CONHC_6H_5$
107.5	9.0
140	19.3
170	29.6
185	39.0
195	49.0
200	59.5
205	73.2
209 mpt.	100.0

(Menschutkin, Z. anorg. 1909, **61.** 109.)

Solubility of $MgBr_2$ in aniline.

$MgBr_2$ forms with aniline three complexes; $MgBr_2$, $6C_6H_5NH_2$; $MgBr_2$, $4C_6H_5NH_2$; $MgBr_2$, $2C_6H_5NH_2$.

Solubility of these complexes in aniline.

Solubility of $MgBr_2$, $6C_6H_5NH_2$ in $C_6H_5NH_2$.

t°	% by weight of $MgBr_2$, $6C_6H_5NH_2$
10	3.2
30	3.9
50	5.1
70	7.5
90	12.8
100	18.5
103.5	27.5

Solubility of $MgBr_2$, $4C_6H_5NH_2$ in $C_6H_5NH_2$.

t°	% by weight of $MgBr_2$, $4C_6H_5NH_2$
103	24.0
120	24.3
140	24.9
160	26.0
180	28.3
200	33.5
220	45.0
230	55.0
237	76.3

Solubility of $MgBr_2$, $2C_6H_5NH_2$ in C_6H_5 NH_2

t°	% by weight of $MgBr_2$, $2C_6H_5NH_2$
237	76.3
250	77.3
260	78.1
270	79.0

(Menschutkin, Z. anorg. 1907, **52.** 159.)

Solubility of $MgBr_2$ in benzaldehyde.

$MgBr_2$ forms with benzaldehyde a complex, $MgBr_2$, $3C_6H_5CHO$.

Solubility of $MgBr_2$, $3C_6H_5CHO$ in C_6H_5CHO at t°.

t°	% by wt. $MgBr_2$, $3C_6H_5CHO$	t°	% by wt. $MgBr_2$, $3C_6H_5CHO$
0	0.7	140	17.8
30	1.3	145	37.5
60	1.9	146	65.0
80	2.5	148	84.5
100	3.4	153	93.2
120	6.0	159 mpt.	100
130	9.5		

(Menschutkin, Z. anorg. 1907, **53.** 26.)

Solubility of $MgBr_2$ in methylal.

$MgBr_2$ forms with methylal a complex, $MgBr_2$, $2CH_2(OCH_3)_2$.

Solubility of $MgBr_2$, $2CH_2(OCH_3)_2$ in $CH_2(OCH_3)_2$ at t°.

t°	% by wt. $MgBr_2$, $2CH_2(OCH_3)_2$
20	0.3
40	0.45
60	0.6
80	0.75
100	0.9
106	1.1
106	86.2
108	90.8
110	95.4
112 mpt.	100

(Menschutkin, Z. anorg. 1907, **53.** 32.)

Solubility of $MgBr_2$ in dimethylcarbinol.

$MgBr_2$ forms with dimethylcarbinol a complex, $MgBr_2$, $4(CH_3)_2CHOH$.

Solubility of $MgBr_2$, $4(CH_3)_2CHOH$ in $(CH_3)_2CHOH$ at t°.

t°	% by weight of $MgBr_2$, $4(CH_3)_2CHOH$	t°	% by weight of $MgBr_2$, $4(CH_3)_2CHOH$
0	40.0	110	62.5
20	42.2	120	67.3
40	45.0	130	74.0
60	48.5	136	83.6
80	53.3	138	90.00
100	59.0	139 mpt.	100

(Menschutkin.)

Solubility of $MgBr_2$ in trimethylcarbinol.

$MgBr_2$ forms with trimethylcarbinol a complex, $MgBr_2$, $4(CH_3)_3COH$.

Solubility of $MgBr_2$, $4(CH_3)_3COH$ in $(CH_3)_3COH$ at t°.

t°	% by weight of $MgBr_2$, $4(CH_3)_3COH$	t°	% by weight of $MgBr_2$, $4(CH_3)_3COH$
24.4	0.06	65	50.5
25	1.0	70	62.5
35	9.5	75	77.0
45	19.1	77.5	85.0
55	32.2	79	91.5
60	40.5	80 mpt.	100

Menschutkin.)

Solubility of $MgBr_2$ in phenylhydrazine.

$MgBr_2$ forms with $C_6H_5NHNH_2$ a complex, $MgBr_2$, $6C_6H_5NHNH_2$.

Solubility of $MgBr_2$, $6C_6H_5NHNH_2$ in $C_6H_5NHNH_2$ at t°.

t°	% by wt. of $MgBr_2$, $6C_6H_5NHNH_2$
20	3.0
40	7.0
60	16.4
80	33.0
99	54.8
100	54.8
140	60.8
180	68.4
200	73.4

(Menschutkin, Z. anorg. 1907, **52.** 162.)

Solubility of $MgBr_2$ in urea.

$MgBr_2$ forms with urea a complex, $MgBr_2$, $6CO(NH_2)_2$.

Solubility of $MgBr_2$, $6CO(NH_2)_2$ in urea at t°.

t°	% by wt. $MgBr_2$, $6CO(NH_2)_2$
108.5	24.2
115	29.8
120	35.0
125	41.6
127	45.5
130	60.0

(Menschutkin, Z. anorg. 1909, **61.** 116.)

$MgBr_2$, $6CO(NH_2)_2$ decomposes at 130° giving $MgBr_2$, $4CO(NH_2)_2$.

Solubility of $MgBr_2$, $4CO(NH_2)_2$ in urea at t°.

t°	% by wt. $MgBr_2$, $4CO(NH_2)_2$
130	58.0
145	60.7
160	67.2
165	71.4
170	83.7
171	96.0

(Menschutkin, Z. anorg. 1909, **61.** 116.)

Solubility of $MgBr_2$ in urethane.

$MgBr_2$ forms with urethane a complex, $MgBr_2$, $6NH_2COOC_2H_5$.

Solubility of $MgBr_2$, $6NH_2COOC_2H_5$ in $NH_2COOC_2H_5$ at t°.

t°	% by wt. $MgBr_2$, $6NH_2COOC_2H_5$
35	43.3
50	45.6
70	51.3
80	56.2
85	59.8
90	66.5
*91.5	75.5

* Mpt. of $MgBr_2$, $6NH_2COOC_2H_5$.

(Menschutkin, Z. anorg. 1909, **61.** 113.)

$MgBr_2$, $6NH_2COOC_2H_5$ decomposes at 90.5–91° forming $MgBr_2$, $4NH_2COOC_2H_5$.

Solubility of $MgBr_2$, $4NH_2COOC_2H_5$ in $NH_2COOC_2H_5$ at t°.

t°	% by wt. $MgBr_2$, $4NH_2COOC_2H_5$
91	69.4
100	73.8
110	80.0
115	84.1
120	90.0
123 mpt.	100.0

(Menschutkin.)

$+6H_2O$.

Solubility of $MgBr_2+6H_2O$ in H_2O at t°.

t°	% by weight of $MgBr_2+6H_2O$	t°	% by weight of $MgBr_2+6H_2O$
0	76.0	120	89.0
20	78.1	140	92.0
40	80.2	150	94.9
60	82.3	160	98.0
80	84.4	164 mpt.	100
100	86.6		

(Menschutkin, Z. anorg. 1907, **52.** 153.)

Sp. gr. of solution sat. at 18° = 1.655, and contains 50.8% $MgBr_2$. (Mylius and Funk, B. 1897, **30.** 1718.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in alcohol. Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+10H_2O$. Sol. in H_2O. (Panfiloff, Chem. Soc. **26.** 234.)

Magnesium manganous bromide, $MgBr_2$, $2MnBr_2+12H_2O$.

Deliquescent. (Saunders, Am. Ch. J. **14.** 150.)

Magnesium mercuric bromide, $MgBr_2$, $HgBr_2$

Deliquescent.

$MgBr_2$, $2HgBr_2$. Not deliquescent.

Magnesium molybdenyl bromide, $MgBr_2$, $MoOBr_3+7H_2O$.

(Weinland and Knoll, Z. anorg. 1905, **44.** 112.)

Magnesium potassium bromide, $MgBr_2$, $2KBr+6H_2O$.

Easily sol. in H_2O, from which KBr crystallises at 75 to 87°. Alcohol dissolves out $MgBr_2$. (Löwig, Repert. **29.** 261.)

Formula is $MgBr_2$, $KBr+6H_2O$. Deliquescent. (Lerch, J. pr. (2) **28.** 338.)

Magnesium stannic bromide.
See **Bromostannate, magnesium.**

Magnesium chloride, $MgCl_2$.

Deliquescent. Very sol. in H_2O with evolution of heat. The solution decomposes on evaporation losing HCl, when less than 6 mols. H_2O are present to 1 mol. $MgCl_2$. (Casaseca, C. R. **37.** 350.)

Anhydrous. Sol. in 1.857 pts. H_2O at 15°. (Gerlach.)

Sol. in 1 pt. cold H_2O. (Fourcroy.)

Sat. $MgCl_2$+Aq at 12.5° contains 64.8% $MgCl_2$. (Hassenfratz.)

100 pts. H_2O at 15.5° dissolve 200 pts. $MgCl_2$. (Ure's Dict.)

100 pts. H_2O dissolve 52.2 pts. $MgCl_2$ at 0° and sp. gr. of sat. solution = 1.3619 at 15°. (Engel, Bull. Soc. (2) **47.** 318.)

1000 mols. H_2O dissolve 108 mols. $MgCl_2$ at 25°C. (Löwenherz, Z. phys. Ch. 1894, **13.** 479.)

100 mols. $MgCl_2$+Aq contain at t°:

t°	67.5	68.5	68.7	79.5	79.95
Mol. $MgCl_2$	11.58	11.92	11.71	12.28	12.39

t°	116.67	152.6	181-2	186
Mol. $MgCl_2$	16.2	18.24	23.8	24.1-24.4

(Vant Hoff and Meyerhoffer, B. A. B. **1897,** 73.)

Solubility of $MgCl_2$ in H_2O at t°.

t°	% $MgCl_2$	Solid phase
—10	11.4	Ice
—20	16.	"
—30	19.4	"
—33.6	20.6	Ice+$MgCl_2$, $12H_2O$
—20	26.7	$MgCl_2$, $12H_2O$
—16.4	30.5	"
—16.8	31.6	$MgCl_2$, $12H_2O$+ $MgCl_2$, $8H_2O$
— 3.4	34.3	$MgCl_2$, $8H_2O$+$MgCl_2$, $6H_2O$
0	34.6	$MgCl_2$, $6H_2O$
10	34.9	"
20	35.3	"
22	35.6	"
40	36.5	"
60	37.9	"
80	39.8	"
100	42.2	"
116.7	46.1	$MgCl_2$, $6H_2O$+$MgCl_2$, $4H_2O$
152.6	49.1	$MgCl_2$, $4H_2O$
181.5	55.8	$MgCl_2$, $4H_2O$+$MgCl_2$, $2H_2O$
186	56.1	$MgCl_2$, $2H_2O$

(Landolt-Börnstein, Tab. 5th Ed. **1912.** 480.)

See also $MgCl_2+6H_2O$.

Sp. gr. of $MgCl_2$+Aq at 15°.

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
1	1.0084	13	1.1130	25	1.2274
2	1.0169	14	1.1220	26	1.2378
3	1.0253	15	1.1311	27	1.2482
4	1.0338	16	1.1404	28	1.2586
5	1.0422	17	1.1498	29	1.2690
6	1.0510	18	1.1592	30	1.2794
7	1.0597	19	1.1686	31	1.2903
8	1.0684	20	1.1780	32	1.3012
9	1.0772	21	1.1879	33	1.3121
10	1.0859	22	1.1977	34	1.3230
11	1.0949	23	1.2076	35	1.3340
12	1.1040	24	1.2175	..	...

(Gerlach, Z. anal. **8.** 281.)

Sp. gr. of $MgCl_2$+Aq at 18°.

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
5	1.0416	20	1.1764	34	1.3210
10	1.0859	30	1.2779	..	....

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $MgCl_2$+Aq at 0°. S = pts. salt in 100 pts. of solution; S_1 = mols. salt in 100 mols. solution.

S	S_1	Sp. gr.
29.2056	7.230	1.2788
20.9293	4.762	1.1927
15.7989	3.423	1.1427
11.3249	2.355	1.1007
6.2008	1.233	1.0545

(Charpy, A. ch. (6) **29.** 23.)

Sp. gr. of $MgCl_2$+Aq at 19.5°.

Pts. $MgCl_2$ in 100 pts. H_2O	Sp. gr.	Pts. $MgCl_2$ in 100 pts. H_2O	Sp. gr.
10.7	1.0826	35.3	1.2388
22.0	1.1592	51.5	1.3235

(Kremers, Pogg. **104.** 155.)

Sp. gr. of $MgCl_2$+Aq at 14°.

% $MgCl_2+6H_2O$	Sp. gr.	% $MgCl_2+6H_2O$	Sp. gr.	% $MgCl_2+6H_2O$	Sp. gr.
0	0.9993	17	1.0682	34	1.1407
1	1.0033	18	1.0724	35	1.1451
2	1.0073	19	1.0765	36	1.1495
3	1.0113	20	1.0807	37	1.1540
4	1.0154	21	1.0849	38	1.1584
5	1.0194	22	1.0891	39	1.1628
6	1.0234	23	1.0933	40	1.1673
7	1.0274	24	1.0976	41	1.1718
8	1.031[illegible]	25	1.1018	42	1.1763
9	1.0355	26	1.1061	43	1.1809
10	1.0395	27	1.1103	44	1.1855
11	1.0435	28	1.1146	45	1.1901
12	1.0476	29	1.1189	46	1.1948
13	1.0517	30	1.1232	47	1.1995
14	1.0558	31	1.1275	48	1.2042
15	1.0599	32	1.1319	..	....
16	1.0641	33	1.1363	..	....

(Oudemans, Z. anal. **7.** 420.)

Sp. gr. of $MgCl_2$+Aq at 24°.

% $MgCl_2+6H_2O$	Sp. gr.	% $MgCl_2+6H_2O$	Sp. gr.	% $MgCl_2+6H_2O$	Sp. gr.
2	1.0069	30	1.1062	58	1.2167
4	1.0138	32	1.1137	60	1.2252
6	1.0207	34	1.1212	62	1.2338
8	1.0276	36	1.1288	64	1.2425
10	1.0345	38	1.1364	66	1.2513
12	1.0415	40	1.1441	68	1.2602
14	1.0485	42	1.1519	70	1.2692
16	1.0556	44	1.1598	72	1.2783
18	1.0627	46	1.1677	74	1.2875
20	1.0698	48	1.1756	76	1.2968
22	1.0770	50	1.1836	78	1.3063
24	1.0842	52	1.1918	80	1.3159
26	1.0915	54	1.2000	..	....
28	1.0988	56	1.2083	..	....

(Gerlach, Z. anal. **8.** 283. Calculated from Schiff.)

Sp. gr. of $MgCl_2$+Aq at 25°.

Concentration of $MnCl_2$+Aq.	Sp. gr.
1–normal	1.1375
1/2– "	1.0188
1/4– "	1.0091
1/8– "	1.0043

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Sp. gr. of $MgCl_2$+Aq.

½ $MgCl_2$ g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.4400	1.000372
0.8801	1.000741
1.7780	1.001458
3.4533	1.002888
7.4691	1.006219
14.7187	1.012235
29.6307	1.024647

(Dijken, Z. phys. Ch. 1897, **24.** 108.)

Sp. gr. of $MgCl_2$ at 20.1°.

p = per cent strength of solution; d = observed duensity; w = volume conc. in grams per cc. $\left(\frac{pd}{100}=w.\right)$

p	d	w
28.83	1.2569	0.36237
25.59	1.2241	0.31327
20.31	1.1735	0.23842
15.79	1.1324	0.17877
10.185	1.0833	0.11033
8.058	1.0650	0.08583
5.919	1.0473	0.06198
3.913	1.0304	0.04022
3.903	1.0240	0.03210
1.743	1.0126	0.01765

(Barnes, J. Phys. Chem. 1898, **2.** 546.)

Sp. gr. of $MgCl_2$+Aq at t°.

t°	Concentration of $MgCl_2$+Aq	Sp. gr.
23	1 pt. $MgCl_2$ in 8.1874 pts. H_2O	1.0906
24	1 pt. " " 102.1 " "	1.0065

(Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Sp. gr. of $MgCl_2$ at 0°.

G. $MgCl_2$ in 100 ccm. of solution	6.7158	9.9506
Sp. gr.	1.0591	1.0845
G. $MgCl_2$ in 100 ccm. of sol.	13.8111	20.004
Sp. gr.	1.1106	1.1605

(Bremer, C. C. **1902,** I. 293.)

Sp. gr. of $MgCl_2$+Aq at 20° containing M g. mols. $MgCl_2$ per l.

M	0.00493	0.007327	0.01	0.03104
Sp. gr.	1.000344	1.000524	1.000842	1.002756
M	0.05108	0.07171	0.10	0.25
Sp. gr.	1.004224	1.006036	1.008505	1.020966
M	0.50	0.75	0.9415	
Sp. gr.	1.038496	1.056905	1.069617	

(Jones and Pearce, Am. Ch. J. 1907, **38.** 699.)

$MgCl_2$+Aq containing 10% $MgCl_2$ boils at 101.6°; containing 20% $MgCl_2$ boils at 106.2°; containing 30% $MgCl_2$ boils at 115.6°. (Gerlach.)

Sat. $MgCl_2$+Aq forms a crust at 122.5°, and contains 52.9 pts. $MgCl_2$ to 100 pts. H_2O. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $MgCl_2$+Aq. P=pts. $MgCl_2$ to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	4.9	111°	34.6	121°	50.8
102	9.2	112	36.6	122	52.2
103	13.2	113	38.4	123	53.6
104	16.7	114	40.2	124	55.0
105	19.9	115	41.8	125	56.4
106	22.5	116	43.4	126	57.7
107	25.0	117	44.9	127	59.0
108	27.5	118	46.4	128	60.3
109	29.9	119	47.9	129	61.6
110	32.3	120	49.4	130	62.9

(Gerlach, Z. anal. **26.** 440.)

B.-pt. of $MgCl_2$+Aq containing % $MgCl_2$.

% $MgCl_2$	B.-pt.	% $MgCl_2$	B.-pt.
4.6	101°	11.6	103°
8.4	102	14.3	104

(Skinner, Chem. Soc. **61.** 341.)

Sol. in KCl+Aq at 50°. (Uhlig, C. C. **1913,** II. 749.)

Sol. in 7 pts. alcohol at 15°. (Bergmann.)
" 5 " " moderate heat. (.B)

100 pts. alcohol of given sp. gr. dissolve pts. $MgCl_2$:

Sp. gr.	Pts. $MgCl_2$	Sp. gr.	Pts. $MgCl_2$
0.900	21 25	0.834	36.25
0 848	23 75	0.817	50.00

(Kirwan.)

$MgCl_2+6H_2O$ is sol. in 5 pts. alcohol of 0.90 sp. gr. and in 2 pts. alcohol of 0.817 sp. gr.
Sol. in 0.1828 pt. strong alcohol at 82.5°. (Wenzel.)

B.-pt. of an alcoholic solution of $MgCl_2$.

% $MgCl_2$	B.-pt.
5.56	78.43°+0.73°
8.53	" +1.34
9.62	" +1.77
13.84	" +3.54

(Skinner, Chem. Soc. **61.** 341.)

Even more sol. in acetic ether than $CaCl_2$. (Cann, C. R. **102.** 363.)

Sol. in boiling amyl alcohol. (Riggs, Sill. Am. J. **144.** 103.)

Sl. sol. in anhydrous pyridine. Sol. in 97%, 95% and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Insol. in CS_2. (Arctowski, Z. anorg. **1894, 6.** 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Insol. in methyl acetate. (Naumann, B. 1909 **42.** 3790.)

$+2H_2O$. Very deliquescent. (Ditte, A. ch. 1881, (5) **22.** 560.)

$+4H_2O$. (van't Hoff and Meyerhoffer.)

$+6H_2O$. Deliquescent. Sol. in 0.6 pt. cold, and 0.273 pt. hot H_2O. (Casaseca, *l. c.*)

Solubility in H_2O at t°.

t°	1000 mols H_2O dissolve mols $MgCl_2$	100 g. H_2O dissolve g. $MgCl_2$
3.5	99.6	52.65
25.0	104.5	55.26
50.0	110.6	58.66

(Biltz and Marcus, Z. anorg. 1911, **71.** 169.)

Solubility in KCl+NH_4Cl+Aq at 25° has been studied. (Biltz and Marcus, Z. anorg. 1911, **71.** 178.)

When the solid phases are $MgSO_4+6H_2O$ and $MgCl_2+6H_2O$, 1000 mols. H_2O dissolve 104 mols. $MgCl_2$ and 14 mols. $MgSO_4$ at 25°. (Löwenherz, Z. phys. Ch. 1894, **13.** 480.)

Solubility of $MgCl_2+6H_2O$ in $(NH_4)MgCl_3$+ $6H_2O$+Aq at t°.

t°	Per 1000 mols H_2O	
	Mols NH_4Cl	Mols $MgCl_2$
3.5	0.5	99.5
25.0	0.5	103.8
50.0	0.8	111.2

(Biltz and Marcus, Z. anorg. 1911, **71.** 170.)

Solubility data of $MgCl_2$+KCl+$MgKCl_3$ are given by van't Hoff and Meyerhoffer. (Z. phys. Ch. 1899, **30.** 64.)

$+8H_2O$. Pptd. from an aqueous solution which contains about 10 mols. H_2O to 1 mol. $MgCl_2$.

$+12H_2O$. Pptd. from an aq. solution which contains 1 mol. $MgCl_2$ in about 12.06 mols. of H_2O. (Bogorodsky, C. C. **1899,** I. 246.)

Magnesium manganous chloride, $MgCl_2$, $2MnCl_2+12H_2O$.

Deliquescent. Very sol. in H_2O and alcohol. (Saunders, Am. Ch. J. **14.** 148.)

$2MgCl_2$, $MnCl_2+12H_2O$. Ppt. Deliquesces in the air. (Gossner, C. C. **1904,** I. 707.)

Magnesium mercuric chloride, $MgCl_2$, $HgCl_2$ $+6H_2O$.

Very deliquescent. More sol. than the following salt. (v. Bonsdorff, Pogg. **17.** 133.)

$MgCl_2$, $3HgCl_2+5H_2O$. Sol. in H_2O with-

out decomp. Easily sol. in alcohol. (v. Bonsdorff.)

Magnesium phosphoryl chloride, $MgCl_2$, $POCl_3$.

Deliquescent. Sol. in H_2O with evolution of heat and decomposition. Very sl. sol. in warm $POCl_3$. (Casselmann, A. **98.** 223.)

Magnesium potassium chloride, $MgCl_2$, $2KCl+6H_2O$.

Deliquescent, forming a solution of $MgCl_2$, while KCl remains undissolved. 100 pts. H_2O dissolve 64.5 pts. at 18.75°. 20 pts. salt dissolved in 80 pts. H_2O lower the temp. 1.75°. (Bischof.) Alcohol dissolves out $MgCl_2$. Decomp. into the two salts by solution in H_2O. (Marcet.)

A sat. solution in contact with solid KCl and KCl, $MgCl_2$, H_2O at 50° contains 79.5 mol. $MgCl_2$ and 14.9 mol. KCl per 1000 mol. H_2O. A sat. solution in contact with solid $MgCl_2$, $6H_2O$ and KCl, $MgCl_2$, H_2O at 50° contains 111.9 mol. $MgCl_2$ and 1.2 mol. KCl per 1000 mol. H_2O. (Uhlig, Chem. Soc. 1913, **104.** (2) 775; C. B. Miner. **1913,** 417.)

Min. *Carnallite.*

Magnesium rubidium chloride, $MgCl_2$, $RbCl+6H_2O$.

Not decomp. by a small quantity of H_2O. (Feit and Kubierscky, Ch. Ztg. **16.** 335.)

Magnesium sodium chloride, $MgCl_2$, $NaCl+2H_2O$.

Sol. in H_2O. (Poggiale.)

Magnesium thallic chloride, $2TlCl_3$, $MgCl_2+6H_2O$.

Hydroscopic. Can be cryst. from H_2O. (Gewecke, A. 1909, **366.** 224.)

Magnesium stannic chloride.

See **Chlorostannate, magnesium.**

Magnesium vanadium chloride, $MgCl_2$, VCl_3+H_2O.

Difficultly sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Magnesium zinc chloride, $MgCl_2$, $ZnCl_2+6H_2O$.

Deliquescent; sol. in H_2O. (Warner, C. N. **27.** 271.)

Magnesium chloride ammonia, $MgCl_2$, $4NH_3$.

Easily decomp. (Clark, A. **78.** 369.)

Magnesium chloride hydroxylamine, $MgCl_2$, $2NH_2OH+2H_2O$.

100 g. of solution in H_2O contain 44.4% at 20°. (Antonow, J. Russ. Phys. Chem. Soc. 1905, **37.** 478.)

Magnesium fluoride, MgF_2.

1 l. H_2O dissolves 76 mg. MgF_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

87 mg. are dissolved in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Scarcely sol. in acids. (Gay-Lussac and Thénard.) Insol. in excess of HF. When precipitated, is sol. in aqueous solution of ammonium and magnesium salts. Sol. in dil. HNO_3+Aq, from which it is precipitated by alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Min. *Sellaite.*

Magnesium potassium fluoride, MgF_2, KF.

Decomp. by H_2SO_4. (Duboin, C. R. 1895, **120.** 679.)

MgF_2, 2KF. Decomp. by H_2SO_4. (Duboin.)

Magnesium sodium fluoride, MgF_2, NaF.

Insol. in H_2O. (Geuther, J. B. **1865.** 173.)

Magnesium stannic fluoride.

See **Fluostannate, magnesium.**

Magnesium titanium fluoride.

See **Fluotitanate, magnesium.**

Magnesium zirconium fluoride.

See **Fluozirconate, magnesium.**

Magnesium hydrosulphide, MgS_2H_2.

Known only in aqueous solution, which decomposes on warming. Solution containing 16% MgS_2H_2 has sp. gr. 1.118 at 12°. (Divers and Shimidzu, Chem. Soc. **45.** 699.)

Magnesium hydroxide, MgO_2H_2.

MgO is sol. in 55,368 pts. H_2O at ordinary temp., and also at 100°. (Fresenius, A. **59.** 117.)

MgO is sol. in 5142 pts. H_2O at 15.5° (Fyfe); in 5800 pts. at 15.8° (Henry, J. Pharm. **13.** 2); in 7900 pts. (Kirwan); in 16,000 pts. (Dalton); in 100,000–200,000 pts. cold H_2O (Bineau); in 36,000 pts. boiling H_2O (Fyfe, Ed. Phil. J. **5.** 305.)

Calculated from electrical conductivity of MgO_2H_2+Aq, 1 l. H_2O dissolves 9 mg. MgO_2H_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Calculated from electrical conductivity, 1 l. H_2O dissolves 00.076 g. MgO_2H_2 at 18°. (Dupré and Brutus, Z. angew. Ch. 1903, **16.** 55.)

Presence of CaO_2H_2 or $CaSO_4$ does not decrease the solubility. (Henry.) Presence of the salts of the alkali metals, especially ammonium salts, increase the solubility. Insol. in conc. Na_2SO_4, $NaNO_3$, NaCl, or KNO_3+Aq. (Karsten.) Sol. in NH_4OH+Aq, but insol. in KOH+Aq. (Odling.)

Easily sol. in acids. Sol. in an aqueous solution of sugar. Boiling alcohol dissolves traces.

Solubility of MgO_2H_2 in NH_4Cl+Aq at 29°.

Conc. of NH_4Cl+Aq (Normal)	Acid required for liberated NH_3 in 25 cc. (Normal)	Normality of		G. per l.	
		MgO_2H_2	NH_4Cl	MgO_2H_2	NH_4Cl
0.7	0.09835	0.156	0.388	4.55	20.86
0.466	0.1108	0.108	0.250	3.15	13.39
0.35	0.09835	0.089	0.172	2.60	9.21
0.23	0.1108	0.0638	0.106	1.86	5.67
0.17	0.1108	0.049	0 0771	1.43	4.13

(Herz and Muhs, Z. anorg. 1909, **38.** 140.)

Solubility of MgO_2H_2 in NH_4NO_3+Aq at 29°.

Conc of NH_4NO_3 +Aq (Normal)	Acid required for liberated NH_3 in 25cc. (Normal)	Normality of		G. per l.	
		MgO_2H_2	NH_4NO_3	MgO_2H_2	NH_4NO_3
0.35	0.1108	0.0833	0.1834	2.43	14.69
0.175	0.1108	0.0495	0.076	1.45	6.09

(Herz and Muhs.)

Completely insol. in 16% NaCl+Aq in presence of 0.8 g. NaOH. (Maigret, Bull. Soc. (3) **33.** 631.)

Solubility of MgO_2H_2 in NaCl+NaOH+Aq.

G. NaCl per l.	G. MgO per l. of solution with added	
	0.8 g. NaOH per l.	4.0 g. NaOH per l.
125	0.07	0.03
140	0.045	...
160	None	None

(Maigret.)

Freshly pptd. $Mg(OH)_2$ is sol. in $Th(NO_3)_4$ +Aq forming a colloidal solution. (Halla, Z. anorg. 1912, **79.** 262.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II, 1014.)

See also **Magnesium oxide.**

Min. *Brucite.* Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

2MgO, $3H_2O$. (Bender, B. **3.** 932.)

Magnesium iodide, MgI_2.

Very deliquescent.

Solubility in H_2O. See MgI_2+6, and $8H_2O$.

Sp. gr. of MgI_2+Aq at 19.5° containing:

5	10	15	20	25	30% MgI_2,
1.043	1.088	1.139	1.194	1.254	1.32
35	40	45	50	55	60% MgI_2.
1.395	1.474	1.568	1.668	1.78	1.915

(Kremers, Pogg. **111.** 62, calculated by Gerlach, Z. anal. **8.** 285.)

MgI_2+Aq decomp. slightly on evaporation.

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in alcohol, ether, and wood-spirit.

Solubility of MgI_2 in alcohols.

MgI_2 forms with methyl alcohol a complex, MgI_2, $6CH_3OH$.

Solubility of MgI_2, $6CH_3OH$ in CH_3OH at t°.

t°	% by weight of MgI_2, CH_3OH	t°	% by weight of MgI_2, $6CH_3OH$
0	49.6	120	66.2
20	52.6	140	69.5
40	55.3	160	73.2
60	58.0	180	77.1
80	60.6	200	81.5
100	63.3		

(Menschutkin, Z. anorg. 1907, **52.** 15.)

MgI_2 forms with ethyl alcohol a complex, MgI_2, $6C_2H_5OH$.

Solubility of MgI_2, $6C_2H_5OH$ in C_2H_5OH at t°.

t°	% by weight of MgI_2, $6C_2H_5OH$	t°	% by weight of MgI_2, $6 C_2H_5OH$
0	21.9	120	82.7
20	33.2	130	87.2
40	44.4	135	90.0
60	55.3	140	93.3
80	65.5	143	96.0
100	74.7	145	98.0
110	78.8	146.5 mpt.	100

(Menschutkin.)

MgI_2 forms with dimethylcarbinol a complex, MgI_2, $6(CH_3)_2CHOH$.

Solubility of MgI_2, $6(CH_3)_2CHOH$ in $(CH_3)_2CHOH$ at t°.

t°	% by weight of MgI_2, $6(CH_3)_2CHOH$	t°	% by weight of MgI_2, $6(CH_3)_2CHOH$
10	57.1	110	76.2
30	60.0	120	79.4
50	63.3	130	84.8
70	67.0	136	91.7
90	71.2	138 mpt.	100

(Menschutkin.)

Solubility of MgI_2 in ether at t°.

t°	% MgI_2	% MgI_2, $2C_4H_{10}O$
5.4	1.45	2.2
11.8	2.43	3.7
15.6	3.46	5.3
18.1	5.4	8.3
20.4	7.55	11.6
22.2	11.28	17.3

(Menschutkin, Z. anorg. 1906, **49.** 41.)

t°	% MgI_2	% $MgI_2, 2C_4H_{10}O$
	in lower layer	
14.8	35.5	54.4
17.6	35.5	54.4
20	35.8	54.8
28.4	35.5	54.4
33	35.7	54.7
35	35.3	54.1
	in upper layer	
18.6	13.57	20.8
23.2	14.4	22.1
24.4	14.6	22.4
32.4	15.82	24.2
	in solution when two layers mix	
37.3	19.4	29.3
38.5	22.45	34.4
38.5	26.07	39.9
38.5	29.8	45.7
38	32.8	50.3

(Menschutkin.)

Solubility of MgI_2 in acetic acid.

MgI_2 forms with acetic acid a complex, $MgI_2, 6CH_3COOH$.

Solubility of $MgI_2, 6CH_3COOH$ in CH_3COOH at t°.

t°	% by wt. $MgI_2, 6CH_3COOH$
20	0.6
40	2.0
60	5.0
70	9.5
75	13.0
80	18.5
85	27.1
95	42.0
105	54.5
115	65.0
125	73.8
135	85.0
140	94.0
142 mpt.	100.0

(Menschutkin, Z. anorg. 1907, **54.** 93.)

Solubility of MgI_2 in acetone.

MgI_2 forms with acetone a complex, $MgI_2, 6CH_3COCH_3$.

Solubility of $MgI_2, 6CH_3COCH_3$ in CH_3COCH_3 at t°.

t°	% by wt. $MgI_2, 6CH_3COCH_3$
0	4.9
30	6.7
50	8.3
60	10.2
70	15.2
80	28.6
85	40.0
90	59.2
95	80.0
100	92.5
105	98.5
106.5 mpt.	100

(Menschutkin, Z. anorg. 1907, **53.** 30.)

Solubility of MgI_2 in acetal.

MgI_2 forms with acetal a complex, $MgI_2, 2CH_3CH(OC_2H_5)_2$.

Solubility of $MgI_2, 2CH_3CH(OC_2H_5)_2$ in $CH_3CH(OC_2H_5)_2$ at t°.

t°	% by wt. $MgI_2, 2CH_3CH(OC_2H_5)_2$
20	0.15
60	0.45
77	0.6
77	92.0
79	93.7
81	95.5
83	97.3
86 mpt.	100

(Menschutkin, Z. anorg. 1907, **53.** 33.)

Solubility of MgI_2 in acetamide.

MgI_2 forms with acetamide a complex, $MgI_2, 6CH_3CONH_2$.

Solubility of $MgI_2, 6CH_3CONH_2$ in CH_3CONH_2 at t°.

t°	% by wt. of $MgI_2, 6CH_3CONH_2$
49	56.5
80	63.4
110	70.5
130	76.0
150	82.1
160	85.5
170	90.8
175	96.2
177 mpt.	100.0

(Menschutkin, Z. anorg. 1909, **61.** 108.)

Solubility of MgI_2 in acetonitrile.

MgI_2 forms with acetonitrile a complex, $MgI_2, 6CH_3CN$.

Solubility of $MgI_2, 6CH_3CN$ in CH_3CN at t°.

t°	% by wt. $MgI_2, 6CH_3CN$
0	37.2
30	49.8
50	58.2
70	67.9
80	76.5
89	91.3

(Menschutkin, Z. anorg. 1909, **61.** 110.)

Solubility of MgI_2 in benzaldehyde.

MgI_2 forms with benzaldehyde a complex, $MgI_2, 6C_6H_5CHO$.

Solubility of $MgI_2, 6C_6H_5CHO$ in C_6H_5CHO at t°.

t°	% by wt. $MgI_2, 6C_6H_5CHO$
0	3.2
20	3.8
40	5.3
60	7.7
80	11.0
100	18.5
110	26.5
120	40.0
125	53.0
130	74.5
133	86.0
136	94.2
139 mpt.	100

(Menschutkin, Z. anorg. 1907, **55.** 28.)

Solubility of MgI_2 in methyl acetate.

MgI_2 forms with methyl acetate a complex, $MgI_2, 6CH_3COOCH_3$.

Solubility of $MgI_2, 6CH_3COOCH_3$ in CH_3COOCH_3 at t°.

t°	% by wt. $MgI_2, 6CH_3COOCH_3$
0	0.4
30	0.55
60	0.75
90	0.9
100	1.8
103	2.4
103	74.2
110	81.7
120	98.0
121 mpt.	100.0

(Menschutkin, Z. anorg. 1909, **61.** 101.)

Solubility of MgI_2 in methyl acetate.

MgI_2 forms with ethyl acetate a complex, $MgI_2, 6CH_3COOC_2H_5$.

Solubility of $MgI_2, 6CH_3COOC_2H_5$ in $CH_3COOC_2H_5$ at t°.

t°	% by wt. $MgI_2, 6CH_3COOC_2H_5$
0	3.2
20	4.8
40	8.6
50	13.7
55	21.5
60	38.0
65	63.5
70	90.5
75	97.7
78.5 mpt.	100.0

(Menschutkin.)

Solubility of MgI_2 in ethyl formate.

MgI_2 forms with ethyl formate a complex, $MgI_2, 6HCOOC_2H_5$.

Solubility of $MgI_2, 6HCOOC_2H_5$ in $HCOOC_2H_5$ at t°.

t°	% by wt. $MgI_2, 6HCOOC_2H_5$
0	15.1
10	17.4
20	20.5
30	25
40	31.8
50	44
60	68
70.5 mpt.	100

(Menschutkin.)

Solubility of MgI_2 in isoamylacetate.

MgI_2 forms with isoamylacetate a complex, $MgI_2, 6CH_3COO(iso)C_5H_{11}$.

Solubility of $MgI_2, 6CH_3COO(iso)C_5H_{11}$ in $CH_3COO(iso)C_5H_{11}$ at t°.

t°	% by wt. $MgI_2, 6CH_3COO(iso)C_5H_{11}$
0	7.7
20	11.5
40	20.9
45	25.5
50	33.2
55	47.8
57.5	63.0
60 mpt.	100.0

(Menschutkin.)

Solubility of MgI_2 in isobutyl acetate.

MgI_2 forms with isobutylacetate a complex, $MgI_2, 6CH_3COOC_4H_9$.

Solubility of MgI_2, $6CH_3COO(iso)C_4H_9$ in $CH_3COO(iso)C_4H_9$.

t°	% by wt. MgI_2, $6CH_3COO(iso)C_4H_9$
0	10.5
20	13.6
40	17.6
50	20.4
60	24.9
70	33.7
75	40.5
80	52.0
85	89.0
87.5 mpt.	100.0

(Menschutkin.)

Solubility of MgI_2 in propyl acetate.

MgI_2 forms with propyl acetate a complex, MgI_2, $6CH_3COOC_3H_7$.

Solubility of MgI_2, $6CH_3COOC_3H_7$ in $CH_3COOC_3H_7$ at t°.

t°	% by wt. MgI_2, $6CH_3COOC_3H_7$
0	4.1
20	5.4
30	6.5
35	7.8
40	19.0
45	46.0
50	72.5
55	88.2
60	96.0
65 mpt.	100.0

(Menschutkin.)

Solubility of MgI_2 in urethane.

MgI_2 forms with urethane a complex, MgI_2, $6NH_2COOC_2H_5$.

Solubility of MgI_2, $6NH_2COOC_2H_5$ in $NH_2COOC_2H_5$ at t°.

t°	% by wt. MgI_2, $6NH_2COOC_2H_5$
32	51.8
50	59.4
70	70.7
80	78.8
84	85.0
87 mpt.	100.0

(Menschutkin.)

$+6H_2O$.

Solubility of MgI_2+6H_2O in H_2O at t°.

t°	% by weight of MgI_2+6H_2O	t°	% by weight of MgI_2+6H_2O
43°	89.8	160°	91.7
80°	90.3	200°	93.4
120°	90.9	215°	94.3

(Menschutkin, Z. anorg. 1907, **52.** 156.)

$+8H_2O$. Sp. gr. of solution of MgI_2+8H_2O sat. at 18° containing 59.7% MgI_2=1.909. (Mylius, B. 1897, **30.** 1718.)

Solubility of MgI_2+8H_2O in H_2O at t°.

t°	% by weight of MgI_2+8H_2O
0	76.0
20	81.0
40	88.0
43.5	90.8

(Menschutkin.)

$+10H_2O$. Sol. in H_2O. (Panfiloff, C. C. **1894,** II. 610.)

Magnesium mercuric iodide, MgI_2, HgI_2.

Known only in solution.

$+9H_2O$. Very deliquescent. (Duboin, C. R. 1906, **142.** 1338.)

Very sol. in ethyl, methyl, propyl, butyl, isobutyl, amyl, isopropyl and allyl alcohols, ethyl, amyl, propyl and isobutyl acetates, ethyl cyanide and acetone. Sol. in benzyl alcohol. Decomp. by glycerine. Sl. sol. in ethyl benzoate, amyl benzoate, nitrobenzene. Decomp. by ethyl oxalate. Insol. in toluene, benzene, ethyl iodide, $CHCl_3$, CCl_4, ethylene bromide, monochlor and monobrombenzene. (Duboin, A. ch. 1909, (8) **16.** 276.)

MgI_2, $2HgI_2$. Decomp. by H_2O into HgI_2 and above compound, which remains in solution. (Boullay.)

$+7H_2O$. Sat. solution in H_2O at 17.8° has the composition MgI_2, 1.29 HgI_2, 11.06 H_2O. (Duboin, C. R. 1906, **142.** 1338.)

Magnesium potassium iodide, MgI_2, $KI+6H_2O$.

Deliquescent. (Lerch, J. pr. (2) **28.** 338.) Very hygroscopic. (de Schulten, Bull. Soc. 1900 (3) **23.** 158.)

Magnesium iodide ammonia, MgI_2, $6NH_3$.

Practically insol. in liquid NH_3. (Franklin, J. Am. Chem. Soc. 1913, **35.** 1459.)

Magnesium nitride, Mg_3N_2.

Decomp. by moist air or H_2O. Sol. in dil. or conc. $HCl+Aq$, or HNO_3+Aq. Sol. in warm H_2SO_4. Insol. in alcohol, ethyl iodide, or phosphorus oxychloride. (Briegleb and Geuther, A. **123.** 236.)

Decomp. by H_2O. (Smits, R. t. c. 1894, **12.** 198.)

Easily decomp. H_2O when finely powdered. (Rossel, C. R. 1895, **121.** 942.)

Magnesium ***suboxide*** **(?).**

Decomp. H_2O. Sol. in dil. acids. (Beetz, Pogg. **127.** 45.)

Magnesium oxide, MgO.

Sol. in 50,000–100,000 pts. H_2O (Bineau, C. R. **41.** 510); in 55,368 pts. cold or hot H_2O (Fresenius, A. **59.** 123); in 100,000–200,000 pts. H_2O (Bunsen); in 16,000 pts. H_2O at ord. temp. (Dalton); in 7900 pts. H_2O at ord. temp. (Kirwan); in 5760 pts. H_2O at 15.5°, and 36,000 pts. at 100° (Fyfe).

Calc. from electrical conductivity of MgO +Aq. 1 pt. MgO is sol. in 172,000 pts. H_2O at 18°. (Dupré, Zeit. angew. Ch. 1903, **16.** 55.)

"Heavy" MgO is more sol. in H_2O than "light" MgO. The temp. of preparation affects the rate of solution, the rate being diminished as the temp. of preparation is increased. (Anderson, Chem. Soc. 1905, **87.** 265.)

Easily sol. in acids, even in H_2SO_3+Aq.

Solubility in P_2O_5+Aq at 25°.

Composition of the solution		Sp. gr. 25°/25°	Solid phase
G. MgO per l.	G. P_2O_5 per l.		
0.207	0.486	...	$MgHPO_4$, $3H_2O$
0.280	0.732	...	
0.553	1.917	...	
1.438	4.85	...	
2.23	7.35	1.006	
4.73	16.84	1.017	
11.19	38.59	1.042	
17.33	61.21	1.069	
26.09	93.09	1.109	
37.40	130.7	1.144	
75.5	281.8	1.285	
109.5	439.0	...	
122.6	498.4	1.470	
129.9	546.5	...	
140.0	584.0	...	
146.8	623.3	1.595	
147.3	625.9	...	
150.3	645.8	...	
155.5	680.7	...	
87.1	779.6	1.626	$MgH_4(PO_4)_2$, xH_2O
77.1	809.6	1.644	
70.6	835.1	1.654	

(Cameron, J. phys. Chem. 1907, **11.** 364.)

Sol. in NH_4 salts, NaCl, or KCl+Aq. (Fresenius.)

Solubility in $MgCl_2$+Aq at 25°.

% $MgCl_2$	% MgO as $Mg(OH)_2$
2.36	0.00008
4.47	0.00028
6.79	0.00048
9.02	0.00080
13.14	0.00115
15.15	0.00195
17.53	0.00240
18.52	0.00250
22.04	0.00245
23.78	0.00235
25.13	0.00230
26.88	0.00250
28.34	0.00230
29.80	0.00240
30.04	0.00250
34.22	0.0030

(Robinson, J. phys. Chem. 1909, **13.** 676.)

More sol. in K_2SO_4, and Na_2SO_4+Aq than in H_2O. (Warrington.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in methyl alcohol to form a colloidal solution containing 1.6% MgO. (Neuberg and Rewald. (Biochem. Z. 1908, **9.** 547.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.30 g. MgO; containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.24 g. MgO; containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.22 g. MgO. (Bodenbender, J. B. **1865.** 600.)

See also **Magnesium hydroxide.**

Min. *Periclasite.*

Magnesium *per***oxide,** MgO_2.

Sol. in 14,550 pts. H_2O at 20°. (Foregger and Philipp, J. Soc. Chem. Ind. 1906, **25.** 298.)

5MgO, $2MgO_2+3H_2O$.
3MgO, $2MgO_2+3H_2O$.
2MgO, $2MgO_2+3H_2O$.
4MgO, $2MgO_2+3H_2O$.
Above salts are decomp. by H_2O.
(Carrasco, Gazz. ch. it. 1909, **39,** (1) 47.)

Magnesium oxybromide, $MgBr_2$, $3MgO+12H_2O$.

Decomp. in the air and also by H_2O, alcohol and most reagents. (Tassilly, C. R. 1897, **125.** 607.)

Magnesium oxychloride, $Mg_2OCl_2+16H_2O$.

Easily decomp. by H_2O and alcohol. (André, A. ch. (6) **3.** 80.)

$+6H_2O$. (André.)

2MgO, HCl, $5H_2O$ or 3MgO, $MgCl_2+10H_2O$. Solubility determinations show that this salt is the solid phase in equilibrium at 25° with solutions of $MgCl_2$ and MgO containing from 10–15% $MgCl_2$. (Robinson, J. phys. Chem. 1909, **13.** 677.)

$Mg_6O_5Cl_2$+6, 8, 14, or $17H_2O$. Decomp. by H_2O, which dissolves out $MgCl_2$. (Bender, B. **3.** 932.)

$Mg_{11}O_{10}Cl_2$+14, or $18H_2O$. (Krause, A. **165.** 38.)

$Mg_{10}O_9Cl_2 + 24H_2O = 9MgO$, $MgCl_2 + 24H_2O$. H_2O removes all $MgCl_2$ by long digesting. (Bender, A. **159.** 341.)

+10, and $15H_2O$. (Bender.)

Magnesium oxysulphide, Mg_2OS.

(Reichel, J. pr. (2) **12.** 55.)

Magnesium phosphide, Mg_3P_2.

Decomp. by H_2O, dil. $HCl+Aq$, or HNO_3 +Aq. (Parkinson, Chem. Soc. **5.** (2) 125 and 309.)

Insol. in moderately dil. cold $HCl+Aq$, or boiling dil. H_2SO_4+Aq. Difficultly and slowly sol. in aqua regia. (Blunt, Chem. Soc. **3.** (2) 106.)

Decomp. by H_2O, HCl, conc. H_2SO_4 and by HNO_3. (Gautier, C. R. 1899, **128.** 1169.)

Magnesium silicide, Mg_5Si_3.

Slowly decomp. by warm H_2O. Slowly decomp. by cold, rapidly by hot NH_4Cl+Aq. Decomp. by cold dil. $HCl+Aq$. (Geuther, J. pr. **95.** 425.)

Mg_2Si. Decomp. by $HCl+Aq$ with residue of Si. (Wöhler, A. **107.** 113.)

Slowly decomp. by H_2O at ord. temp. Violently decomp. by HCl. (Lebeau and Bossuet, C. R. 1908, **146.** 284.)

Magnesium sulphide, MgS.

Decomp. by H_2O. (Reichel, J. pr. (2) **12.** 55.)

Sl. sol. in H_2O with rapid decomp. (Fremy.)

Sol. in acids with decomp.

Anhydrous. Crystalline. Only very sl. sol. in cold H_2O. Sol. in HNO_3 and H_2SO_4 at ord. temp. Sol. in PCl_3 and in chromyl chloride. (Mourlot, C. R. 1898, **127.** 182.)

Magnesium ***poly*****sulphide,** MgS_x.

Known only in solution. (Reichel.)

Magnus' green salt.

See **Plato*di*amine chloroplatinite.**

Manganese, Mn.

Decomposes H_2O even in the cold, more rapidly when hot. (Regnault.)

Decomposes cold water violently. (Bunsen.)

Sol. in all dil. acids. Slowly sol. in cold H_2SO_4. (John.)

Insol. in cold, but rapidly sol. in hot H_2SO_4. Very easily sol. in dil. H_2SO_4, or $HCl+Aq$, HNO_3, or $HC_2H_3O_2+Aq$. (Brunner.)

Pure manganese is unaltered in dry air, even when finely powdered. Slowly attacked by cold, quickly by hot H_2O. Very sl. attacked by cold H_2SO_4, rapidly on warming; rapidly attacked by cold dil. H_2SO_4+Aq; violently by conc. HNO_3+Aq; and rapidly by dil. HNO_3, HCl, $HC_2H_3O_2+Aq$, and also $NaOH+Aq$. Sol. in NH_4Cl+Aq. (Prelinger, W. A. B. **102, 2b.** 359.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

½ ccm. oleic acid dissolves 0.0276 g. Mn in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Manganese antimonide, MnSb.

Sol. in hot aqua regia. (Wedekind, B. 1907, **40.** 1266.)

Manganese azoimide, basic, $Mn(OH)N_3$.

Only sl. sol. in H_2O with decomp. (Curtius, J. pr. 1898, (2) **58.** 293.)

Manganese bismuthide, MnBi.

Very sensitive towards acids with the exception of conc. HCl. (Wedekind, B. 1911, **44.** 2665.)

Manganese boride, MnB.

Attacked by cold H_2O and by acids. (Jassoneix, C. R. 1904, **139.** 1210.)

Easily attacked by HCl, H_2SO_4 and HF with evolution of BH_3. (Wedekind, B. 1905, **38.** 1231.)

MnB_2. Sol. in acids, with evolution of H_2. (Troost and Hautefeuille, A. ch. (5) **9.** 65.)

Slowly decomp. by H_2O. Sol. in dil. HCl and other dil. acids with evolution of BH_3. (Wedekind, B. 1905, **38.** 1229.)

Manganous bromide, $MnBr_2$.

Anhydrous. Very deliquescent.

Sat. $MnBr_2+Aq$ contains at:

—21°	+7°	11°	18°	38°	52°	
52.1	56.5	57.0	59.1	62.7	64.2%	$MnBr_2$,

64°	76°	89°	97°	105°	
68.2	70.1	69.7	69.2	70.2%	$MnBr_2$.

(Étard, A. ch. 1894, (7) **2.** 541.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

$+H_2O$. (Lescoeur, A. ch. 1894, (7) **2. 104.**)

$+4H_2O$. More deliquescent than $MnCl_2$. Melts in crystal water when heated. (Berthemot.)

$+6H_2O$. (Kuznetzoff, C. C. **1897,** II. 329.)

Manganous mercuric bromide.

Deliquescent.

Manganous palladium bromide.

See **Bromopalladite, manganous.**

Manganous stannic bromide.

See **Bromostannate, manganous.**

Manganese carbide, MnC.

(Brown, J. pr. **17.** 492.)

MnC_2.

Mn_3C. (Troost and Hautefeuille, A. ch. (5) **9.** 60.)

Decomp. by H_2O and by dil. acids. (Moissan, C. R. 1896, **122.** 422.)

Manganous chloride, $MnCl_2$.

Anhydrous. Deliquescent.

100 pts. H_2O at t° dissolve pts. $MnCl_2$:

t°	Pts. $MnCl_2$	t°	Pts. $MnCl_2$
10	62.16	87.5	122.22
31.25	85.72	106.25	123.81
62.5	122.22	...	...

or, sat. $MnCl_2$+Aq at t° contains:

t°	% $MnCl_2$	t°	% $MnCl_2$
10	38.33	87.5	55.0
31.25	46.15	106.25	55.32
62.5	55.0	...	...

(Brandes, Pogg. **22.** 263.)

See also below under $+2H_2O$, and $+4H_2O$.

Sp. gr. of $MnCl_2$+Aq at 15°. a = sp. gr. if % is $MnCl_2$; b = sp. gr. if % is $MnCl_2+4H_2O$.

%	a	b	%	a	b
5	1.045	1.0285	40	1.443	1.250
10	1.091	1.057	45	1.514	1.290
15	1.138	1.086	50	...	1.331
20	1.189	1.116	55	...	1.375
25	1.245	1.147	60	...	1.419
30	1.306	1.180	65	...	1.463
35	1.372	1.214	70	...	1.508

(Gerlach, Z. anal. **28.** 476.)

Sp. gr. of $MnCl_2$+Aq at room temp.

% $MnCl_2$	Sp. gr.
8.007	1.0960
15.650	1.1963
30.330	1.3372
40.132	1.4530

(Wagner, W. Ann. 1883, **18.** 273.)

Sp. gr. of $MnCl_2$+Aq at t°.

t°	% $MnCl_2$	Sp. gr.
14.5	5.0	1.0457
14.5	11.99	1.1076
14.0	14.98	1.1379
14.5	19.92	1.1891
14.0	23.10	1.2246
14.6	28.51	1.2888

(Long, W. Ann. 1880, **11.** 38.)

Sp. gr. of $MnCl_2$+Aq at 25°.

Concentration of $MnCl_2$+Aq	Sp. gr.
1-normal	1.0513
1/2- "	1.0259
1/4- "	1.0125
1/8- "	1.0063

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Solubility of $MnCl_2$+KCl in H_2O at t°.

t°	% $MnCl_2$	% KCl	Solid phase
6	40.23	...	$MnCl_2$, $4H_2O$
	35.94	9.41	$MnCl_2$, $4H_2O$+$MnCl_2$, KCl, $2H_2O$+KCl
	...	23.06	KCl
28.4	44.46	...	$MnCl_2$, $4H_2O$
	43.28	8.66	$MnCl_2$, $4H_2O$+$MnCl_2$, KCl, $2H_2O$
	38.65	13.79	$MnCl_2$, $4H_2O$+$MnCl_2$, 2KCl, $2H_2O$+KCl
	...	26.91	KCl
52.8	50.14	6.01	$MnCl_2$, $4H_2O$+$MnCl_2$, $2H_2O$+$MnCl_2$, KCl, $2H_2O$
62.6	51.86	...	$MnCl_2$, $2H_2O$
	49.95	6.67	$MnCl_2$, $2H_2O$+$MnCl_2$, KCl, $2H_2O$
	44.05	12.49	$MnCl_2$, KCl, $2H_2O$+$MnCl_2$, 2KCl, $2H_2O$
	36.85	18.77	$MnCl_2$, 2KCl, $2H_2O$+$MnCl_2$, 4KCl
	...	31.57	KCl

(Süss, Z. Kryst. Min. 1912, **51.** 262.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Solutions of $MnCl_2$ in 75% alcohol saturated at t° contain:

t°	% $MnCl_2$	t°	% $MnCl_2$
10	23.1	43.75	37.5
25	36.1	87.5 (B.-pt.)	32.2

Solutions of $MnCl_2$ in absolute alcohol saturated at t° contain:

t°	% $MnCl_2$	t°	% $MnCl_2$
11.25	33.3	76.25	36.2
37.5	33.3	(B.-pt.)	

(Brandes, *l. c.*)

$MnCl_2$ crystallises from above solutions on standing.

When 15–20 vols. ether are added to 1 vol. absolute alcohol sat. with $MnCl_2$, $MnCl_2$ is completely pptd. (Döbereiner.)

Insol. in oil of turpentine.

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+H_2O$. Solubility in HCl+Aq decreases with increasing amt. of HCl. It is greater when hot than cold, but is not inconsiderable even when HCl is conc. 1 l. conc. HCl+Aq sat. at 12° dissolves 190 g. $MnCl_2$ from $MnCl_2+H_2O$. (Ditte, C. R. 1881, **92.** 243.)

$+{}^5/_3H_2O$. $MnCl_2+4H_2O$ effloresces to $MnCl_2+{}^5/_3H_2O$ in a dry atmosphere and under low pressure and not to $MnCl_2+2H_2O$. (Sabatier, Bull. Soc. 1894, (3) **11.** 547.)

$+2H_2O$.

Solubility in H_2O at t°.

t°	Pts. $MnCl_2$ per 100 pts. H_2O	Sp. gr. of sat. solution
60	108.6	1.6108
70	110.6	1.6134
80	112.7	....

(Dawson and Williams, Z. phys. Ch. 1899, **31.** 63.)

Sat. aqueous solution of $MnCl_2+2H_2O$. Contains 51.86% $MnCl_2$ at 62.6°. (Süss. Z. Krist. 1912, **51.** 262.)

$+4H_2O$. Deliquescent.

100 pts. H_2O at t° dissolve:

t°	Pts. $MnCl_2$ $+4H_2O$	t°	Pts. $MnCl_2$ $+4H_2O$
8	151	87.5	641
31.25	265	106.25	656
62.5	641	....	...

(Brandes, *l. c.*)

Sol. in 0.8 pt. H_2O at 18.75°. (Abl.)

Pptd. from solution in 9.17 mols. H_2O. (Kuznetzoff, C. C. **1899,** I. 246.)

Sat. aq. solution contains at:

—22°	—5°	+7°	17°	19°		
34.7	37.8	40.4	41.2	42.3% $MnCl_2$		
35°	55°	57°	80°	100°	140°	
44.4	48.2	50.0	51.0	53.7	54.7% $MnCl_2$.	

(Étard, A. ch. 1894, (7) **2.** 537.)

Solubility in H_2O at t°.

t°	Pts. $MnCl_2$ per 100 pts. H_2O	Sp. gr. of sat. solution
25	77.18	1.4991
30	80.71	1.5049
40	88.59	1.5348
50	98.15	1.5744
*57.65	105.40	1.6097

* Temp. of transition into $MnCl_2+2H_2O$.

(Dawson and Williams, Z. phys. Ch. 1899, **31.** 63.)

Sat. aqueous solution of $MnCl_2+4H_2O$ contains 40.23% $MnCl_2$ at 6°; 44.6% $MnCl_2$ at 28.4°. (Süss, Z. Krist. 1912, **51.** 262.)

100 pts. 75% alcohol dissolve at t°:

t°	Pts. $MnCl_2$ $+4H_2O$	t°	Pts. $MnCl_2$ $+4H_2O$
10	53	43.75	144
25	132	87.5	100.1

(Brandes, *l. c.*)

Insol. in absolute ether, which also does not abstract crystal H_2O.

Insol. in boiling oil of turpentine. (Brandes.

Sol. in conc. HNO_3+Aq.

$+5H_2O$. (Müller-Erzbach, B. 1889, **22.** 3181.)

$+6H_2O$. Pptd. from solution in 11.7 mols. H_2O at —21°. (Kuznetzoff, C. C. **1899,** I. 246.)

Manganese *tri*chloride, $MnCl_3$.

Immediately decomp. by H_2O; sol. in abs. ether and in abs. alcohol. (Holmes, J. Am. Chem. Soc. 1907, **29.** 1285.)

Manganese *tetra*chloride, $MnCl_4$.

Has not been isolated.

Sol. in H_2O, alcohol, or ether. (Nicklès, J. B. **1865.** 225.)

Composition is Mn_2Cl_6. (Christensen, J. pr. (2) **34.** 41.)

Manganese hydrogen *tetra*chloride (chloromanganic acid), $MnCl_4$, 2HCl.

Sol. in ether; decomp. by H_2O. (Franke, (2) **36.** 31.)

Manganese *hepta*chloride, $MnCl_7$(?).

Decomp. by H_2O. (Dumas, Berz. J. B. **7.** 112.)

Has the formula MnO_3Cl (?). (Aschoff, J. pr. **81.** 29.)

Manganous mercuric chloride, $MnCl_2$, $HgCl_2+4H_2O$.

Deliquescent in moist air. Easily sol. in H_2O. (v. Bonsdorff.)

$MnCl_2$, $2HgCl_2$. (Varet, C. R. 1896, **123,** 422.)

Manganous potassium chloride, $MnCl_2$, $KCl+2H_2O$.

Deliquescent. Very sol. in H_2O, but is decomp. thereby. (Remsen and Saunders, Am. Ch. J. **14.** 129.)

$MnCl_2$, $2KCl+2H_2O$. (Süss, Z. Kryst. 1912, **51.** 262.)

Manganic potassium chloride, $MnCl_3$, $2KCl+H_2O$.

Decomp. by H_2O. Sol. in HCl apparently without decomp. (Rice, Chem. Soc. 1898, **73.** 261.)

$MnCl_4$, 2KCl. Very easily decomp. (Meyer and Best, Z. anorg. 1899, **22.** 186.)

$MnCl_4$, $MnCl_3$, 5KCl. Easily decomp. (Meyer and Best, Z. anorg. 1899, **22.** 185.)

Manganous rubidium chloride, $MnCl_2$, 2RbCl.

(Godeffroy.)

$+3H_2O$. Easily sol. in H_2O. Insol. in alcohol; conc. HCl+ppt. anhydrous salt from aqueous solution. (Godeffroy, Arch. Pharm. (3) **12.** 40.)

Contains only $2H_2O$. (Saunders, Am. Ch. J. **14.** 139.)

Manganous thallic chloride, $MnCl_2$, $2TlCl_3+6H_2O$.

Can be cryst. from H_2O. (Gewecke, A. 1909, **366.** 224.)

Manganous stannic chloride.

See **Chlorostannate, manganous.**

Manganous chloride hydrazine, $MnCl_2$, $2N_2H_4$.

Ppt. (Franzen, Z. anorg. 1908, **60.** 285.)

Manganous chloride hydroxylamine, $MnCl_2$, $2NH_2OH$.

Very stable; insol. in alcohol. (Feldt, B. 1894, **27.** 405.)

Manganous fluoride, MnF_2.

Only sol. in H_2O containing HF. (Berzelius.)

Insol. in H_2O; decomp. by boiling with H_2O; sl. sol. in liquid NH_3; easily sol. in cold or hot conc. HNO_3 and HCl; slowly sol in dil. HCl; decomp. by fused K_2CO_3, KOH, KNO_3, and $KClO_3$; insol. in alcohol and ether. Slowly sol. in acetic acid. (Moissan, C. R. 1900, **130.** 1160.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Manganese ***tri*****fluoride,** MnF_3.

Completely sol. in a little H_2O, but decomp. by dilution or boiling. (Berzelius.)

$+6H_2O$. Efflorescent. (Christensen, J. pr. (2) **35.** 57.)

Sol. in H_2SO_4, HCl, HNO_3; decomp. by H_2O; insol. in most organic solvents. (Moissan, C. R. 1900, **130.** 626.)

Manganomanganic fluoride, $Mn_3F_8+10H_2O$.

Sol. in a little H_2O, but decomp. by dilution. (Nicklès, C. R. **67.** 448.)

Manganese ***tetra*****fluoride,** MnF_4.

Not isolated. Sol. in absolute alcohol or ether; decomp. by H_2O. (Nicklès, C. R. **65.** 107.)

Probably does not exist. (Christensen, J. pr. (2) **35.** 161.)

Manganese ***hepta*****fluoride,** MnF_7 (?).

Sol. in H_2O with decomp. (Wöhler.)

Manganese ***sesqui*****fluoride** ***with*** **MF.**

See also **Fluomanganate, M.**

Manganic nickel fluoride, $2NiF_2$, $Mn_2F_6+8H_2O$.

(Christensen, J. pr. (2) **34.** 41.)

Manganic potassium fluoride, Mn_2F_6, $4KF+2H_2O$.

Decomp. by H_2O. Sol. in conc. HCl+Aq, dil. HNO_3+Aq, conc. H_2SO_4+Aq, H_3PO_4+Aq, $H_2C_2O_4$+Aq, $H_2C_4H_4O_6$+Aq, and dil. HF+Aq. (Christensen, J. pr. (2) **35.** 72.)

MnF_4, 2KF. Difficultly sol. in H_2O. Decomp. by much H_2O. (Nicklès, C. R. **65.** 107.)

True composition is Mn_2F_6, 4KF, also with $2H_2O$. (Christensen, J. pr. (2) **34.** 41.)

MnF_4, 4KF. (Nicklès.)

See also **Fluomanganate, potassium.**

Manganic rubidium fluoride.

See **Fluomanganate, rubidium.**

Manganic silver fluoride, 2AgF, $Mn_2F_6+14H_2O$.

Sol. in HF+Aq. (Christensen, J. pr. (2) **34.** 41.)

Manganic sodium fluoride, Mn_2F_6, 4NaF.

Decomp. by much H_2O. Not as sol. in HF+Aq as the K salt. (Christensen, J. pr. (2) **35.** 161.)

Manganomanganic thallous fluoride, $5TlF, 2MnF_3, MnF_2$.

Decomp. by H_2O.
Sl. sol. in dil., easily sol. in conc. HF.
Sol. in conc. HCl, dil. HNO_3, and cold or hot conc. H_2SO_4.
Sol. in warm H_2O_2 containing H_2SO_4.
Sol. in dil. tartaric and oxalic acids. (Ephraim, B. 1909, **42.** 4458.)

Manganous stannic fluoride.
See **Fluostannate, manganous.**

Manganic zinc fluoride, $2ZnF_2, Mn_2F_6+8H_2O$
See **Fluomanganate, zinc.**

Manganous zirconium fluoride.
See **Fluozirconate, manganous.**

Manganous fluoride ammonia, $3MnF_2, 2NH_3$.
(Moissan, C. R. 1900, **130.** 1161.)

Manganous hydroxide, MnO_2H_2.

2.15 x 10^{-5} g.-mol. are sol. in 1 l. H_2O at 18°. (Sackur, Z. Elektrochem, 1909, **15.** 846.)
Solubility in H_2O = 0.6 x 10^{-4} g. mol. (Herz, Z. anorg. 1899, **22.** 284.)
1 l. H_2O dissolves 2 x 10^{-4} mol. MnO_2H_2. (Tamm, Z. phys. Ch. 1910, **74.** 500.)
Very sl. sol. in H_2O or alkalies. (Fresenius.) Easily sol. in acids. Insol. in NaOH, or KOH+Aq. Sol. in NH_4 salts+Aq. Insol. in NH_4OH+Aq. Sol. in NaOH+Aq in presence of glycerine. (Donath, Dingl. **229.** 542.)
Not pptd. by NH_4OH+Aq in presence of $H_2C_4H_4O_6$; by KOH+Aq in presence of cane sugar; by KOH+Aq in presence of Na citrate.
Solubility of MnO_2H_2 in organic Na salts+Aq. (0.5 normal.)

Na tartrate, 0.0068 mol. per l.
Na malate, 0.0042 " " "
Na citrate, 0.0126 " " "
(Tamm, Z. phys. Ch. 1910, **74.** 496.)
Min. *Pyrochroite.*

Manganomanganic hydroxide, Mn_3O_4, xH_2O.

Not attacked by boiling NH_4Cl+Aq. Behaves towards acids as Mn_2O_3.

Manganic hydroxide, Mn_2O_3, H_2O.

Insol. in hot or cold dil. H_2SO_4+Aq.
Sol. in conc. H_2SO_4 at somewhat over 100°. (Carius.)
Sol. in tartaric, oxalic, and malic acids, with subsequent decomp. Insol. in formic, acetic, benzoic, or hippuric acids. (Hermann, Pogg. **74.** 303.)
Insol. in NH_4Cl+Aq. Insol. in cane sugar +Aq. (Peschier.)
Min. *Manganite.* Sol. in conc. HCl+Aq. Sl. sol. in conc. H_2SO_4.

Manganese ***di*****hydroxide,** MnO_2, H_2O.
See **Manganous acid.**

Manganous iodide, MnI_2.

Anhydrous. Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)
Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)
Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)
$+4H_2O$. Very deliquescent, and sol. in H_2O. (Kuznetzoff, C. C. **1900,** II. 525.)
$+9H_2O$. (Kuznetzoff.)

Manganous mercuric iodide, $MnI_2, 2HgI_2+6H_2O$.

Decomp. by H_2O. Sol. without decomp. in alcohol and acetone. (Dobroserdoff, C. C. **1901,** I. 363.)
$3MnI_2, 5HgI_2+20H_2O$.
A sat. solution in H_2O at 17° has composition 1.4 MnI_2, HgI_2+10.22 H_2O and sp. gr. = 2.98. (Duboin, C. R. 1906, **142.** 1338.)
Very sol. without decomp. in methyl, propyl, isopropyl, isobutyl, and allyl alcohols, ethyl acetate and ethyl cyanide. Somewhat less sol. in amyl, propyl and isobutyl acetates, acetone, acetic acid, formic acid (with ppnt. of HgI_2), ethyl benzoate, ethyl oxalate, butyl alcohol, amyl alcohol and nitrobenzene. Sl. decomp. by glycerine. Insol. in ethyl nitrate, ethylene bromide, toluene, benzene, $CHCl_3$, CCl_4, ethyl iodide, monobrom- and monochlorbenzene. (Duboin, A. ch. 1909, (8), **16.** 278.)

Manganese nitride, Mn_3N_2.

Sol. in HNO_3 only on heating. HCl+Aq dissolves only in presence of Pt. Aqua regia dissolves slowly. H_2SO_4 acts only when hot and conc. Insol. in acetic acid. (Prelinger, M. 1894, **15.** 398.)
Mn_5N_2. Sol. in NH_4Cl+Aq and NH_4OH+Aq; insol. in HCl; sol. in HNO_3+Aq. with decomp. (Prelinger, M. 1894, **15.** 398.)
Mn_7N_2. Easily attacked by acids and alkalies. (Wedekind, B. 1908, **41.** 3772.)

Manganous oxide, MnO.

Insol. in H_2O. Easily sol. in acids. Readily sol. in NH_4Cl+Aq.

Manganic oxide (Manganese ***sesqui*****oxide),** Mn_2O_3.

Decomp. by boiling with HNO_3+Aq into MnO, which dissolves, and MnO_2, which is insol. (Berthier); also by boiling with dil. H_2SO_4+Aq. (Turner.) Sol. in hot conc. H_2SO_4 or HCl+Aq. Sol. in cold HCl+Aq without decomp. If perfectly pure, is insol. in dil. H_2SO_4+Aq, but if it contains any MnO, it dissolves. (Rose.) Insol. in boiling NH_4Cl+Aq.
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.50 g. Mn_2O_3; containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.37 g. Mn_2O_3; containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.32 g. Mn_2O_3. (Bodenbender, J. B. **1865.** 600.)

Min. *Braunite.*

Colloidal. Solution in H_2O containing 0.21 g. to a litre is precipitated by KNO_3+Aq (1 : 1000); K_2SO_4+Aq (1 : 1100); $(NH_4)_2SO_4$+Aq (1 : 1500); NaCl+Aq (1 : 1580); $MgSO_4$+Aq (1 : 40,983); $BaCl_2$+Aq (1 : 58,823); $MnSO_4$+Aq (1 : 147,929); $(NH_4)_2Al_2(SO_4)_4$+Aq (1 : 362,318); $K_2Cr_2(SO_4)_4$+Aq (1 : 416,668); HCl+Aq (1 : 61,350); $HC_2H_3O_2$ (1 : 17,262); H_2SO_4 (1 : 62,500). (Spring and de Boeck, Bull. Soc. (2) **48.** 170.)

Manganomanganic oxide, Mn_3O_4.

Insol. in H_2O. Boiling dil. or conc. HNO_3+Aq dissolves out MnO (Berthier); also boiling dil. H_2SO_4+Aq. (Turner.) Sol. in hot HCl+Aq. (Otto.) NH_4Cl+Aq dissolves out MnO. (Rose.) Sol. without decomp. in hot very conc. H_3PO_4+Aq, and cold conc. H_2SO_4, HCl, oxalic, and tartaric acids+Aq.

Min. *Hausmannite.*

Manganese *di***oxide,** MnO_2.

Min. *Pyrolusite.* Insol. in H_2O. Very slowly sol. in conc. H_2SO_4 with evolution of O_2. Sol. in cold HCl+Aq; decomp. by hot HCl+Aq. Sol. in aqua regia. Sol. in SO_2+Aq or N_2O_3+Aq. (Karsten.)

Insol. in HNO_3, or dil. H_2SO_4+Aq, except in presence of organic reducing substances. Decomp. by citric acid, and more easily by oxalic acid. (Bolton.)

Sl. sol. in hot conc., but insol. in dil. HNO_3+Aq. (Deville.) When pure it is insol. in cold dil. H_2SO_4+Aq, but if a small quantity of MnO is added much MnO_2 dissolves. (Carius.)

Not decomp. by boiling NH_4Cl+Aq.

Easily sol. in a mixture of nitrososulphuric acid and conc. HCl+Aq. (Bornträger, Rep. anal. Ch. **1887.** 741.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899**, II. 1014.)

Manganese oxides, Mn_3O_5, Mn_6O_{11}, etc.

See **Manganite, manganous.**

Manganese *tri***oxide,** MnO_3.

Deliquescent. Sol. in H_2O, with subsequent decomp. Decomp. by ether. Sol. in conc. H_2SO_4. (Franke, J. pr. (2) **36.** 31.)

Manganese *tetr***oxide,** MnO_4 (?).

Sl. sol. in H_2O with decomp. Decomp. by H_2SO_4 or ether. (Franke, J. pr. (2) **36.** 166.)

Manganese *hept***oxide,** Mn_2O_7.

Very unstable; takes up H_2O from air. Sol. in H_2O with evolution of heat and rapid decomposition. Sol. in conc. H_2SO_4 without decomp. (Aschoff.)

Manganese oxychloride, $3Mn_2O_3$, $MnCl_2$.

Insol. in H_2O. (Saint-Gilles, C. R. **55.** 329.)

$MnCl_2$, MnO (?). (Gorgeu, A. ch. (6) **4.** 515.)

MnO_3Cl. *See* **Manganyl chloride.**

Manganic oxyfluoride, $MnOF_2$.

Sol. in absolute ether.

$MnOF_2$, 2HF = fluoxymanganic acid. (Nicklès, C. R. **659.** 107.)

Manganic oxyfluoride potassium fluoride.

See **Fluoxymanganate, potassium.**

Manganic *sesqui***oxyfluoride potassium fluoride.**

See ***Sesqui*****fluoxymanganate, potassium.**

Manganous oxyiodide, MnI_2, $MnO+6H_2O$.

Sol. in H_2O with decomp. (Kuznetzoff, C. C. **1913**, I. 1659.)

Manganese oxysulphide, MnO, MnS.

Sol. in acids. (Arfvedson, Pogg. **1.** 50.)

Manganese phosphide, Mn_3P_2.

Insol. in dil. acids; sol. in hot conc. HNO_3. (Wedekind, B. 1907, **40.** 1268.)

Sol. in aqua regia; insol. in HNO_3. (Granger, C. R. 1897, **124.** 191.)

Mn_5P_2. HCl+Aq. dissolves out Mn_3P_2 and leaves Mn_7P_2, which is sol. in HNO_3+Aq. (Wöhler and Merkel, A. **86.** 371.)

Not attacked by boiling H_2O or by HCl. Easily sol. in warm HNO_3 or aqua regia. (Wedekind and Veit, B. 1907, **40.** 1268.)

xMn_3P_2, yMn_4P_2. Easily sol. in aqua regia; partly sol. in H_2SO_4 or HCl+Aq. (Struve, J. pr. **79.** 321.)

Mn_6P_2. Insol. in HCl+Aq. Sol. in HNO_3+Aq. (Schrötter, W. A. B. **1849, 1.** 305.)

Manganous phosphoselenide, MnS, P_2Se.

Insol. in H_2O. Sol. in HCl+Aq or HNO_3+Aq. Insol. in cold, sl. decomp. by hot alkalies+Aq. (Hahn, J. pr. **93.** 436.)

2MnSe, P_2Se_3. Insol. in cold, slowly sol. in hot HCl+Aq. Not decomp. by alkalies.

2MnSe, P_2Se_5. Easily decomp. by acids. (Hahn.)

Manganese selenide, MnSe.

Decomp. by H_2O and min. acids. (Wedekind, B. 1911, **44.** 2667.)

Cryst. Sl. decomp. by H_2O at 100°; easily sol. in dil. acids. (Fonzes-Diacon, C. R. 1900, **130.** 1025.)

Manganese silicide.

Sol. in HF; only very sl. sol. in other acids. (Warren, C. N. 1898, **78.** 319.)

Mg_5Si_2. Sol. in HCl+Aq with evolution of SiH_4. (Wöhler, A. **106.** 54.)

Mn_2Si. Insol. in H_2O. (Vigouroux, C. R. 1895, **121.** 772.)

Easily sol. in HF. (Wedekind, B. 1911, **44.** 2668.)

Easily sol. in dil. acids, HF and HNO_3. Insol. in KOH+Aq. (Vigouroux, A. ch. 1897, (7) **12.** 179.)

Easily sol. in HF when heated; in HCl when red hot. Sol. in dil. min. acids with decomp. (Vigouroux, C. R. 1895, **121.** 772.)

Insol. in HNO_3; sol. in dil. or conc. HCl. Slowly decomp. by alkali hydroxides. (Lebeau, C. R. 1903, **136.** 91.)

Mn_2Si. Easily sol. in molten alkali. (Vigouroux, C. R. 1895, **121.** 772.)

MnSi. Slowly attacked by hot conc. HCl. Not acted upon by dil. or conc. HNO_3 or H_2SO_4. (Lebeau, C. R. 1903, **136.** 91.)

$MnSi_2$. Not attacked by HNO_3 or H_2SO_4. Easily sol. in cold HF; decomp. by conc. alkalies+Aq. (Lebeau, C. R. 1903, **136.** 233.)

Manganous sulphide, MnS.

Anhydrous. Insol. in H_2O. Sol. in weak acids, even in acetic acid.

1 l. H_2O dissolves 71.60×10^{-6} moles MnS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Min. *Alabandite.* Sol. in HCl+Aq.

$+\frac{1}{2}H_2O$. *Green.* Decomp. by boiling with H_2O. Sol. in weak acids, as acetic or sulphurous acid. Very sl. sol. in $(NH_4)_2S$+Aq. (Wackenroder.)

Sol. in NH_4 salts+Aq. 100 ccm. of sat. NH_4Cl+Aq at 12° dissolve 0.43 g. MnS. (Clermont and Guyot, C. R. **85.** 37.)

$+{}^3/_2H_2O$. *Flesh-colored.* Less sol. in NH_4 salts, or acetic acid+Aq than the preceding salt. 100 ccm. of sat. NH_4Cl+Aq at 12° dissolve 0.088 g. (Clermont and Guyot.)

Neither green nor flesh-coloured MnS contains H_2O. (Antony and Donnini, Gazz. ch. it. **23.** 560.)

MnS is not pptd. in presence of alkali citrates, tartrates, or grape sugar; cane or milk sugar do not prevent precipitation. (Spiller.) Not pptd. in presence of $Na_4P_2O_7$. (Rose.)

Manganese sulphide, Mn_3S_4.

Decomp. by H_2O. Sol. in cold dil. acids. (Gautier and Hallopeau, C. R. 1889, **108.** 809.)

Manganese *di*sulphide, MnS_2.

(Senarmont, J. pr. **51.** 385.)

Min. *Hauerite.* Decomp. by hot HCl+Aq with separation of S.

Manganous phosphorus sulphide, MnS, P_2S.

Sol. in HCl+Aq with decomp. (Berzelius, A. **46.** 147.)

Manganous potassium sulphide, 3MnS, K_2S.

Nearly insol. in water, alcohol, or ether. Easily sol. in acids. (Völcker, A. **59.** 35.)

Manganous sodium sulphide, 3MnS, Na_2S.

Insol. in H_2O, alcohol, or ether. Sol. in dil. acids, and SO_2+Aq. (Völcker.)

2MnS, Na_2S. Decomp. by H_2O. (Schneider, Pogg. **151.** 446.)

Manganese telluride, MnTe.

Decomp. by H_2O and min. acids. (Wedekind, B. 1911, **44.** 2667.)

Manganic acid, H_2MnO_4.

Known only in solution, which decomposes rapidly. (Franke, J. pr. (2) **36.** 31.)

Barium manganate, $BaMnO_4$.

Insol. in H_2O; decomp. by acids. (Mitscherlich.)

Didymium manganate, $Di_2(MnO_4)_3$.

Insol. in H_2O. Sol. in H_2SO_4+Aq. (Frerichs and Smith, A. **191.** 331.)

Does not exist. (Cleve, B. **11.** 912.)

Lanthanum manganate, $La_2(MnO_4)_3$.

Ppt. (Frerichs and Smith, A. **191.** 331.)

Does not exist. (Cleve, B. **11.** 912.)

Manganese manganate, Mn_2O_3, MnO_3=$3MnO_2$.

See **Manganese *di*oxide.**

Lead manganate, $PbMnO_4+2H_2O$.

Ppt. (Jolles, C. C. **1888.** 58.)

Potassium manganate, K_2MnO_4.

Sol. in water containing alkalies without decomp., but decomp. by pure H_2O. Can be recrystallised from dil. KOH+Aq.

Solubility in KOH+Aq at t°.

Solvent	t°	Mol. K_2MnO_4 in 1 l. of sat. solution
2-N KOH	0	0.907
	10	1.013
	20	1.140
	30	1.252
	45	1.424
4-N KOH	0	0.554
	17	0.681
	25	0.733
	30	0.772
	40	0.852
	45	0.889
	51	0.938
	60	1.003
	70	1.074
	80	1.143
6-N KOH	0	0.155
	15	0.224
	23	0.261
	30	0.303
	40	0.362
	45	0.388
	60	0.469
	70	0.528
	80	0.587
8-N KOH	0	0.063
	10	0.070
	20	0.078
	30	0.096
	40	0.119
	50	0.142
	60	0.167
	70	0.196
	80	0.222
10-N KOH	0	0.0145
	10	0.0152
	20	0.0160
	30	0.0215
	40	0.0305
	50	0.0462
	63	0.0620
	70	0.0700
	80	0.0830

(Sackur, Z. Elektrochem. 1912, **18.** 724.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Potassium manganate permanganate, K_2MnO_4, $KMnO_4$.

Sol. without decomp. in 20% KOH+Aq. (Gorgeu, A. ch. (3) **61.** 355.)

Sodium manganate, $Na_2MnO_4+10H_2O$.

Sol. in H_2O, with partial decomp. (Gentele, J. pr. **82.** 58.)

Strontium manganate, $SrMnO_4$.

Insol. in H_2O. (Fromherz.)

***Per*manganic acid.**

See **Permanganic acid.**

Manganicyanhydric acid, $H_3Mn(CN)_6$.

Not known in the free state.

Barium manganicyanide, $Ba_3[Mn(CN)_6]_2$.

Sol. in H_2O. (Fittig and Eaton.)

Barium potassium manganicyanide barium cyanide, $2KBaMn(CN)_6$, $3Ba(CN)_2+8H_2O$

Decomp. by H_2O. (Lehmann, Dissert. **1898.**)

Calcium manganicyanide, $Ca_3[Mn(CN)_6]_2$.

Sol. in H_2O. (Fittig and Eaton.)

Potassium manganicyanide, $K_3Mn(CN)_6$.

Sol. in H_2O. (Christensen, J. pr. (2) **31.** 163.)

Sodium manganicyanide, $Na_3Mn(CN)_6+2H_2O$.

Sol. in H_2O. (Fittig and Eaton.)

Manganimanganic acid.

Barium manganimanganate, $Ba_3Mn_2O_8+H_2O$.

Insol. in H_2O. Identical with Rosenstiehl's "basic barium manganate," (J. Pharm. 1864, **46.** 344). (Auger and Billy, C. R. 1904, **138.** 501.)

Lithium manganimanganate, $Li_6Mn_2O_8+H_2O$.

Insol. in H_2O. (Auger and Billy.)

Manganiperiodic acid, H_2O, Mn_2O_3, I_2O_7.

Wholly insol. in H_2O, in hot dil. or conc. HNO_3 and in hot dil. H_2SO_4. (Price, Am. Ch. J. 1903, **30.** 182.)

Potassium manganiperiodate, K_2O, Mn_2O_3, I_2O_7.

Apparently entirely insol. and unchanged when boiled with H_2O, dil. or conc. HNO_3, or dil. H_2SO_4. (Price.)

Sodium manganiperiodate, Na_2O, Mn_2O_3, I_2O_7.

Apparently insol. and unchanged when treated with boiling H_2O, boiling dil. or conc. HNO_3 and boiling dil. H_2SO_4. (Price.)

Manganocyanhydric acid, $H_4Mn(CN)_6$.

Most easily decomp. Sl. sol. in alcohol. Insol. in ether. (Descamps, A. ch. (5) **24.** 185.)

Ammonium cuprous manganocyanide, $(NH_4)_2Cu_2Mn(CN)_6$.

Sol. in H_2O; decomp. by acids and alkalies; very unstable. (Straus, Z. anorg. 1895, **9.** 14.)

Ammonium manganous manganocyanide, $NH_4CN, Mn(CN)_2 = (NH_4)_2MnMn(CN)_6$.

Sol. in NH_4CN+Aq. (Fittig and Eaton, A. **145.** 157.)

Barium manganocyanide, $Ba_2Mn(CN)_6$.

Sol. in cold H_2O. (Fittig and Eaton.)

Calcium manganocyanide, $Ca_2Mn(CN)_6$.

Very deliquescent. Sol. in H_2O; insol. in alcohol. (Fittig and Eaton.)

Cuprous potassium manganocyanide, $Cu_2K_2Mn(CN)_6$.

Sol. in H_2O with sl. decomp. Easily decomp. by acids and alkalies. (Straus, Z. anorg. 1895, **9.** 12.)

Cuprous sodium manganocyanide, $Cu_2Na_2Mn(CN)_6$.

Sol. in H_2O with only sl. decomp. Partially decomp. by acids. (Straus.)

Manganous potassium manganocyanide, $KCN, Mn(CN)_2 = K_2MnMn(CN)_6$.

Ppt. Sol. in KCN+Aq.

Potassium manganocyanide, $K_4Mn(CN)_6 + 3H_2O$.

Very efflorescent. Sol. in H_2O; decomp. by boiling.

Potassium manganocyanide chloride, $K_4Mn(CN)_6$, KCl.

Easily sol. in H_2O. (Descamps.)

Sodium manganocyanide, $Na_4Mn(CN)_6 + 8H_2O$.

Very efflorescent. Easily sol. in H_2O. (Fittig and Eaton.)

Strontium manganocyanide, $Sr_2Mn(CN)_6$.

As the Ba comp. (Descamps.)

*Per*manganomolybdic acid.

See **Permanganomolybdic acid.**

*Per*manganotungstic acid.

See **Permanganotungstic acid.**

Manganosulphuric acid.

See **Sulphate, manganic.**

Manganous acid, $H_2MnO_3 = MnO_2, H_2O$.

Insol. in H_2O. (Franke, J. pr. (2) **36.** 451.)

$2MnO_2, H_2O$ (?). Min. *Wad.*

Barium manganite, $BaO, 5MnO_2$.

Sl. sol. in HCl+Aq, less sol. in HNO_3+Aq. (Rissler, Bull. Soc. (2) **30.** 111.)

$BaO, 7MnO_2$. (Rousseau, C. R. **104.** 786.)

$BaO, 2MnO_2$. Insol. in H_2O.

BaO, MnO_2. Insol. in H_2O. (Rousseau, C. R. **102.** 425.)

$Ba(H_3Mn_4O_{10})_2$. (Morawski and Stingl, J. pr. (2) **18.** 92.)

Calcium manganite, $CaO, 5MnO_2$.

Easily sol. in HCl+Aq, less in HNO_3+Aq. (Rissler.)

$3CaO, MnO_2$ (?). Decomp. by H_2O. Sol. in HCl+Aq with evolution of Cl. Scarcely sol. in cold HNO_3, but sol. on heating. (Dufau, A. ch. 1897, (7) **12.** 275.)

$2CaO, MnO_2$. Sol. in dil. min. acids. (Rousseau, C. R. **116.** 1060.)

$CaO, 2MnO_2$. (Rousseau, C. R. **102.** 425.)

$CaO, 3MnO_2$.

CaO, MnO_2. Sol. in fuming HCl+Aq, but not in dil. HNO_3+Aq. (Rousseau, C. R. **116.** 1060.)

Chromium manganite, $Cr_2O_3, 3MnO_2 = Cr_2(MnO_3)_3$.

Slowly decomp. by acids. (Gröger, Z. anorg. 1905, **44.** 458.)

Cobaltous manganite, $CoO, MnO_2 + 2H_2O$.

Ppt. (Salinger, Z. anorg. 1903, **33.** 352.)

$+4H_2O$. Ppt. (Salinger.)

Cobalt copper manganite, $CoO, CuO, 2MnO_2 + 4H_2O$.

Min. *Asbolite.* Sol. in HCl+Aq, with evolution of Cl.

Cupric manganite, $CuO, 4MnO_2$.

(Gorgeu, Bull. Soc. 1903, (3) **29.** 1167.)

$CuO, 8MnO_2 + 3H_2O$. (Baubigny, C. R. 1897, **124.** 955.)

Cupric manganous manganite, $4CuO, MnO, 7MnO_2 + 8H_2O$.

Ppt. (Salinger, Dissert. 1902.)

$Mn_2O_3, 3CuO$. Sol. in HCl+Aq. (Schneider, Am. Ch. J. **9.** 269.)

Lead manganite, $PbO, 5MnO_2$.

Not attacked by conc. acids; sol. in aqua regia. (Rissler.)

Magnesium manganite, $2MgO, MnO_2$.

(Lemoine, Ann. Min. (7) **3.** 5.)

$+xH_2O$. (Vollard.)

Manganous manganite, $Mn_3O_5 = MnO, 2MnO_2$.

(Reissig, A. **103.** 27.)

$Mn_6O_{11} = MnO, 5MnO_2$. (Veley, Chem. Soc. **38.** 581.)

$3MnO_2$, $2MnO$. Decomp. by dil. H_2SO_4+Aq. (Franke, J. pr. (2) **36.** 166.)
$3MnO_2$, $MnO+H_2O$. Min. *Varvicite.*

Manganous zinc manganite, MnO, ZnO, MnO_2.
(Gorgeu, Bull. Soc. 1903, (3) **29.** 1168.)
$2MnO$, ZnO, $2MnO_2$. (Gorgeu.)

Potassium manganite, K_2O, $2MnO_2$.
Insol. in H_2O.
K_2O, $5MnO_2$.
K_2O, $7MnO_2+3H_2O$.
K_2O, $8MnO_2+3H_2O=KH_3Mn_4O_{10}$. (Morawski and Stingl, J. pr. (2) **18.** 91.)
Does not exist. (Wright and Menke, Chem. Soc. **37.** 22.)
K_2O, $10MnO_2$.
K_2O, $16MnO_2+6H_2O$. Sol. in conc. HCl+Aq. (Rousseau, C. R. **114.** 72.)

Silver manganite, $AgH_3Mn_4O_{10}$.
(Morawski and Stingl, J. pr. (2) **18.** 92.)
Ag_2MnO_3. Ppt. (Gorgeu, C. R. **110.** 958.)

Silver (argentous) manganite, Ag_4O, Mn_2O_3 (?).
Insol. in cold dil. HNO_3+Aq, and separates Mn_2O_3 on warming. Insol. in NH_4OH+Aq. (Rose, Pogg. **101.** 229.)

Silver (argentoargentic) manganite, Ag_4O, $2Ag_2O$, Mn_2O_3 (?).
(Rose.)

Sodium manganite, Na_2O, $5MnO_2$.
Insol. in H_2O. (Rousseau, C. R. **103.** 261.)
Na_2O, $12MnO_2$. Insol. in H_2O. (Rousseau.)
$+4H_2O$. (Rousseau, C. R. **112.** 525.)
Na_2O, $8MnO_2+5H_2O$. (Rousseau.)
Na_2O, $16MnO_2+8H_2O$. (Rousseau.)

Strontium manganite, MnO_2, SrO.
Insol. in H_2O.
$2MnO_2$, SrO. Insol. in H_2O. (Rousseau, C. R. **101.** 167.)
MnO_2, $5SrO$. Sol. in HCl, or HNO_3+Aq. (Rissler, Bull. Soc. (2) **30.** 110.)

Zinc manganite, ZnO, $5MnO_2$.
Insol. in H_2O. (Rissler.)
ZnO, $4MnO_2$. (Gorgeu, Bull. Soc. 1903, (3) **29.** 1168.)
$3ZnO$, $MnO_2+7\frac{1}{2}H_2O$. (Salinger, Dissert. **1902.**)
$27ZnO$, $2MnO_2+25H_2O$. Insol. in H_2O. (Salinger.)

Manganyl chloride, MnO_3Cl.
Decomp. by H_2O. (Aschoff, J. pr. **81.** 29.)

Melanocobaltic chloride, $Co_2(NH_3)_6Cl_4NH_2Cl$, or, $Co_2(NH_3)_6Cl_5NH_2$.
Very sl. sol. in cold H_2O or very dil. HCl+Aq. Decomp. by long standing or warming. Cold conc. HCl or dil. H_2SO_4+Aq does not attack, but decomp. on warming. HNO_3+Aq decomp. on warming. Sol. in cold H_2SO_4 or NH_4OH+Aq; from both solutions it can be precipitated by HCl+Aq. (Vortmann, B. **10.** 1455.)

—— **chloroplatinate,** $Co_2(NH_3)_6NH_2Cl_5$, $PtCl_4$.
Ppt. (Vortmann, B. **15.** 1902.)
$Co_2(NH_3)_6NH_2Cl_3(OH)_2$, $PtCl_4$. Ppt. (Vortmann.)

—— **mercuric chloride,** $Co_2(NH_3)_6(NH_2)Cl_3(OH)_2$, $3HgCl_2+H_2O$.
Ppt. Difficultly sol. in cold H_2O, quite easily in warm H_2O acidified with HCl. (Vortmann.)

—— **chloride chromate,** $Co_2(NH_3)_6NH_2Cl_3Cr_2O_7+H_2O$.
Sol. in hot H_2O. (Vortmann.)

Mercurammonium comps.
See **Mercury ammonium comps.**

Mercuriammonium bromide, $Hg(NH_2)Br$.
See **Dimercuriammonium ammonium bromide.**

Mercuriammonium chloride, $Hg(NH_2)Cl$.
See ***Di*mercuriammonium ammonium chloride.**

Mercuriammonium oxy*di*mercuriammonium chloride, $4Hg(NH_2)Cl$, $NH_2(HgOHg)Cl$.
(Millon.)
Correct composition is *Di*mercuriammonium ammonium chloride, NHg_2Cl, NH_4Cl, which see. (Balestra, Gazz. ch. it. **21, 2.** 294.)
$Hg(NH_2)Cl$, $2NH_2(HgOHg)Cl$. (Millon.)
Correct composition is *Di*mercuriammonium mercuric chloride, $2NHg_2Cl$, $HgCl_2$+H_2O, or *Di*mercuriammonium hydrogen chloride, NHg_2Cl, HCl. (Balestra.)

Mercuriammonium nitrate, $2NH_3$, $2HgO$, $N_2O_5=NH_2HgNO_3+\frac{1}{2}H_2O$.
Easily decomp. by HCl, or alkali sulphides+Aq. Sl. sol. in HNO+Aq. Insol. in H_2SO_4, NH_4OH, or KOH+Aq. (Mitscherlich.)
Is *di*mercuriammonium ammonium nitrate, NHg_2NO_3, $NH_4NO_3+H_2O$. (Pesci, Gazz. ch. it. **20.** 485.)

Mercuriammonium oxy*di*mercuriammonium nitrate, $3HgO, 2NH_3, N_2O_5 = NH_2HgNO_3(NHg_2OH_2)NO_3+H_2O$.

Decomp. by boiling with H_2O, which dissolves out NH_4NO_3. Sol. in NH_4NO_3+Aq containing NH_4OH. (Mitscherlich.)

Is *di*mercuriammonium ammonium nitrate, $3NHg_2NO_3$, $NH_4NO_3+2H_2O$. (Pesci, Gazz. ch. it. **20.** 485.)

Mercuriammonium oxy*di*mercuriammonium sulphate, $(NH_2Hg)_2SO_4$, $3(NHg_2OH_2)_2SO_4$.

Boiling H_2O dissolves out H_2SO_4. Gradually decomp. by boiling KOH+Aq. Completely sol. in NH_4Cl+Aq. Sol. in conc. or dil. HCl, or very dil. H_2SO_4+Aq. Insol. in conc. or dil. HNO_3+Aq or conc. H_2SO_4. (Schneider.)

Correct formula is $7(NHg_2)_2SO_4$, $(NH_4)_2SO_4+12H_2O$, *di*mercuriammonium ammonium sulphate. (Pesci, Gazz. ch. it. **20.** 485.)

Mercuri*di*ammonium chloride (fusible white precipitate), $Hg(NH_3)_2Cl_2$.

Is *di*mercuriammonium ammonium chloride, Hg_2NCl, $3NH_4Cl$, which see. (Rammelsberg J. pr. **38.** 558.)

Mercuri*di*ammonium mercuric chloride, $Hg(NH_3)_2Cl_2$, $HgCl_2$.

Insol. in H_2O, but gradually decomp. by boiling therewith. (Rose, Pogg. **20.** 158.)

Partly sol. in H_2O. (Kane.)

Mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$.

H_2O extracts all the NH_3. Partly sol. in little alcohol. Partly sol. in ether without decomp. (Nessler.)

Correct composition is *di*mercuriammonium ammonium iodide, NHg_2I, $3NH_4I$. (Pesci, Gazz. ch. it. **20.** 485.)

Mercuri*di*ammonium cupric iodide, $4NH_3$, CuI_2, HgI_2.

Decomp. by H_2O. Sol. in alcohol+ $HC_2H_3O_2$. (Jörgensen, J. pr. (2) **2.** 347.)

$2Hg(NH_3)_2I_2$. CuI_2. (Decomp. by H_2O. (Jörgensen.)

Mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$.

Decomp. by H_2O. Partly sol. in a little alcohol. Partly sol. in ether. (Nessler.)

Correct composition is *di*mercuriammonium ammonium iodide, NHg_2I, $3NH_4I$. (Pesci.)

Mercuridiammonium mercuric iodide, $Hg(NH_3)_2$, HgI_2, or NH_3, HgI_2.

Decomp. by H_2O or dil. acids. (Caillot and Corriol, J. Pharm. **9.** 381.)

Correct composition is *di*mercuriammonium ammonium mercuric iodide, $3NHg_2I$, $8NH_4I$, $4HgI_2$. (Pesci, Gazz. ch. it. **20.** 485.)

Mercuri*di*ammonium sulphate, $Hg(NH_3)_2SO_4$.

Decomp. with H_2O.

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

$+H_2O$. Decomp. by H_2O. Easily sol. in HCl, very dil. H_2SO_4+Aq, or HNO_3+Aq. Insol. in conc. HNO_3+Aq. Sol. in $(NH_4)_2SO_4$+Aq or NH_4Cl+Aq. Decomp. by KOH+Aq. (Schneider, J. pr. **75.** 136.)

Correct composition is $(NHg_2)_2SO_4$, $3(NH_4)_2SO_4+12H_2O$, *di*mercuriammonium ammonium sulphate. (Pesci.)

***Di*mercuriammonium acetate,** $NHg_2C_2H_3O_2$.

Insol. in H_2O or alcohol. Sol. in HCl or $NH_4C_2H_3O_2$+Aq. (Balestra, Gazz. ch. it. **22, 2.** 563.)

***Di*mercuriammonium ammonium acetate,** $NHg_2C_2H_3O_2$, $3NH_4C_2H_3O_2+H_2O$.

Deliquescent; sol. in a little H_2O without decomp., but decomp. into $NHg_2C_2H_3O_2$ and $NH_4C_2H_3O_2$ by excess of H_2O. (Balestra.)

—— **arsenate,** $NHg_2H_2AsO_4$.

(Hirzel, Zeit. Pharm. **1853.** 3.)

——**bromate,** $NHg_2BrO_3+1\frac{1}{2}H_2O$.

Ppt. (Rammelsberg, Pogg. **55.** 82.)

Is oxy*di*mercuriammonium bromate, $(NH_2Hg_2O)BrO_3$.

—— **bromide,** NHg_2Br.

Insol. in H_2O or HNO_3. Sol. in HCl+Aq. (Pesci, Gazz. ch. it. **19.** 509.)

Sol. in KI, or $Na_2S_2O_3$+Aq with evolution of NH_3. (Balestra, Gazz. ch. it. **22, 2. 558.**)

Sol. in ammoniacal solutions of ammonium salts and in aq. acids. (Franklin, J. Am. Chem. Soc. 1905, **27.** 839.)

—— **ammonium bromide,** NHg_2Br, NH_4Br.

Decomp. by H_2O. (Pesci, Gazz. ch. it. **19.** 511.)

$4NHg_2Br$, $5NH_4Br$. Decomp. by H_2O. Insol. in $(NH_4)_2CO_3$+Aq. Sol. in conc. or dil. HCl+Aq. Insol. in HNO_3+Aq. (Pesci.)

NHg_2Br, $3NH_4Br$. Decomp. by H_2O. Easily sol. in HCl+Aq. Insol. in alcohol. (Pesci.)

Sol. in NH_4Br, NH_4Cl, or NH_4I+Aq; sol. in KI, or $Na_2S_2O_3$+Aq.

—— **mercuric bromide,** $2NHg_2Br$, $HgBr_2$.

Ppt. Sol. in HBr and in HCl. (Ray, Chem. Soc. 1902, **81.** 649.)

—— **carbonate,** $(NHg_2)_2CO_3+2H_2O$.

Ppt. Not decomp. by KOH+Aq, but easily by K_2S, or KI+Aq. (Rammelsberg, J. pr. (2) **38.** 567.)

*Di*mercuriammonium chloride, NHg_2Cl.

Not attacked by boiling H_2O. Sl. attacked by cold dil. HCl+Aq, but is gradually dissolved thereby. Decomp. by hot KOH+Aq. (Weyl.)

Sol. in KI, or $Na_2S_2O_3$+Aq with evolution of NH_3.

$+H_2O$. Nearly insol. in H_2O; easily sol. in HNO_3, and HCl+Aq. Not decomp. by KOH+Aq. Decomp. by KCl, NaCl, or KI+Aq. (Rammelsberg, Pogg. **48.** 181.)

—— **hydrogen chloride,** NHg_2Cl, 2HCl.

Correct composition of mercuric chloramide chloride. (Balestra, Gazz. ch. it. **21, 2.** 299.)

Decomp. by H_2O.

NHg_2Cl, HCl. Decomp. by H_2O. (Balestra, *l. c.*)

NHg_2Cl, 4HCl. Sol. in H_2O. (Rây, Proc. Chem. Soc. 1901, **17.** 96.)

—— **ammonium chloride,** NHg_2Cl, NH_4Cl. **(Infusible white precipitate.)**

Correct composition of what has been called mercuric chloramide, $Hg(NH_2)Cl$. (Rammelsberg, J. pr. **38.** 558.)

Insol. in cold, decomp. by hot H_2O. (Millon, A. ch. (3) **18.** 413.) Sol. in 600 pts. H_2O. (Wittstein.) Sol. in 719.98 pts. H_2O at 18.75°. (Abl.) Insol. in alcohol.

Sol. in acids, even in $HC_2H_3O_2$+Aq, also in NH_4NO_3, $(NH_4)_2SO_4$, and $NH_4C_2H_3O_2$+Aq. (Pelouze and Fremy.)

Sol. in warm NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sl. sol. in alkali chlorides+Aq, which partially decomp. (Miahle, A. ch. (3) **5.** 180.)

Decomp. by KOH+Aq. Sol. in KI, or $Na_2S_2O_3$+Aq, with evolution of NH_3. (Balestra.)

When freshly prepared is sol. in conc, NH_4OH+Aq. (Saha and Choudhuri, Z. anorg. 1910, **67.** 359.)

Sol. in excess of $(NH_4)_2HPO_4$+Aq. Insol. in excess of Na_2HPO_4+Aq. (Carnegie and Burt, C. N. 1897, **76.** 175.)

Insol. in excess of NH_4OH+Aq. (Carnegie and Burt.)

NHg_2Cl, $3NH_4Cl$ **(Fusible white precipitate).**

Correct composition of what has been called mercuri*di*ammonium chloride, $Hg(NH_3)_2Cl_2$. (Rammelsberg, J. pr. (2) **38.** 558.)

Decomp. by hot H_2O. Sol. in acids, even $HC_2H_3O_2$+Aq. Not decomp. by cold, but by boiling KOH+Aq. (Weyl.)

Sol. in warm, less in cold NH_4OH+Aq. (Mitscherlich.)

Sol. in KI, or $Na_2S_2O_3$+Aq, with evolution of NH_3. (Balestra.)

Sol. in 10% HNO_3, H_2SO_4 and acetic acid. (Hofmann and Marburg, A. 1899, **305.** 198.)

*Di*mercuriammonium mercuric chloride, $2NHg_2Cl$, $HgCl_2$.

Insol. in, and not decomp. by boiling H_2O, alkalies, conc. HNO_3, or dil. H_2SO_4+Aq. Sol. in boiling HCl+Aq. (Mitscherlich, J. pr **19.** 453.)

Sl. decomp. by H_2O, readily by KOH+Aq. (Gaudechon, A. ch. 1911, (8) **22.** 212.)

Ppt. Sol. in HBr. (Rây, Proc. Chem. Soc. 1902, **18.** 86.)

—— **chloride ammonia,** NHg_2Cl, $\frac{1}{2}NH_3$.

Decomp. by water and by NH_4OH+Aq. (Gaudechon, A. ch. 1911, (8) **22.** 212.)

—— **chromate.**

See **Oxy*di*mercuriammonium chromate.**

—— **hydroxide,** NHg_2OH.

Takes up H_2O to form NHg_2OH+H_2O or $(NHg_2OH_2)OH$, oxy*di*mercuriammonium hydroxide, which also see.

Sol. in warm HCl or HNO_3+Aq.

—— **iodate,** NHg_2IO_3, $2NH_4IO_3$.

Insol. in HNO_3. (Rammelsberg, J. pr. (2) **38.** 568.)

—— **iodide,** NHg_2I.

Insol. in H_2O. Sol. in HCl+Aq. Decomp. by boiling with KOH+Aq or KCl+Aq. (Weyl, Pogg. **121.** 601.) Decomp. by hot KI, or $Na_2S_2O_3$+Aq. (Balestra.)

Decomp. by dilute HCl. Sol. in ammonium salts+Aq. (Franklin, Z. anorg. 1905, **46.** 21.)

$+H_2O$. *See* **Oxy*di*mercuriammonium iodide.**

—— **ammonium iodide,** NHg_2I, $3NH_4I$.

Correct composition of mercuri*di*ammonium iodide, $Hg(NH_3)_2I_2$. (Pesci, Gazz. ch. it. **20.** 485.)

$3NHg_2I$, $8NH_4I$, $4HgI_2$. Correct formula for mercuri*di*ammonium mercuric iodide, $Hg(NH_3)_2I_2$, HgI_2. (Pesci.)

—— **nitrate,** NHg_2NO_3.

Insol. in H_2O. (Rammelsberg, J. pr. (2) **38.** 566.)

Sol. in KI, or $Na_2S_2O_3$+Aq, with evolution of NH_3. (Balestra, Gazz. ch. it. **22, 2.** 560.)

$+H_2O$. (Hofmann and Marburg, A. 1899, **305.** 212.)

Sl. sol. in HNO_3. (Ray, Z. anorg. 1902, **33.** 209.)

—— **ammonium nitrate,** NHg_2NO_3, NH_4NO_3 $+H_2O$.

Correct formula for mercuriammonium nitrate, $NH_2HgNO_3+\frac{1}{2}H_2O$. (Pesci, Gazz. ch. it. **20.** 485.)

NHg_2NO_3, $2NH_4NO_3+2H_2O$. Correct for-

mula for oxy*di*mercuriammonium ammonium nitrate, $(NHg_2OH_2)NO_3$, $2NH_4NO_3+H_2O$. (Pesci.)

NHg_2NO_3, $3NH_4NO_3$. Decomp. by cold H_2O; sol. in NH_4OH+Aq. (Pesci.)

$3NHg_2NO_3$, $NH_4NO_3+2H_2O$. Correct formula for mercuriammonium oxy*di*mercuriammonium nitrate, NH_2HgNO_3, $(NHg_2OH_2)NO_3$ $+H_2O$. (Pesci.)

***Di*mercuriammonium nitrite,** NHg_2NO_2.

Readily sol. in warm HCl or HBr. (Rây, Chem. Soc. 1902, **81.** 648.)

$+\frac{1}{2}H_2O$. Ppt. Sol. in HCl. (Rây, Proc. Chem. Soc. 1902, **18.** 85.)

$+H_2O$. (Hofmann and Marburg, A. 1899, **305.** 214.)

—— **oxide,** $(NHg_2)_2O$.

Slowly decomp. by H_2O. Sol. in HCl, or HNO_3+Aq. Decomp. by hot KOH, or KCl +Aq. (Weyl, Pogg. **121.** 601.)

Sol. in KCN+Aq by heating 4–5 hours at 130°. Not completely sol. in HCl owing to formation of Hg_2Cl_2. (Gaudechon, C. R. 1907, **144.** 1419.)

—— **phosphate,** $(NHg_2)_2PO_4$, $2NHg_2OH+10H_2O$.

(Rammelsberg, J. pr. (2) **38.** 567.)

See **Oxy*di*mercuriammonium phosphate.**

—— **ammonium salicylate,** $2NHg_2C_6H_4OHCO_2$, $5NH_4C_6H_4OHCO_2$.

Decomp. by H_2O. Sol. in $NH_4C_2H_3O_2$, HCl, or KI+Aq. (Balestra.)

—— **selenate,** $(NHg)_2SeO_4+2H_2O$.

Ppt. Insol. in H_2O; sol. in NH_4OH+Aq. (Cameron and Davy, C. N. **44.** 63.)

—— **sulphate,** $(NHg_2)_2SO_4+2H_2O$.

Insol. in H_2O. Easily sol. in HCl+Aq. (Rammelsberg, J. pr. (2) **38.** 565.) Sol. (Kane), insol. (Hirzel) in HNO_3+Aq.

Sol. in KI, or $Na_2S_2O_3$+Aq with evolution of NH_3. (Balestra.)

$+H_2O$. Insol. in H_2O; sol. in HCl. (Rây, Chem. Soc. 1905, **87.** 9.)

—— **ammonium sulphate,** $(NHg_2)_2SO_4$, $3(NH_4)_2SO_4+4H_2O$.

Correct formula for mercuri*di*ammonium sulphate, $2NH_3$, HgO, SO_3+H_2O. (Pesci, Gazz. ch. it. **20.** 485.)

$5(NHg_2)_2SO_4$, $14(NH_4)_2SO_4+16H_2O$. (Pesci.)

$7(NHg_2)_2SO_4$, $(NH_4)_2SO_4+12H_2O$. Correct formula for mercuriammonium oxy*di*mercuriammonium sulphate, $(NHg_2H_2)_2SO_4$, $3(NHg_2OH_2)_2SO_4$. (Pesci.)

***Di*mercuriammonium tartrate,** $(NHg_2)_2C_4H_4O_6+2\frac{1}{2}H_2O$.

Insol. in H_2O. Sol. in HCl, KI, $Na_2S_2O_3$, $NH_4C_2H_3O_2$, or $(NH_4)_2C_4H_4O_6$+Aq. (Balestra, Gazz. ch. it. **22, 2.** 563.)

—— **ammonium tartrate,** $2(NHg_2)_2C_4H_4O_6$, $(NH_4)_2C_4H_4O_6+H_2O$.

As above. (B.)

***Tri*mercuriammonium sulphate,** $(NHg_2)(NHgH_2)SO_4+2H_2O$.

Decomp. by H_2O. (Millon.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

***Di*mercuriarsonium mercuric chloride,** $AsHg_3Cl_3 = AsHg_2Cl$, $HgCl_2$.

Decomp. by H_2O. Decomp. by warm HNO_3+Aq. (Rose, Pogg. **51.** 423.)

Mercurimidosulphonic acid, $(HO_3S)_4N_2Hg$.

Very unstable. (Berglund, B. **9.** 256.)

Barium mercurimidosulphonate, $Ba_2(SO_3)_4N_2Hg+5H_2O$.

(Berglund, B. **9.** 256.)

Cadmium ——, $Cd_2HgN_2(SO_3)_4+12H_2O$.

Unstable; sl. sol. in H_2O. (Berglund, Bull. Soc. (2) **25.** 452.)

Cobalt ——, $Co_2HgN_2(SO_3)_4+15H_2O$.

Sol. in H_2O. (B.)

Copper ——, $Cu_2HgN_2(SO_3)_4+15H_2O$.

Very sol. in H_2O. (B.)

Magnesium ——, $Mg_2HgN_2(SO_3)_4+15H_2O$.

Very sol. in H_2O. (B.)

Manganous ——, $Mn_2HgN_2(SO_3)_4+10H_2O$.

Unstable. (B.)

Mercuric ——, $(Hg_2O)_2HgN_2(SO_3)_4$.

Nearly insol. in H_2O. (B.)

Nickel ——, $Ni_2HgN_2(SO_3)_4+15H_2O$.

(B.)

Potassium ——, $(KO_3S)_4N_2Hg+4H_2O$.

Precipitate. (Raschig, A. **241.** 161.)

Potassium silver ——, $(AgSO_3)_2(KSO_3)_2HgN_2$ $+3H_2O$.

Sl. sol. in H_2O. (Berglund.)

Sodium ——, $(NaSO_3)_4HgN_2+5H_2O$.

More sol. in H_2O than K salt. (Berglund.)

Strontium ——, $Sr_2(SO_3)_4HgN_2+15H_2O$.

More sol. than Ba salt. (B.)

Zinc mercurimidosulphonate, $Zn_2(SO_3)_4HgN_2+15H_2O$.

Very sol. in H_2O. (B.)

_Di_mercuriphosphonium mercuric bromide, $2PHg_2Br, HgBr_2$.

(Lemoult, C. R. 1907, **145.** 1176.)

_Di_mercuriphosphonium mercuric chloride, $HgCl_2, PHg_2Cl$.

(Lemoult, C. R. 1907, **145.** 1176.)

$+1\frac{1}{2}H_2O$. Decomp. by hot, slowly by cold H_2O into Hg, HCl, and H_3PO_3. Decomp. by acids or alkalies. (Rose, Pogg. **40.** 75.)

_Di_mercuriphosphonium mercuric iodide, HgI_2, PHg_2I.

Slowly decomp. by cold or warm H_2O, quickly by MOH+Aq . Not attacked by HCl or H_2SO_4+Aq. Rapidly attacked by HNO_3 and aqua regia. (Lemoult, C. R. 1904, **139.** 479.)

_Di_mercuriphosphonium mercuric nitrate, $P_2Hg_3, 6HgO, 3N_2O_5=2[PHg_2NO_3, Hg(NO_3)_2], 3HgO$.

(Rose, Pogg. **40.** 75.)

Dimercuriphosphonium mercuric sulphate, $P_2Hg_3, 6HgO, 4SO_3+4H_2O=(PHg_2)_2SO_4, 3HgSO_4, 2HgO+4H_2O$.

Sol. in aqua regia. (Rose, Pogg. **40.** 75.)

Mercuric acid.

Calcium mercurate (?).

(Berthollet, A. ch. **1.** 61.)

Potassium mercurate, $K_2O, 2HgO$.

Gradually decomp. by H_2O; less rapidly by absolute alcohol. (St. Meunier, C. R. **60.** 557.)

Sodium mercurate, Na_2O, HgO.

(Bettekoff, Bull. Soc. (2) **34.** 328.)

Mercuroammonium chloride, $Hg(NH_3)Cl$.

(Rose, Pogg. **20.** 158.)

Mixture of Hg, $HgNH_2Cl$, and NH_4Cl. (Barfoed, J. pr. (2) **39.** 201.)

—— **nitrate,** $(NHg_2H_2)NO_3$, "*Hahnemann's soluble mercury.*"

Sol. in hot HCl, and $HC_2H_3O_2$+Aq. Decomp. by NH_4OH+Aq, or NH_4 salts+Aq. Probably mixture of mercurous salts and Hg.

Mercuro*di*ammonium chloride, $Hg_2(NH_3)_2Cl_2$.

Easily decomp. (Rose, Pogg. **20.** 158.)

Mixture of Hg, NH_2HgCl, and NH_4Cl. (Barfoed, J. pr. (2) **39.** 201.)

Mercuro*di*ammonium fluoride, $Hg_2(NH_3)_2F_2$ (?).

Decomp. by H_2O. (Finkener, Pogg. **110.** 147.)

Mercurosulphonic acid.

Mercurosulphonates, $Hg(SO_3M)_2$.

Correct composition for the double sulphites, $HgSO_3, M_2SO_3$. (Divers and Shimidzu, Chem. Soc. **49.** 583; Barth, Z. phys. Ch. **9.** 195.)

Mercuroxy-comps.

See **Oxymercur- comps.**

Mercury, Hg.

Not attacked by H_2O. Not attacked by boiling conc. HCl or dil. H_2SO_4+Aq. Easily sol. in dil. or conc. HNO_3+Aq; also in HBr or HI+Aq.

Not attacked by pure HNO_3 unless heated, but readily attacked by cold dil. HNO_3+Aq containing NO. (Millon.)

Anhydrous H_2SO_4 attacks Hg gradually at ord. temp. (Berthelot, C. R. 1897, **125.** 749.)

H_2SO_4 attacks only when hot and conc. (Ditte, A. ch. 1890, (6) **19.** 68.)

Conc. H_2SO_4 does not attack dry or moist Hg either with or without air. (Pitman, J. Am. Chem. Soc. 1898, **20.** 100.)

H_2SO_4 attacks Hg at 20° if it contains 99.7%; does not attack if it contains only 95.6%. (Baskerville, J. Am. Chem. Soc. 1898, **20.** 515.)

Insol. in H_2SO_3+Aq alone or in presence of HCl or dil. H_2SO_4. (Berthelot, A. ch. 1898, (7) **14.** 198.)

Not attacked by HF+Aq at any temp. (Gay-Lussac.)

HI dissolves Hg rapidly at ord. temp. (Norris and Cottrell, Am. Ch. J. 1896, **18.** 99.)

More rapidly attacked by HBr+Aq than by HCl+Aq. Rapidly acted upon by HI in absence of O. (Bailey, Chem. Soc. 1888, **53.** 760.)

Not attacked by pure HCl+Aq, but in presence of O, $Hg_2OCl_2+H_2O$ is formed. Action is apparently less in sunlight than in the dark. (Bailey, Chem. Soc. 1888, **53.** 759.)

Small amts. of ferric salts hinder action of HNO_3 on Hg, but it is hastened by presence of $Mn(NO_3)_2$ or $NaNO_3$. (Ray, Chem. Soc. 1911, **99.** 1015.)

HNO_3 under 33% does not attack Hg if metal and acid are kept in motion and HNO_2 is absent. (Veley, B. 1895, **28.** 928.)

Rapidly sol. in HClO. (Balard, Dissert. **1834.**)

Alkali chlorides+Aq in presence of air decomp. Hg; action is not increased by heat. (Miahle.)

Insol. in alkali chlorides+Aq in neutral or

alkaline solution. (Bhaduri, Z. anorg. 1897, **13.** 407.)

Very sol. in conc. solution of I in KI+Aq. (Varet, Bull. Soc. 1897, (3) **17.** 451.)

Slowly sol. in KCl or KI+Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, **59.** 136.)

Slowly sol. in Na_2S+Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, **59.** 137.)

Hg is appreciably sol. in the sulpho salts of Mo, W, V, As, Sb and Sn. (Storch, B. 1883, **16.** 2015.)

Persulphates in alkali or neutral solution attack Hg. $(NH_4)_2S_2O_8$ in NH_4OH solution has strongest action. This dissolves Hg by repeated shaking at high temp. (Tarugi, Gazz. ch. it. 1903, **33,** (1) 127.)

Insol. in KCN+Aq. (Elmer, J. pr. 1888, (2) [illegible]42.)

Slowly sol. in KCN+Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, **59.** 136.)

Sol. in considerable quantity in 6% KCN+Aq. (Goyder, C. N. 1894, **69.** 268.)

Most sol. in $K_4Fe(CN)_6$+Aq when KOH is present. (Smith, J. Am. Chem. Soc. 1905, **27.** 544.)

Hg dissolves in Br_2 in the presence of KBr sl. faster than in I_2 but in $CuBr_2$ much more slowly. (Van Name and Edgar, Am. J. Sci. 1910, (4) **29.** 255.)

Not attacked by PCl_3 even at 350°. (Moissan, A. ch. 1885 (6) **6.** 457.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

½ ccm. oleic acid dissolves 0.0075 g. Hg in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Mercurous acetylide, $Hg_2C_2+H_2O$.

(Burkard and Travers, Chem. Soc. 1902, **81.** 1271.)

Mercuric acetylide, basic, $2HgO, 3HgC_2+2H_2O$.

(Burkard and Travers, Chem. Soc. 1902, **81.** 1272.)

Mercuric acetylide, HgC_2.

Very sol. in HCl with evolution of H_2C_2. (Keiser, Am. Ch. J. 1893, **15.** 535.)

$+{}^1/_3H_2O$. Insol. in H_2O, alcohol and ether. Sol. in NH_4 acetate+Aq, and in KCN+Aq. Sl. attacked by cold HCl, easily by hot. Easily sol. in HNO_3. Dil. H_2SO_4 attacks slowly; conc. causes explosion. (Plimpton and Travers, Chem. Soc. 1894, **65.** 267.)

Mercuric acetylide chloride, $HgC_2, HgCl_2+\frac{1}{2}H_2O$.

Not acted upon by dil. HCl. Decomp. by fuming HNO_3 or aqua regia. Insol. in alcohol and ether. (Keiser, Am. Ch. J. 1893, **15.** 538.)

Mercuric acetylide mercuromercuric chloride, $HgC_2, HgCl, HgCl_2+H_2O$.

Insol. in all ordinary solvents. (Biltz and Mumm, B. 1904, **37.** 4420.)

Mercurous amidofluoride, $HgNH_2F$.

Insol. in H_2O, HNO_3 and H_2SO_4. Sol. in dil. HCl.

Probably *di*mercuriammonium ammonium fluoride, NHg_2F, NH_4F. (Böhm, Z. anorg. 1904, **43.** 327.)

Mercury ammonium comps.

See—

Mercuroammonium comps., NH_3HgR.

*Di***mercuroammonium comps.,** NH_2Hg_2R.

Mercurous chloramide, $Hg(NH_2)Cl$.

*Di***mercuriammonium comps.,** $NHgR$.

Mercuric chlor-, brom-, etc., amide, $Hg(NH_2)R$.

Mercuri*di***ammonium comps.,** $Hg(NH_3)_2R$.

Mercuriammonium comps., $HgNH_2R$.

*Di***mercuri***di***ammonium comps.,** $Hg_2N_2H_4R$.

*Tri***mercuriammonium comps.,** $N_2H_2Hg_3R$.

Oxy*di***mercuriammonium comps.,** $(NH_2Hg_2O)R$.

Mercurous arsinchloride, AsHgCl.

Decomp. by H_2O. (Capitaine, J. Pharm. **25.** 559.)

Mercurous arsinchloride chloride, $AsHg_2Cl_2 = 2AsHgCl, Hg_2Cl_2$ (?).

Decomp. by H_2O. (Capitaine.)

Mercurous azoimide, HgN_3.

Wholly insol. in H_2O. (Curtius, B. **24.** 3321.)

1 l. H_2O dissolves 0.25 g. (Wöhler and Krupko, B. 1913, **46.** 2050.)

Mercuric azoimide, HgN_6.

Sol. in H_2O especially when hot. (Berthelot and Vieille, Bull. Soc. 1894, (3) **11.** 747.)

Moderately sol. in H_2O. (Wöhler and Krupko, B. 1913, **46.** 2050.)

Mercuric bromamide, $Hg(NH_2)Br$.

Insol. in H_2O and alcohol. Sl. sol. in NH_4OH+Aq. (Mitscherlich, J. pr. **19.** 455.)

Correct composition is *di*mercuriammonium ammonium bromide, Hg_2NBr, NH_4Br, which see. (Pesci, Gazz. ch. it. **19.** 511.)

Mercurous bromide, Hg_2Br_2.

Solubility in $H_2O = 9.1 \times 10^{-7}$ g. equiv. per l. (Bodländer, Z. phys. Ch. 1898, **27.** 61.)

Solubility in $H_2O = 7 \times 10^{-8}$ mols. per liter at 25°. (Sherrill, Z. phys. Ch. 193, **430.** 735.)

Solubility in H_2O at 25° = 1.4×10^{-7} equivalents per l. (Thompson, J. Am. Chem. Soc. 1906, **28.** 762.)

Insol. in H_2O and dil. acids. Decomp. by HCl+Aq. Sol. in hot conc. H_2SO_4 with evolution of SO_2. Sl. sol. in hot HNO_3+Aq of 1.42 sp. gr. (Stromann, B. **20.** 2818.)

Decomp. into Hg and $HgBr_2$ by boiling with NH_4Br, or NH_4Cl+Aq; also by ammonium carbonate or succinate, but not by ammonium sulphate or nitrate. (Wittstein.)

Sol. in $Hg(NO_3)_2$+Aq. (Wackenroder, A. **41.** 317.)

Partially decomp. by alkali chlorides+Aq; when out of contact of air this decomp. is slight and $HgBr_2$ is formed, while in the air $HgCl_2$ is the resulting product. Much more rapidly decomp. in hot than cold solutions. (Miahle, A. ch. (3) **5.** 177.)

A solution of HgBr in 0.1−N KBr contains about 1 mg. Hg ions in 1300 l.

Insol. in alcohol.

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014.)

Mercuric bromide, $HgBr_2$.

Sol. in 250 pts. H_2O at ordinary temp., and 25 pts boiling H_2O. (Wittstein.) Sol. in 240 pts. H_2O at 18.75°. (Abl.)

Sol. in 94 pts. H_2O at 9°, and in 4–5 pts. at 100°. (Lassaigne, J. chim. méd. **12.** 177.)

Solubility in g-equivalents per litre = 2×10^{-2}. (Bodländer, Z. phys. Ch. 1898, **27.** 61.)

1 l. H_2O dissolves about 4 g. at ord. temp. (Morse, Z. phys. Ch. 1902, **41.** 731.)

1 l. H_2O dissolves 0.017 mol. at 25°. (Jander, Dissert. **1902.**)

Solubility in H_2O at 25° = 0.017 mol. liter. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Solubility at ord. temp. = 0.8%; at bpt. = 8–9%. (Larine, J. Pharm. 1904, (6) **20.** 450.)

Solubility in cold H_2O = 4%, but solution prepared by heating contains more Hg on account of decomp. into HBr and oxybromide. (Vicario, C. C. **1907,** II. 1224.)

1 l. H_2O dissolves about 5–6 g. at ord. temp. (Gaudechon, A. ch. 1911, (8) **22.** 212.)

1 l. aqueous solution at 25° contains 0.017 mol. (Herz and Paul, Z. anorg. 1913, **83.** 431.)

Decomp. by warm HNO_3, or H_2SO_4+Aq. Sol. in warm H_2SO_4. (Ditte, A. ch. (5) **17.** 124.)

1 mol. is sol. in 1 mol. warm HI+Aq. in 1 mol. cold conc. HCl and in ½ mol. hot conc. HCl. (Löwig.)

Solubility of $HgBr_2$ in KBr+Aq at 25°.

Mols. per liter	
KBr	$HgBr_2$
0.	0.017
0.05	0.055
0.10	0.088
0.5	0.0359
0.866	0.611
2	1.407
3	2.096
4	2.339

(Sherrill, Z. phys. Ch. 1903, **43.** 705.)

Solubility in various salts+Aq at 25°.

Salt	In 10 ccm. of the solution	
	Millimols $HgBr_2$	Millimols salt
NaBr	0.17	0
	0.78	1.18
	2.85	5.96
	5.40	11.42
	12.76	24.48
	15.50	29.97
	23.06	52.46
KBr	0.17	0
	0.98	2.09
	4.72	7.70
	13.60	23.80
	19.30	34.70
$CaBr_2$	0.17	0
	1.17	0.72
	6.76	6.45
	13.58	18.92
	27.66	24.79
	36.66	37.54
$SrBr_2$	0.17	0
	1.04	0.62
	4.71	3.28
	9.02	6.68
	17.70	14.01
	22.38	18.72
$BaBr_2$	0.17	0
	3.70	2.74
	5.40	3.96
	7.59	5.79
	14.78	10.96

(Herz and Paul, Z. anorg. 1913, **82.** 434.)

Solubility in 0.1−N $Hg(NO_3)_2$+Aq is about 20 g. per liter. (Morse, Z. phys. Ch. 1902, **41.** 731.)

Sol. in KBr or NaBr+Aq. (Jander, Dissert. **1902.**)

Solubility in 10 cc. Br_2+Aq at 25°.

Millimol Br_2	0.753	1.797	2.231
" Hg	0.1844	0.1947	0.2120

(Herz and Paul, Z. anorg. 1914, **85.** 215.)

Sat. solution in liquid SO_2 contains about 1.5% $HgBr_2$ at 159.4°. (Niggli, Z. anorg. 1912, **75.** 182.)

Moderately sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

1 ccm. of sat. solution in abs. alcohol at ord. temp. contains 0.0958 g. $HgBr_2$; at bpt. contains 0.1262 g. (Hamper, Ch. Z. 1887, **11.** 905.)

Solubility of $HgBr_2$ in alcohols+Aq at t°.

Alcohol	t°	G. $HgBr_2$ per 100 g. alcohol
Methyl alcohol	0	41.15
	10	49.5
	19	66.3
	22	60.9
	39	71.3
	65	90.8
	97	139.1
Ethyl alcohol	0	25.2
	10	26.3
	19	29.7
	39	31.9
	65	44.5
	89	66.9
Propyl alcohol	0	14.6
	10	15.6
	19	15.5
	39	20.8
	65	31.3
	86.5	42.7
Isobutyl alcohol	0	4.61
	10	5.63
	23	6.65
	39	9.58
	65	15.80

(Timofeiew, Dissert. **1894.**)

Much more sol. than HgI_2 in alcohol. 100 g. of solution sat. at 0° contain 13.33–13.05 g. $HgBr_2$; 16.53 g. at 25°; 22.63 g. at 50°. (Reinders, Z. phys. Ch. 1900, **32.** 522.)

Solubility of $HgBr_2$ in methyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.
$HgBr_2$ = millimols. $HgBr_2$ in 10 cc. of the solution.

P	$HgBr_2$	Sp. gr.	P	$HgBr_2$	Sp. gr.
0	0.167	1.0022	47.06	0.700	0.9401
10.60	0.201	0.9857	64.00	1.90	0.9386
30.77	0.358	0.9588	78.05	4.07	0.9744
37.21	0.422	0.9508	100	13.96	1.2275

(Herz and Anders, Z. anorg. 1907, **52.** 165.)

Solubility of $HgBr_2$ in ethyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.
$HgBr_2$ = millimols. $HgBr_2$ in 10 cc. of the solution.

P	$HgBr_2$	Sp. gr.
0	0.167	1.0022
20.18	0.187	0.9717
40.69	0.440	0.9435
70.01	1.829	0.9214
100	6.337	0.9873

(Herz and Anders.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. $HgBr_2$ in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	5.02	1.227
11.11	4.728	1.1954
23.8	4.153	1.1524
65.2	2.530	1.0257
91.8	1.635	0.9437
93.75	1.586	0.9368
96.6	1.466	0.9275
100	1.873	0.9213

(Herz and Kuhn, Z. anorg. 1908, **60.** 158.)

Solubility in mixtures of ethyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. $HgBr_2$ in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	2.28	0.9873
8.1	2.225	0.9802
17.85	2.106	0.9740
56.6	1.763	0.9487
88.6	1.476	0.9269
91.2	1.464	0.9239
95.2	1.406	0.9227
100	1.378	0.9213

(Herz and Kuhn, Z. anorg. 1908, **60.** 161.)

Solubility of $HgBr_2$ in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixtures.
$HgBr_2$ = g. $HgBr_2$ in 10 ccm. of the solution.
S25° 4° = sp. gr. of the sat. solution.

P	$HgBr_2$	S 25°/4°
0	2.28	0.9873
4.37	2.31	0.9932
10.4	2.54	1.009
41.02	3.33	1.080
80.69	4.57	1.185
84.77	4.68	1.193
91.25	4.86	1.211
100	5.02	1.227

(Herz and Kuhn, Z. anorg. 1908, **58.** 163.)

Cold sat. solution in anhydrous ether contains 0.00567 g. in 1 cc.; hot solution contains 0.032 g. (Hampe, Ch. Z. 1887, **11.** 905.)

Solubility in organic solvents at 18°-20°.

100 g. chloroform dissolve 0.126 g. $HgBr_2$.

100 g. tetrachlormethane dissolve 0.003 g. $HgBr_2$.

100 g. bromoform dissolve 0.679 g. $HgBr_2$.

100 g. ethyl bromide dissolve 2.310 g. $HgBr_2$.

100 g. ethylene dibromide dissolve 2.340 g. $HgBr_2$.

(Sulc, Z. anorg. 1900, **25.** 401.)

Solubility in CS_2 at t°.

t°	100 pts. sat. solution contain pts. $HgBr_2$
—10	0.049
5	0.068
0	0.087
+ 5	0.105
10	0.122
15	0.140
20	0.187
25	0.232
30	0.274

(Arctowski, Z. anorg. 1894, **6.** 267.)

100 g. boiling methyl acetate (bpt. 56.2-56.7°) dissolves 24 g. $HgBr_2$. (Schroeder and Steiner, J. pr. 1909, (2) **79.** 49.)

1 g. $HgBr_2$ is sol. in 4.56 g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.09. (Naumann, B. 1909, **42.** 3795.)

100 g. anhydrous ethyl acetate or sat. with H_2O at 18° dissolve 130.5-135 g. $HgBr_2$. (Hamers, Dissert. **1906.**)

Solubility of $HgBr_2$ in ethyl acetate+Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate +Aq.

$HgBr_2$ = millimols $HgBr_2$ in 10 cc. of the solution.

P	$HgBr_2$	Sp. gr.
0	0.167	1.0022
4.39	0.159	1.0018
96.76	7.42	1.1159
100	3.93	1.0113

(Herz and Anders, Z. anorg. 1907, **52.** 172.)

1 pt. $HgBr_2$ sol. in 7.66 pts. ethyl acetate at 18°. (Naumann, B. 1910, **43.** 315.)

Easily sol. in acetone. (Oppenheim, B. **2.** 572.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Acetone dissolves much more $HgBr_2$ than HgI_2. 100 g. sat. solution at 25° contain 34.58 g. $HgBr_2$. (Reinders, Z. phys. Ch. 1900, **32.** 514.)

Solubility in diethyl oxalate is much greater than that of HgI_2 and is equal to 12% at 100°. (Reinders, Z. phys. Ch. 1900, **32.** 507.)

Solubility in benzene = 0.0194 mol. per l. at 25°. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, **9.** 647.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Solubility in aniline.

S = temp. of solidification.

Mols. $HgBr_2$ per 100	S	Mols. $HgBr_2$ per 100	S	Mols. $HgBr_2$ per 100	S
4.9	9°	25.4	115.5°	49.6	123
10.	43.5	33.9	117	54.9	124
12.5	57	39.5	108	58.8	134
14.9	68	41.9	113	64.0	133
19.7	89	43.9	118		
23.4	106	46 2	121		

(Staronka, Anz. Ak. Wiss. Krakau, **1910, 372.**)

Solubility of $HgBr_2$ in quinoline.

S = temp. of solidification.

Mols. $HgBr_2$ per 100	4.4	8.9	14.3	17.6
S	88°	111°	127°	134°

(Staronka, Anz. Wiss. Krakau, **1910.** 372.)

Mol. weight determined in ethyl sulphide. (Werner, Z. anorg. 1897, **15.** 30.)

$+4H_2O$. (Thomsen.)

Mercuric *per***bromide,** $HgBr_4$.

(Herz and Paul, Z. anorg. 1914, **85.** 216.)

Mercuric hydrogen bromide (Bromomercuric acid), $HgBr_2$, $HBr = HHgBr_3$.

Decomp. by H_2O. (Neumann, M. **10.** 236.)

Mercuric nickel bromide, basic, $HgBr_2$, $NiBr_2$, $6NiO + 20H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 369.)

Mercuric platinum bromide.

See **Bromoplatinate, mercuric.**

Mercuric potassium bromide, $HgBr_2$, KBr.

Sol. in H_2O, but decomp. by a large amount, with separation of one half of the $HgBr_2$. (v. Bonsdorff, Pogg. **19.** 339.)

$2HgBr_2$, $KBr + 2H_2O$. Permanent. Sol. in H_2O and alcohol. (v. Bonsdorff.)

Mercuric sodium bromide, $HgBr_2$, NaBr.

Deliquescent. (v. Bonsdorff.)

(Varet, C. R. 1890, **111,** 527.)

$HgBr_2$, $2NaBr$.

Very sol. in H_2O. (Vicario, J. Pharm. 1907, (6) **26.** 145.)

$2HgBr_2$, $NaBr+3H_2O$. Sol. in H_2O and alcohol. (Berthemot.)

Mercuric strontium bromide, $HgBr_2$, $SrBr_2$.

Sol. in all proportions of H_2O. (Löwig, Mag. Pharm. **33.** 7.)

$2HgBr_2$, $SrBr_2$. Decomp. by H_2O into $HgBr_2$ and $HgBr_2$, $SrBr_2$. (Löwig.)

Mercuric zinc bromide.

Deliquescent in moist air. (v. Bonsdorff.)

Mercuric zinc bromide cyanide ammonia.

See **Cyanide zinc bromide ammonia, mercuric.**

Mercuric bromide ammonia, $HgBr_2$, $2NH_3$.

Decomp. by boiling H_2O. Sol. in min. acids and acetic acid. (Naumann, B. 1910, **43.** 316.)

Mercuric bromide cadmium oxide, $HgBr_2$, $CdO+H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 371.)

Mercuric bromide cupric oxide, $HgBr_2$, $CuO+3H_2O$.

(Mailhe, Bull. Soc. 1901, (3) **25.** 791.)

Mercuric bromide hydrazine, $HgBr_2$, N_2H_4.

(Hofmann and Marburg, A. 1899, **305.** 215.)

Mercuric bromide potassium chloride, $HgBr_2$, $2KCl$.

Decomp. by H_2O. (Harth, Z. anorg. 1897, **14.** 345.)

Mercuric bromide zinc oxide, $HgBr_2$, $ZnO+8H_2O$.

(Mailhe, C. R. 1901, **132,** 1274.)

Mercuric bromoiodide, $HgBrI$.

Sol. in alcohol and ether. Can be recrystallised from ether without decomp. (Oppenheim, B. **2.** 571.)

Mercurous chloramide, $Hg_2(NH_2)Cl$.

Insol. in boiling H_2O or NH_4OH+Aq. (Kane, A. ch. (2) **72.** 215.)

Mixture of Hg and $HgNH_2Cl$. (Barfoed, J. pr. (2), **39.** 201.)

Mercuric chloramide, $Hg(NH_2)Cl$.

Composition is *di*mercuriammonium ammonium chloride, Hg_2NCl, NH_4Cl, which see.

Mercuric chloramide oxymercuriammonium chloride, $4Hg(NH_2)Cl$, $(NHg_2OH_2)Cl$. (Millon.)

Correct composition is *di*mercuriammonium ammonium chloride, NHg_2Cl, NH_4Cl, which see. (Balestra, Gazz. ch. it. **21.** (2) 294.)

$Hg(NH_2)Cl$, $(NHg_2OH_2)Cl$. (Millon.)

True composition is *di*mercuriammonium mercuric chloride, $2Hg_2NCl$, $HgCl_2+H_2O$; or *di*mercuriammonium hydrogen chloride, NHg_2Cl, HCl. (Balestra.)

Mercuric chloramide chloride, $Hg(NH_2)Cl$, $HgCl_2$.

Properties as mercuric chloramide. Decomp. by cold $HCl+Aq$. (Millon.)

True composition is *di*mercuriammonium hydrogen chloride, NHg_2Cl, $2HCl$. (Balestra, Gazz. ch. it. **21.** (2) 294.)

Mercuric chloramide chromate, $2Hg(NH_2)Cl$, $HgCrO_4$.

Decomp. by hot H_2O. Easily sol. in HNO_3 or $HCl+Aq$. (Jäger and Krüss, B. **22.** 2048.)

Mercurous chloride, Hg_2Cl_2.

Almost absolutely insol. in cold, but gradually sl. decomp. by boiling H_2O.

Calculated from electrical conductivity of Hg_2Cl_2+Aq, 1 l. H_2O dissolves 3.1 mg. Hg_2Cl_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

1 l. H_2O dissolves 2 mg. Hg_2Cl_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1 l. H_2O dissolves 1.4 mg. at 0.5°; 2.1 mg. at 18°; 2.8 mg. at 24.6°; 7 mg. at 43°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 150.)

When finely divided, is 10% more sol. than when coarsely crystalline. (Sauer, Z. phys. Ch. 1904, **47.** 184.)

Solubility in $H_2O = 0.8 \times 10^{-6}$ g. mol. (Ley, Z. Elektrochem. **1904, 10. 301.**)

Sl. sol. with decomp. in boiling H_2O free from air, 20 ccm. H_2O affording 0.002 g. $HgCl_2$ after boiling 1 hour with Hg_2Cl_2. (Miahle, A. ch. (3) **5.** 176.) $Hg_2(NO_3)_2+Aq$ containing 1 pt. $Hg_2(NO_3)_2$ to 250,000 pts. H_2O give ppt. of Hg_2Cl_2 with $HCl+Aq$. Sol. with decomp. in conc. $HCl+Aq$, hot HNO_3+Aq, aqua regia, or Cl_2+Aq. (Fresenius.) Insol. in cold dil. acids, but slowly sol. on heating.

The solubility of Hg_2Cl_2 in $HCl+Aq$ increases slowly with time, and finally reaches a point where it increases very rapidly, which takes place sooner the more dil. the acid. Presence of $Hg_2(NO_3)_2+Aq$ helps the solubility. (Why not oxidation to $HgCl_2$?) (Varenne, C. R. **92.** 1161.)

Solubility of Hg_2Cl_2 in HCl+Aq at 25°.
Solid phase = Hg_2Cl_2+0.1 g. Hg.

G. per l.		Sp. gr. of solutions
HCl	Hg_2Cl_2	
31.69	0.034	...
36.46	0.048	...
95.43	0.207	1.042
158.4	0.399	1.069
209.2	0.548	1.091
267.3	0.654	1.114
278.7	0.675	1.119
317.3	0.670	1.132
364.6	0.673	1.153

(Richards and Archibald, Z. phys. Ch. 1902, **40.** 385.)

Cold conc. H_2SO_4 does not dissolve or decomp. Boiling H_2SO_4 dissolves with evolution of SO_2. (Vogel.)

Solubility of Hg_2Cl_2 in chlorides+Aq at 25°.
Solid phase = Hg_2Cl_2+0.1 g. Hg.

Salt	G. per liter		Sp. gr. of solutions
	NaCl	Hg_2Cl_2	
NaCl	5.85	0.0041	...
	58.50	0.041	1.040
	119.	0.129	1.078
	148.25	0.194	1.093
	222.3	0.380	1.142
	292.5	0.643	1.188
$BaCl_2$	104.15	0.044	1.088
	156.22	0.088	1.134
	208.30	0.107	1.174
	312.54	0.231	1.263
$CaCl_2$	39.96	0.022	...
	55.5	0.033	...
	111	0.081	1.064
	138.75	0.118	1.105
	195.36	0.231	1.151
	257.52	0.322	1.205
	324.67	0.430	1.243
	432.9	0.518	1.315
	499.5	0.510	1.358

(Richards and Archibald, Z. phys. Ch. 1902, **40.** 385.)

Sol. in cold HCN+Aq with separation of Hg.

Sol. in alkali chlorides+Aq. NH_4Cl+Aq dissolves out $HgCl_2$ at ord. temp., much more at 40–50°. Dil. NH_4Cl+Aq decomposes more slowly than conc. Access of air hastens reaction. (Miahle.)

When heated several hours to 40–50°, 100 pts. NH_4Cl+833 pts. H_2O form 0.75 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2; 100 pts. NaCl+833 pts. H_2O form 0.33 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2; 100 pts. KCl+833 pts. H_2O form 0.25 pt. $HgCl_2$ from 25 pts. $HgCl_2$; 100 pts. $BaCl_2$+833 pts. H_2O form 0.33 pt. $HgCl_2$ from 25 pts. Hg_2Cl_2. (Miahle, J. Pharm. **26.** 108.)

Other chlorides act as NH_4Cl, only less vigorously. (Pettenkofer.)

By boiling 1 pt. Hg_2Cl_2 10 times with a solution of 1 pt. NaCl each time, the Hg_2Cl_2 is finally completely decomp. (Henne.)

Boiling $BaCl_2$+Aq or $CaCl_2$+Aq dissolve traces. K_2SO_4+Aq, KNO_3+Aq, or $KHC_4H_4O_6$+Aq do not dissolve. (Pettenkofer.)

Sol. in $(NH_4)_2SO_4$+Aq. Insol. in NH_4 nitrate, or succinate+Aq. (Wittstein.)

Sol. in hot $Hg_2(NO_3)_2$+Aq, and still more in hot $Hg(NO_3)_2$+Aq; on cooling it crystallises out completely. 25 g. Hg_2Cl_2 dissolve in 1.5 l. H_2O containing 50 g. $Hg(NO_3)_2$. (Debray, C. R. **70.** 995.)

Sol. in $PtCl_2$+Aq.

Decomp. by NH_4OH+Aq.

Decomp. by KOH, or NaOH+Aq.

Sol. in $Na_2S_2O_3$+Aq. (Faktor, C. C. **1905,** I. 1524.)

Very sl. sol. in NH_4 succinate. (Wittstein.)

Insol. in $SbCl_3$. (Klemensiewicz, C. C. **1908,** II. 1850.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol or ether. More sol. in H_2O containing pepsin and an acid than in H_2O, and is not converted thereby into $HgCl_2$. (Torsellini, Ann. Chim. Ch. farm. (4) **4.** 105.)

Small amts. are sol. with decomp. in alcohol, ether and $CHCl_3$. 1 g. $CHCl_3$ dissolves 0.0046 g. Hg_2Cl_2. (Maclagan, Arch. Pharm. 1884, **222,** 788.)

Formic acid (95%) dissolves at 16.5°, 0.02%; at 18°, 0.0003%. (Aschan, Ch. Z. 1913, **37.** 1117.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Hamers, Dissert. **1906;** Naumann, B. 1904, **37.** 3602.)

Somewhat sol. in hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, **28.** 1216.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Solubility in organic solvents at 18–20°.

100 g. chloroform dissolve traces of HgCl.

100 g. bromoform dissolve 0.055 g. HgCl.

100 g. ethyl bromide dissolve traces of HgCl.

100 g. ethylene dibromide dissolve traces of HgCl. (Sulc. Z. anorg. 1900, **25.** 401.)

Mercuric chloride, $HgCl_2$.

Permanent.

Sol. in 18.5 pts. H^2O at 13.8°, and 2–3 pts. at 100°. (J. Davy, 1822.) Sol. in 3 pts. boiling H^2O. (Wenzel.) Sol. in 18.23 pts. H^2O at 10°, and 3 pts. at 100°. (M. R. and P.) Sol. in 18.46 pts. at 18.75°. (Abl.) Sol. in 16 pts. cold, and 3 pts. warm H_2O. (Dumas.)

100 pts. H_2O dissolve pts. $HgCl_2$ at t°:

t°	Pts. $HgCl_2$	t°	Pts. $HgCl_2$	t°	Pts. $HgCl_2$
0	5.73	40	9.62	80	24.30
10	6.57	50	11.34	90	37.05
20	7.39	60	13.86	100	53.96
30	8.43	70	17.29	...	...

(Poggiale, A. ch. (3) **8.** 468.)

Solubility of $HgCl_2$ in H_2O.

t°	% $HgCl_2$	t°	% $HgCl_2$
+ 1	3.9	80	23.6
4.5	4.8	87	28.2
4.5	4.8	100	39.3
7.5	5.1	121	59.7
13.8	5.2	127	69.7
25.1	7.1	140	77.0
29.5	7.6	150	78.4
38.0	9.9	159	80.2
49	11.3	160	81.7
61	15.1	165	81.8

(Étard, A. ch. 1894, (7) **2.** 557.)

71.17 g. $HgCl_2$ are sol. in 1 l. H_2O at 25°. (Morse, Z. phys. Ch. 1902, **41.** 726.)

Solubility at 25° = 0.267 mol. in 1 l. H_2O. (Jander, Z. Elektrochem. 1903, **8.** 688.)

Solubility in H_2O at 25° = 0.263 mol. liter. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Sat. $HgCl_2$+Aq at 25° contains 6.9% $HgCl_2$. (Foote, Am. Ch. J. 1906, **35.** 238.)

$HgCl_2$+Aq contains 3.95 g. $HgCl_2$ in 100 g. of solution at 0°; 7.67 g. at 30°. (Schreinemakers, Ch. Weekbl. 1910, **7.** 202.)

$HgCl_2$+Aq sat. at (?) contains 6.8% $HgCl_2$. (Abe, J. Tok. Chem. Soc. 1912, **33.** 1087.)

$HgCl_2$+Aq sat. at 35° contains 8.51% $HgCl_2$. (Schreinemakers and Thonus, Ver. K. Akad. Wet. Amsterdam, 1912, **21.** 333.)

1 l. aqueous solution sat. at 25° contains 0.265 mol. $HgCl_2$. (Herz and Paul, Z. anorg. 1913, **82.** 431.)

H_2O dissolves 7.39% at 20°. (Aschan, Ch. Z. 1913, **37.** 1117.)

$HgCl_2$+Aq sat. at 8° has 1.041 sp. gr. (Anthon, **1837.**)

Sp. gr. of $HgCl_2$+Aq at 20°.

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
1	1.0072	4	1.0323
2	1.0148	5	1.0411
3	1.0236	...	...

(Schröder, calculated by Gerlach, Z. anal. **27.** 306.)

Sp. gr. of $HgCl_2$+Aq at 15°.

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
8	1.071	11	1.1035
9	1.0815	12	1.115
10	1.095	13	1.127

(Mendelejeff, calculated by Gerlach, Z. anal. **27.** 306.)

Sp. gr. of $HgCl_2$+Aq.

% $HgCl_2$	Sp. gr. at 0°	at 10°	at 20°	at 30°
4.72	1.04070	1.04033	1.03856	1.03566
3.57	1.03050	1.03022	1.02885	1.02577
2.42	1.02035	1.02018	1.01856	1.01585
1.22	1.01008	1.00990	1.00835	1.00575

(Schröder, B. **19.** 161 R.)

Sp. gr. of $HgCl_2$+Aq at room temp. containing:

0.226	3.55% $HgCl_2$.
1.0233	1.0328

(Wagner, W. Ann. 1883, **18.** 266.)

Sp. gr. of $HgCl_2$+Aq at 25°.

Concentration of $HgCl_2$+Aq.	Sp. gr.
1/4-normal	1.0275
1/8- "	1.0138

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

Sp. gr. at 16°/4° of $HgCl_2$+Aq containing 4.5256% $HgCl_2$ = 1.03806.

Sp. gr. at 16°/4° of $HgCl_2$+Aq containing 4.2224% $HgCl_2$ = 1.03491. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

$HgCl_2$+Aq containing 6.04% $HgCl_2$ has sp. gr. 20°/20° = 1.0523.

$HgCl_2$+Aq containing 6.08% $HgCl_2$ has sp. gr. 20°/20° = 1.0526.

(Le Blanc and Rohland, Z. phys. ch. 1896, **19.** 282.)

Sat. $HgCl_2$+Aq boils at 101.1°. (Griffiths.)

B.-pt. of $HgCl_2$+Aq

% $HgCl_2$	B.-pt.	% $HgCl_2$	B.-pt.
4.8	100.10°	11.04	100.20°
9.0	100.16	15.2	100.275

(Skinner, Chem. Soc. **61.** 340.)

Solubility in HCl+Aq is greater than in H_2O. (Dumas.)

Sol. in 0.5 pt. HCl+Aq of 1.158 sp. gr. at 23.3°, forming a solution of 2.412 sp. gr. (Davy, **1822.**)

Solubility of $HgCl_2$ in HCl+Aq.

Pts. HCl in 100 pts. H_2O	Pts. $HgCl_2$ dissolved by 100 pts. liquid	Pts. HCl in 100 pts. H_2O	Pts. $HgCl_2$ dissolved by 100 pts. liquid
0.0	6.8	21.6	127.4
5.6	46.8	31.0	141.9
10.1	73.7	50.0	148.0
13.8	87.8	68.0	154.0

(Ditte, A. ch. (5) **22.** 551.)

Solubility in HCl+Aq at 0°. $\frac{HgCl_2}{2}$ = ½mols.

$HgCl_2$ (in mgs.) in 10 ccm. solution; HCl =mols. HCl ditto; H_2O =grms. H_2O present.

$\frac{HgCl_2}{2}$	HCl.	Sp. gr.	H_2O
9.7	4.3	1.117	9.704
19.8	9.9	1.238	9.340
35.5	17.8	1.427	9.816
55.6	26.9	1.665	8.135
68.9	32.25	1.811	7.714
72.37	34.25	1.874	7.679
85.5	41.5	2 023	7.131
88.65	48.1	2.066	6.893
95.675	70.875	2.198	6.431

(Engel, A. ch. (6) **17.** 362.)

Not decomp. by H_2SO_4 or HNO_3+Aq.

Sol. in 630 pts. H_2SO_4, and in more than 500 pts. hot HNO_3+Aq of 1.41 sp. gr. without decomp. (J. Davy.)

Sol. in H_2SO_4, HNO_3, HIO_3, or H_2CrO_4 without decomp. (Millon, A. ch. (3) **18.** 373.)

Very sl. sol. in HNO_3, but not decomp. thereby. (Wurtz.)

Solubility of $HgCl_2$ in NH_4Cl+Aq at 30°.

Composition of liquid phase			Solid phase
% $HgCl_2$	% NH_4Cl	% H_2O	
0	29.5	70.5	NH_4Cl
15.68	27.56	56.76	"
22.80	26.91	50.29	"
31.96	26.16	41.88	"
42.45	25.05	32.50	"
50.05	24.79	25.16	NH_4Cl+$HgCl_2$, $2NH_4Cl$, H_2O
50.60	24.31	25.09	$HgCl_2$, $2NH_4Cl$, H_2O
53.08	22.77	24.15	"
55.97	21.42	22.61	"
58.91	20.06	21.03	$HgCl_2$, $2NH_4Cl$, H_2O+
58.89	19.98	21.13	$HgCl_2$, NH_4Cl, H_2O
56.83	18.86	24.61	$HgCl_2$, NH_4Cl, H_2O
56.38	18.50	25.12	"
55.83	17.70	26.47	"
55.70	17.13	27.17	"
55.58	16.82	27.60	"

Solubility of $HgCl_2$ in NH_4Cl+Aq at 30°—*Continued.*

Composition of liquid phase			Solid phase
% $HgCl_2$	% NH_4Cl	% H_2O	
55.55	15.04	28.51	$HgCl_2$, NH_4Cl, H_2O
55.85	15.35	28.80	"
56.71	14.22	29.07	"
57.04	14.10	28.86	$HgCl_2$, NH_4Cl, H_2O+
56.98	14.14	28.88	$3HgCl_2$, $2NH_4Cl$, H_2O
56.83	13.90	29.27	$3HgCl_2$, $2NH_4Cl$, H_2O
56.26	13.04	30.70	"
56.43	11 88	31.69	"
56.70	11.05	32.23	"
57.05	9.92	33.02	"
58.55	9.23	32.22	"
58.65	9.20	32.15	$3HgCl_2$, $2NH_4Cl$, H_2O+ $9HgCl_2$, $2NH_4Cl$
51.83	8.76	39.41	$9HgCl_2$, $2NH_4Cl$.
46.00	7.52	46.48	"
39.02	6.28	54.70	"
35.60	5.26	59.14	"
35.10	5.18	59.72	"
32.90	5.06	62.04	"
29.65	3.62	66.73	$9HgCl_2$, $2NH_4Cl$+$HgCl_2$
40.12	5.13	54.75	$HgCl_2$
21.00	2.29	76.71	"
7.67	0	92.33	"

(Meerburg, Z. anorg. 1908, **59.** 139.)

1 pt. sat. NaCl+Aq dissolves 1.29 pts. $HgCl_2$ at 14°. (Voit, A. **104.** 354.)

Sat. NaCl+Aq (20 grains H_2O+7 grains NaCl) dissolves 32 grains $HgCl_2$ at 15.5°, and 3 grains more on warming. Sp. gr. of solution =2.14. (Davy, **1822.**)

Sat. KCl+Aq (21 grains H_2O+7 grains KCl) dissolves 8 grains $HgCl_2$ on being gently heated. (Davy.)

Sat. $BaCl_2$+Aq (29 grains H_2O+8.7 grains $BaCl_2$+$2H_2O$) dissolves 16 grains $HgCl_2$ at 15.5°, and 4 grains more on heating. Sp. gr. of solution =1.9. (Davy.)

$MgCl_2$+Aq (31 grains HCl+Aq of 1.58 sp. gr. neutralised with MgO) dissolves 40 grains $HgCl_2$, and 25 grains more on gently heating. Sp. gr. of solution = 2.83. (Davy.)

Sol. in sat. KCl, NaCl+Aq, and in $MnCl_2$, $ZnCl_2$, $CoCl_2$, $FeCl_2$, $NiCl_2$, and $CuCl_2$+Aq. (v. Bonsdorff, Pogg. **17.** 123.)

The solubility in H_2O is greatly increased by the addition of cupric chloride. 8.5% $HgCl_2$ is sol. in pure H_2O and 52.8% $HgCl_2$ is sol. in 18.06% $CuCl_2$+Aq. (Schreinemakers, C. C. **1913,** I. 1858.)

Solubility of $HgCl_2$+KCl at 25%.

Composition of solution		Composition of undissolved residue			Solid phase
% KCl	% $HgCl_2$	% KCl	% $HgCl_2$	% H_2O	
26.46	0	100	0	...	KCl
26.24	15.04	...	3.63	....	KCl+2KCl, $HgCl_2$, H_2O
26.23	15.02	..	26.15	....	"
26.33	15 02	...	52.01	...	"
26.33	14.92	..	61.04	...	"
23.74	18.91	34 61	61 66	3.73	2KCl, $HgCl_2$, H_2O
22.36	21.39	34.77	62.02	3.21	"
21.39	23 88	34.05	61 84	3.35	"
20.32	27.62	...	65 24	....	2KCl, $HgCl_2$, H_2O+KCl, $HgCl_2$, H_2O
20.26	27.38		73 98	...	"
17.85	25.34	21.89	75.10	3 01	KCl, $HgCl_2$, H_2O
9 26	18.95	21.02	73.36	5 62	"
7.80	19.56	20.76	73 06	6.18	"
6.84	22.81	20.75	74.54	4.71	"
6.66	24.32	20 54	73.99	5.47	"
6.52	25.13	..	76 46	...	KCl, $HgCl_2$, H_2O+KCl, $2HgCl_2$, $2H_2O$
6.64	25.16	..	80.60	...	"
6 27	25 11	12.09	83 20	4.71	KCl, $2HgCl_2$, $2H_2O$
5.77	24.73	11.87	83.18	4.95	"
4.68	24.75	..	84.46	...	KCl, $2HgCl_2$, $2H_2O$+$HgCl_2$
4.66	25 17	..	93.58	....	"
4.69	24.82	...	98 50	...	"
0	6 90	0	100	0	$HgCl_2$

(Foote and Levy, Am. Ch. J. 1906, **35.** 239.)

Solubility of $HgCl_2$+KCl at 20°.

G. per 100 g. H_2O		Solid phase
KCl	$HgCl_2$	
0	7.39	$HgCl_2$
1.12	11.63	"
2.39	15.72	"
4.05	22.17	"
4.84	25.16	$HgCl_2$+$2HgCl_2$, KCl
5.60	25.13	$2HgCl_2$, KCl
6.71	25.66	"
7.39	26.41	$2HgCl_2$, KCl+$HgCl_2$, KCl
7.46	24.70	$HgCl_2$, KCl
8.95	19.93	"
15	22.87	"
17.57	26.12	"
20.35	29	"
26.31	34.83	"
30.32	39.10	"
34.12	42.82	$HgCl_2$, KCl+$HgCl_2$, 2KCl
34.18	39.34	$HgCl_2$, 2KCl
34.34	35.16	"
34.54	30.63	"
37.72	24.30	"
41.13	19.33	$HgCl_2$, 2KCl+KCl
39.66	15.76	KCl
37.87	10.28	"
35.32	2.1	"

(Tichomiroff, J. russ. Phys. Chem. Soc. 1907 **39.** 731.)

Solubility of $HgCl_2$+RbCl in H_2O. Solubility data are given showing double salts formed at 25°. (Foote and Levy, l. c.)

Solubility in NaCl+Aq. 100 pts. NaCl+Aq containing given % NaCl dissolve g. $HgCl_2$.

% NaCl	g. $HgCl_2$ at 15°	g. $HgCl_2$ at 65°	g. $HgCl_2$ at 100°
26	128	152	208
25	120	142	196
10	58	68	110
5	30	36	64
1	14	18	48
0.5	10	13	44

(Homeyer and Ritsert, Pharm. Ztg. **33.** 738.)

Solubility of $HgCl_2$+NaCl at 25%.

Composition of solution		Composition of undissolved residue			Solid phase
% NaCl	% $HgCl_2$	% NaCl	% $HgCl_2$	% H_2O	
26 5	0	100	0	0	NaCl
18.66	51 35	.	16.39	.	NaCl+NaCl, $HgCl_2$, $2H_2O$
18 71	51.32	.	21.98	.	"
18 64	51.42	.	65.45	.	"
18 87	51 26		71.25	.	"
14.97	57 74	16 38	74.18	9 44	NaCl, $HgCl_2$, $2H_2O$
14.03	59 69	16 36	74 21	9 43	"
13 25	62 16	16 16	74 70	9 14	"
13 17	62 59	15 96	74 76	9 28	"
12 97	62 50	.	78 20	..	NaCl, $HgCl_2$, $2H_2O$+$HgCl_2$
13 14	62.48		88 64	.	"
13.15	62 55	.	90 83	..	"

(Foote and Levy, Am. Ch. J. 1906, **35.** 239.)

105.0 g. $HgCl_2$ are sol. in 1 l. of 0.1-N $Hg(NO_3)_2$+Aq at 25°. (Morse, Z. phys. Ch. 1902, **4** . 726.)

Solubility in MCl+Aq at 25°.

Salt	In 10 ccm. of the solution	
	Millimols $HgCl_2$	Millimols salt
LiCl	2.65	0
	3.51	4.14
	6.66	8.35
	10.21	12.71
	16.78	17.38
	22.14	22.65
	28.96	30.91
	30.62	35.27
NaCl	2.65	0
	3.72	2.12
	5.08	4.16
	7.48	6.71
	11.92	11.53
	20.22	19.41
	27.54	27.83
	34.34	31.62

Solubility in MCl+Aq at 25°.—*Continued.*

Salt	In 10 ccm. of the solution	
	Millimols $HgCl_2$	Millimols salt
KCl	2.65	0
	3.55	1.74
	3.81	2.21
	8.36	6.83
$MgCl_2$	2.65	0
	3.74	1.68
	7.19	4.15
	11.31	5.70
	18.64	9.97
	25.69	13.20
	32.06	17.28
$CaCl_2$	2.65	0
	3.64	1.90
	7.66	4.02
	11.08	6.56
	18.11	9.64
	26.45	14.29
	33.04	17.23
$SrCl_2$	2.65	0
	3.15	1.64
	5.63	3.11
	8.29	5.19
	13.42	7.24
	17.76	10.46
	22.93	13.86
$BaCl_2$	2.65	0
	6.97	3.85
	11.67	5.72
	16.20	7.76
	26.45	13.36
	53.48	30.30

(Herz and Paul, Z. anorg. 1913, **82.** 433.)

Solubility in H_2O is increased by presence of I_2. (Herz and Paul, Z. anorg. 1914, **85.** 214.)

Solubility in H_2O is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, **28.** 213.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Abundantly sol. in H_2PtCl_4+Aq. (Nilson, B. 1876, **9.** 1146.)

Sol. in 2.5 pts. cold alcohol (Richter); 3 pts. (Karl); 2.5 pts. alcohol of 0.833 sp. gr. at ordinary temp., and 1.167 pts. on boiling (Berzelius); 2 pts. alcohol of 0.816 sp. gr. at 15.5 (sp. gr. of solution = 1.08) (J. Davy, Phil. Trans. 1822. 358).

At 10°, sol. in 2.57 pts. alcohol of 39° (Cartier), in 2.9 pts. alcohol of 38°; in 3.6 pts. alcohol of 35°; in 4.2 pts. alcohol of 30°; in 9.3 pts. alcohol of 22°; in 14.6 pts. alcohol of 14°. (N. E. Henry.)

Sol. in 25 mols. methyl, 13.1 mols. ethyl, and 20.3 mols. propyl alcohol at 8.5°; in 16.2 mols. methyl, 12.4 mols. ethyl, and 18 mols. propyl alcohol at 20°; in 6.8 mols. methyl, 10.6 mols. ethyl, and 14.6 mols. propyl alcohol at 38.2°. (Timofejew, C. R, **112.** 1224.)

100 pts. absolute methyl alcohol dissolve 66.9 pts. $HgCl_2$ at 25°; 100 pts. absolute ethyl alcohol dissolve 49.5 pts. $HgCl_2$ at 25°. (de Bruyn, Z. phys. Ch. **10.** 783.)

At 15°, 1 pt. by weight is sol. in:—

13.53 pts	H_2O.	
1.5 "	methyl alcohol of sp. gr.	0.7990
2.5 "	ethyl " " " "	0.8100
6.3 "	propyl " " " "	0.8160

(Rohland, Z. anorg. 1899, **18.** 328.)

100 g. $HgCl_2$+CH_3OH contain 1.2 g. $HgCl_2$ at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

Solubility of $HgCl_2$ in methyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.
$HgCl_2$ = millimols $HgCl_2$ in 10 cc. of the solution.

P	$HgCl_2$	Sp. gr.
0	2.67	1.0565
10.60	2.92	1.0441
30.77	4.18	1.0420
37.21	4.96	1.0507
47.06	7.27	1.0809
64.00	14.19	1.2015
78.05	21.11	1.3314
100	17.95	1.2160

(Herz and Anders, Z. anorg. 1907, **52.** 165.)

100 cc. 90% ethyl alcohol dissolve 27.5° g. $HgCl_2$ at 15.5°. Sp. gr. 15° of sat. solution = 1.065. (Greenish and Smith, Pharm. J. 1903, **71.** 881.)

100 g. 99.2% ethyl alcohol dissolve 33.4 g. $HgCl_2$ at 25°. (Osaka.)

Solubility of $HgCl_2$ in ethyl alcohol+Aq at 25°.

P = g. alcohol in 100 g. alcohol+Aq.
$HgCl_2$ = millimols $HgCl_2$ in 10 cc. of the solution.

P	$HgCl_2$	Sp. gr.
0	2.67	1.0565
20.18	2.49	1.0214
40.69	3.94	1.0180
70.01	8.70	1.0616
100	13.61	1.1067

(Herz and Anders, Z. anorg. 1907, **52.** 170.)

Solubility of $HgCl_2$ in ethyl alcohol+Aq at 25°.

% C_2H_5OH	% $HgCl_2$	% C_2H_5OH	% $HgCl_2$
0	6.80	45.84	15.36
5.08	6.65	49.86	18.18
14.49	6.41	53.61	21.40
21	6.55	57.26	24.51
26.25	7.31	60.55	27.67
31.53	8.51	63.95	29.86
36.85	10.32	67.39	32.40
41.36	12.69		

(Abe, J. Tok. Chem. Soc. 1912, **33.** 1087.)

Solubility in alcohol is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, **28.** 213.)

Solubility of $HgCl_2$ in a mixture of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixture.
$HgCl_2$ = g. $HgCl_2$ in 10 ccm. of the solution.
S = sp. gr. of the sat. solution.

P	$HgCl_2$	S 25°/4°
0	3.686	1.107
4.37	3.943	1.130
10.4	4.261	1.157
41.02	5.837	1.294
80.69	6.167	1.321
84.77	5.782	1.288
91.25	5.385	1.254
100	4.862	1.216

(Herz and Kuhn, Z. anorg. 1908, **58.** 161.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. $HgCl_2$ in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	4.862	1.2160
11.11	5.034	1.2278
23.8	5.714	1.2848
65.2	4.228	1.1568
91.8	2.509	1.0090
93.75	2.323	1.0029
96.6	2.152	0.9851
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, **60.** 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. $HgCl_2$ in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	3.686	1.1070
8.1	3.667	1.0988
17.85	3.406	1.0857
56.6	2.711	1.0272
88.6	2.166	0.9854
91.2	2.160	0.9824
95.2	2.087	0.9772
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, **60.** 160.)

Sp. gr. of $HgCl_2$+alcohol.

% $HgCl_2$	Sp. gr. 25°/20°
0	0.7948
5.44	0.8346
6.52	0.8431

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 283.)

Sp. gr. of alcoholic solution of $HgCl_2$.

% $HgCl_2$	Sp. gr. at 0°	at 10°	at 20°	at 30°
0.00	0.83135	0.82286	0.81435	0.80594
1.22	0.8397	0.8312	0.8228	0.8141
2.38	0.8484	0.8399	0.8314	0.8227
4.42	0.8635	0.8549	0.8463	0.8375
8.56	0.8966	0.8877	0.8789	0.8689
12.43	0.9306	0.9213	0.9119	0.9024
15.91	0.9629	0.9523	0.9425	0.9329
19.32	0.9951	0.9852	0.9753	0.9652
22.46	1.0285	1.0184	1.0083	0.9982

(Schröder, B. **19.** 161 R.)

Sp. gr. at 16°/4° of $HgCl_2$+ethyl alcohol containing 23.5489% $HgCl_2$ = 0.99885; containing 11.8801% = 0.88572. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

Sp. gr. at 16°/4° of $HgCl_2$+amyl alcohol containing 10.9948% $HgCl_2$ = 0.89550. (Schönrock, Z. phys. Ch. 1893, **11.** 769.)

Sol. in 4 pts. ether (Karls); in 4.1 pts. (Henry); in 2.86 pts. ether of 0.745 sp. gr. (sp. gr. of solution = 1.08); the solvent power is not increased by elevating the temp., and b.-pt. of ether is not raised. (J. Davy.)

Ether extracts $HgCl_2$ from $HgCl_2$+Aq. (Orfila); very slightly if $HgCl_2$+Aq is dil. (Lassaigne.)

Very sl. sol. in pure ether. (Polis, B. **20.** 717.)

6.35 pts. are sol. in 100 pts. ether at 0°.
6.44 " " " " 100 " " " 18.
6.38 " " " " 100 " " " 35.5.
(Laszczynski, B. 1894, **27.** 2286.)

Sol. in 7½–8 pts. ether. (Madsen, Ch. Z. Repert. 1897, **21.** 169.)

Solubility in 100 cc. ether at 17° = 4.1–4.12 g. (Strömholm, J. pr. 1902, (2), **66.** 450.)

The solubility of $HgCl_2$ in H_2O is only sl affected by the presence of ether. An aqueous solution sat. with ether and $HgCl_2$ contains about 10% less $HgCl_2$ than a pure sat. aqueous solution. Partition coefficient for $HgCl_2 \frac{\text{ether}}{H_2O} = 4.9$ at 0°; 3.02 at 14.6°; 2.80 at 16.8°. (Strömholm, Z. phys. Ch. 1903, **44.** 70.)

Solubility of $HgCl_2$ in ether+Aq at 25°.

% Ether	% H_2O	% $HgCl_2$
87.86	5.22	6.92
1.2	93.6	5.2
5.2	90.5	4.3
5.4	91.8	2.8
5.4	93.1	1.5

(Abe, J. Tok. Chem. Soc. 1912, **33.** 1087.)

Solubility of $HgCl_2$ in ether+ethyl alcohol at 25°.

% Alcohol	% $HgCl_2$	% Alcohol	% $HgCl_2$
67.57	32.43	27.16	36.29
58.59	32.50	22.48	34.08
51.02	37.39	15.20	28.55
44.79	37.96	8.97	20.67
38.69	38.24	0	5.49
32.84	37.75		

(Abe.)

4 pts. ether dissolve 1 pt. $HgCl_2$, but 4 pts. ether+1.33 pts. camphor dissolve 1.33 pts. $HgCl_2$; 4 pts. ether+4 pts. camphor dissolve 2 pts. $HgCl_2$; 4 pts. ether+8 pts. camphor dissolve 4 pts. $HgCl_2$; 4 pts. ether+16 pts. camphor dissolve 8 pts. $HgCl_2$. (Karls, Pogg, **10.** 608.)

3 pts. alcohol dissolve 1 pt. $HgCl_2$, but 3 pts. alcohol+1 pt. camphor dissolve 2 pts. $HgCl_2$; 3 pts. alcohol+3 pts. camphor dissolve 3 pts. $HgCl_2$; 3 pts. alcohol+6 pts. camphor dissolve 6 pts. $HgCl_2$. (Karls, *l. c.*)

Solution can be obtained containing 25 pts. camphor, 16 pts. $HgCl_2$, and only 4 pts. alcohol. Sp. gr. of solution = 1.326. (Simon, Pogg. **37.** 553.)

100 pts. acetone dissolve 60 pts. $HgCl_2$ at 25°. (Krug and M'Elroy, J. Anal. Appl. Ch. 184.)

98.35 pts. $HgCl_2$ are sol. in 100 pts. acetone at 0°.

110.95 pts. $HgCl_2$ are sol. in 100 pts. acetone at 10°.

126.80 pts. $HgCl_2$ are sol. in 100 pts. acetone at 18°. (Lasczynski, B. 1894, **27.** 2287.)

1 g. $HgCl_2$ is sol. in 0.70 g. acetone at 18°. Sg. gr. of sat. solution 18°/4° = 1.956.) (Naumann, B. 1904, **37.** 4334.)

Sat. solution in acetone contains 57.74 g. $HgCl_2$ in 100 g. solution at 25°. (Foote and Haigh, J. Am. Chem. Soc. 1911, **33.** 461.)

Sp. gr. at 26.7°/4° of $HgCl_2$+acetone containing 36.25% $HgCl_2$ = 1.1585. (Schönrock, Z. phys. Ch. 1893, **11.** 769.

Sp. gr. of $HgCl_2$+acetone.

% $HgCl_2$	Sp. gr. 20°/20°
0	0.8003
10.94	0.8847
21.05	0.9799

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 283.)

100 g. methyl acetate dissolve 46 g. at bpt. (56.5°). (Schroeder and Steiner, J. pr. 1909, (2) **79.** 49.)

1 g. $HgCl_2$ is sol. in 2.35 g. methyl acetate at 18°. Sp. gr. 18°/4° of the sat. solution = 1.251. (Naumann, B. 1909, **42.** 3793.)

Solubility in ethyl acetate.

Pts. sol in 100 pts. ethyl acetate.	
Pts. $HgCl_2$	t°
28.92	0
29.03	13
30.71	35
31.87	48
32.77	60
35.98	83

(Laszczynski, B. 1894, **27.** 2286.)

Solubility in ethyl acetate = 1 : 3.466 at 18°. (Alexander, Dissert. **1899.**)

Solubility of $HgCl_2$ in ethyl acetate.

Temp.	0°	13°	30°	40.5°	50.2°
Mol. $HgCl_2$ in 100 mols. $C_4H_8O_2$	15.4	15.9	16.0	16.1	16.3

(Linebarger, Am. Ch. J. 1894, **16.** 214.)

1 g. $HgCl_2$ is sol. in 3.5 g. ethyl acetate at 18°. Sp. gr. of sat. solution 18°/4° = 1.110. (Naumann, B. 1904, **37.** 3602.)

Solubility of $HgCl_2$ in ethyl acetate and acetone at t°.

t°	Molecules $HgCl_2$ sol. in 100 molecules of ethyl acetate	Molecules $HgCl_2$ sol. in 100 molecules of acetone	Solid present in acetone
—15	9.10	14.5	$HgCl_2$, CH_3COCH_3
0	9.25	14.3	"
+10	....	18.7	"
10	....	23.5	$HgCl_2$
17	....	23.2	"
25	9.15	22.8	"

(Aten, Z. phys. Ch. 1906, **54.** 121.)

Solubility of $HgCl_2$ in ethyl acetate+Aq at 25°.

P=g. ethyl acetate in 100 g. ethyl acetate +Aq.

$HgCl_2$=millimols. $HgCl_2$ in 10 cc. of the solution.

P	$HgCl_2$	Sp. gr.
0	2.67	1.0565
4.39	2.72	1.0581
96.76	15.34	1.2371
100	9.75	1.1126

(Herz and Anders, Z. anorg. 1907, **52.** 172.)

1 pt. is sol. in 2.05 pts. ethyl acetate at 18° or 100 g. ethyl acetate dissolve 48.7 g. $HgCl_2$. (Naumann, B. 1910, **43.** 315.)

Easily sol. in glycerine; sol. in 14 pts. glycerine. (Fairley, Monit. Scient. (3) **9.** 685.)

100 g. glycerine dissolve 80 g. $HgCl_2$ at 25°. (Moles and Maquina, Ann. Soc. Eshan. fis quin. 1914, **12.** 383.)

Solubility in organic solvents

Solvent	t°	Sat. solution contains % $HgCl_2$
Methyl alcohol	—34	7.6
	—20	11.5
	—15	12.8
	— 2	18.7
	+ 4	23.2
	12	27.6
	36	53.1
	51	61.0
	62	63.6
	64	63.7
	74	64.3
	100	68.7
	127	75.2
Ethyl alcohol	—60	3.0
	—55	7.8
	—43	8.8
	—40	9.8
	—30	14.3
	—23	18.6
	—21	19.1
	—20	21.9
	—17	22.1
	—11	24.7
	— 9	27.0
	— 5	29.7
	0	29.0
	+ 3	30.0
	7	30.9
	10	31.3
	14	31.3
	19	32.0
	31	34.2
	43	36.4
	51	38.9
	62	42.1
	63	42.5
	68	44.7
	75	45.2
	80	48.0
	92	51.0
	93	51.4
	100	53.6
	115	60.6
	127	65.3
	138	67.8
N-propyl alcohol	—32	14.7
	—22	15.4
	—14	15.6
	0	16.4
	0	16.5
	+16	18.2
	41	23.8
	53	27.9
	62	29.4
	67	32.7
	78	36.4
	100	43.8
	127	52.7
Allyl alcohol	—21	20.6
	— 1	29.6
	+ 8	35.2
	22	48.7
Acetone	—23	51.4
	—18	52.9
	—15	56.6
	—10	56.7
	— 8	58.4
	— 4	59.1
	— 1	60.1
	+ 6	61.9
	12	61.4
	15	61.8
	27	62.0
	36	61.9
	54	62.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % $HgCl_2$
N-butyl alcohol	—21	12.4
	— 6	13.0
	+ 9	14.3
	21	15.9
	59	25.8
	82	33.1
Isobutyl alcohol	—11	5.5
	— 6	6.2
	0	6.7
	+11	7.5
	63	19.3
	98	32.1
	127	42.0
	145	47.2
	155	50.4
Amyl alcohol	—13	8.6
	+26	8.9
	50	14.0
	90	29.8
	106	35.1
Ether	—47	5.6
	—40	5.8
	—35	6.1
	—30	5.9
	—19	5.6
	0	5.8
	+13	5.8
	83	8.4
	100	8.7
	115	9.0
Ethyl formate	—20	29.6
	— 3	29.2
	+24	30.0
	+46	31.0
Ethyl acetate	—50	39.6
	—20	40.5
	—14	40.2
	— 6	40.0
	0	39.5
	+ 7	39.9
	19	40.2
	45	41.6
	66	44.0
	100	47.8
	131	50.1
	150	57.0
	180	59.3
Methyl acetate	—20	42.0
	+24	40.3
	55	41.5
Amyl acetate	+22	18.3
	48	18.5
Ethyl butyrate	+20	12.6
	55	13.5
	71	15.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % $HgCl_2$
Acetic acid	+21	2.7
	22	3.0
	33	5.0
	43	6.0
	50	6.7
	61	8.0
	87	11.0
	95	12.0
	95	12.5
	115	16.0
	116	17.0
	127	20.0
	145	26.3
	182	44.8
	207	55.2
Formic acid	21	2.0
	50	3.2
	90	7.3

Very sl. sol. in propionic and isobutyric acids.

(Étard, A. ch. 1894, (7) **2.** 557 et seq.)

Solubility of $HgCl_2$ in organic solvents at t°.

Solvent	t°	% $HgCl_2$
$CHCl_3$	—20.5	0.01
	+44.2	0.12
C_6H_6	+6.5	0.26
	18.0	0.53
	34.1	0.64
	54.1	1.02
	69.0	1.39
$C_2H_4Cl_2$	0	1.33
	12.5	1.55
	20.8	1.68
	25.3	1.73
	30.2	1.92
	33.0	2.05
	45.9	2.42
$CH_3COOC_2H_5$	0	22.8
	6.5	22.7
	26.1	22.8
	38.5	23.5
	45.3	26.4

Dukelski, Z. anorg. 1907, **53.** 329.

Solubility of $HgCl_2$ in mixed organic solvents at t°.

Solvent	t°	% $HgCl_2$
$C_6H_6+C_2H_5OH$	—2.5	15.20
	0.0	15.40
	6.0	16.38
	20.5	18.40
	20.65	18.50
	24.5	19.33
	34.5	21.34
	54.4	24.84
	54.5	24.42
$C_6H_6+2C_6H_5OH$	—5.2	19.45
	0	20.13
	+9.1	21.65
	20.9	23.57
	24.4	24.19
	36.5	26.53
	53.7	31.27
	74.0	38.74
$CHCl_3+C_2H_5OH$	—20.5	3.82
	—12.0	4.43
	0.0	4.89
	+8.0	5.37
	23.0	7.12
	38.5	8.51
	44.2	9.51
	45.6	9.98
$CHCl_3+2C_2H_5OH$	—20.5	6.60
	0.0	7.69
	+8.0	8.96
	23.0	10.66
	38.5	12.50
	44.2	14.40
$CHCl_3+CH_3OH$	—12.0	1.73
	0.0	3.51
	+8.0	5.63
	23.0	10.15
	24.9	10.71
	30.6	11.40
	38.5	12.02
$CHCl_3+2CH_3OH$	—12.0	3.33
	0.0	6.73
	+8.0	8.21
	23.0	16.56
	24.9	18.45
	30.6	19.70
	38.5	20.83
CCl_4+2CH_3OH	0.0	5.20
	7.7	6.69
	24.9	14.06
	30.6	19.40
	.35.5	20.50
	36.1	21.80
	48.5	21.90

Solubility of $HgCl_2$ in mixed organic solvents at t°—*Continued.*

Solvent	t°	$HgCl_2$
$C_2H_4Cl_2+CH_3OH$	0.0	13.33
	12.5	21.30
	20.8	29.23
	25.3	34.78
	30.2	36.87
	33.0	37.01
	37.4	37.95
	45.9	39.36
$CH_3COOC_2H_5+C_6H_6$	0.0	9.62
	6.5	9.62
	25.7	9.78
	27.6	9.78
	35.5	10.81
	45.3	13.69
$CH_3COOC_2H_5+CHCl_3$	0.0	3.34
	26.1	4.07
	36.1	4.78
	46.0	5.38
	48.5	5.10
$2CH_3COOC_2H_5+CCl_4$	0.0	9.24
	10.3	9.05
	25.7	9.32
	27.6	9.50
	38.5	9.89
	45.3	11.70

(Dukelski, Z. anorg. 1907, **53.** 335.)

Solubility in organic solvents at 18°/20°.

100 g. chloroform dissolve 0.106 g. $HgCl_2$.

100 g. tetrachlormethane dissolve 0.002 g. $HgCl_2$.

100 g. bromoform dissolve 0.486 g. $HgCl_2$.

100 g. ethyl bromide dissolve 2.010 g. $HgCl_2$.

100 g. ethylene dibromide dissolve 1.530 g. $HgCl_2$ (Sulc. Z. anorg. 1900, **25.** 401.)

Solubility of $HgCl_2$ in various organic solvents at 25°.

G. = g. $HgCl_2$ dissolved in 1 mol. of solvent.

Solvent	G. $HgCl_2$
Ethylene chloride	1.216
Tetrachlorethane	0.146
Chloroform	0.120
Dichlorethylene	0.110
Pentachlorethylene	0.039
Trichlorethylene	0.036
Perchlorethylene	0.012
Carbon tetrachloride	Trace

(Hofman, et al., B. 1910, **43.** 188.)

Very sl. sol. in nitromethane at ord. temp. Very sol. on warming. (Bruner, B. 1903, **36.** 3298.)

Solubility in CS_2 at t°.

t°	100 pts. sat. solution contain pts. $HgCl_2$
—10	0.010
— 5	0.014
0	0.018
+ 5	0.022
10	0.026
15	0.032
20	0.042
25	0.053
30	0.063

(Arctowski, Z. anorg. 1894, **6.** 267.)

0.030 g. is dissolved in 100 g. sat. solution in CS_2 at 8°. (Arctowski, Z. anorg. 1894, **6.** 256.)

Formic acid (95%) dissolves 2.1% at 19°. (Aschan, Ch. Z. 1913, **37.** 1117.)

Sol. in molten urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

Sol. in ethyl sulphocyanate. (Kahlenberg, Z. phys. Ch. 1903, **46.** 66.)

Solubility of $HgCl_2$ in benzene.

100 pts. C_6H_6 dissolve at:—

15°	41°	55°	84°
0.54	0.62	0.85	1.80 pts. $HgCl_2$.

(Laszcynski, B. 1894, **27.** 2287.)

Solubility in C_6H_6 = 0.0197 mol./l. at 25°. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Sol. in C_6H_6, toluene, xylene, and other aromatic hydrocarbons. Insol. or only sl. sol. in petroleum ether, hexane, decane and CS_2. (Gulewitsch, B. 1904, **37.** 1563.)

Sol. in p-toluidine. (Werner.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Solubility of $HgCl_2$ in pyridine.

t = point of fusion.

Solid Phase = $HgCl_2$, $2C_5H_5N$.

t°	% $HgCl_2$	t°	% $HgCl_2$	t°	% $HgCl_2$
—32.8	2.76	40.90	29.29	78.0	49.72
—21.9	7.86	50.10	34.94	78.7	50.37
+ 0.02	13.14	60.03	40.36	80.2	51.52
12.58	17.34	70.15	46.44	82.5	52.40
18.78	19.78	70.8	45.77	89.0	56.45
23.60	21.59	74.6	48.00	90.8	57.01
27.23	22.65	75.2	48.38	94.1	60.09
31.05	24.46	76.4	49.15		

Solubility of $HgCl_2$ in pyridine.—*Continued.*

t = point of fusion.

Solid Phase = $HgCl_2$, C_5H_5N.

t°	% $HgCl_2$	t°	% $HgCl_2$	t°	% HgCl
74.7	48.38	90.61	53.50	104.1	60.09
83.5	50.53	75.0°	56.45	104.2	60.72
86.5	52.37	99.5	56.07	104.7	58.97
87.3	52.02	99.5	57.01	107.	63.06
		100.5	57.84		

Solid Phase = $3HgCl_2$, C_5H_5N.

t°	% $HgCl_2$	t°	% $HgCl_2$	t°	% $HgCl_2$
94.7	60.72	113.6	63.06	124.2	65.00
95.2	60.77	114.0	63.18	129.4	65.63
106.4	61.93	115.7	63.37	145.5	69.66
109.8	62.58	118.2	64.09		

(McBride, Z. phys. Ch. 1910, **14.** 196.)

Solubility in pyridine.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5.8	19	27.0	87	38.5	130
5.9	18.5	28.6	(98)	41.0	137
10.2	39.5	30.3	91.5	43.2	142
14.1	52	31.2	92	44.0	143.5
21.4	74.5	33.1	108	47.5	159
25.0	83	35.1	115.5	52.8	173

(Staronka, Anz. Ak. Wiss. Krakau, **1910.** 372.)

Sp. gr. at 16°/4° of $HgCl_2$+pyridine containing 17.53% $HgCl_2$ = 1.1523; containing 6.57% $HgCl_2$ = 1.0388. (Schönrock, Z. phys. Ch. 1893, **11.** 768.)

Mol. weight determined in benzonitrile, methyl- and ethyl-sulphide. (Werner, Z. anorg. 1897, **15. 31.** 26 and 30.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Easily sol. in oil of turpentine and other essential oils; sl. sol. in cold benzene, but much more on heating, crystallising on cooling. (Franchimont, B. **16.** 387.)

Easily sol. in boiling creosote.

Insol. in olive oil.

Insol. in oils and fats but sol. when first dissolved in alcohol, free ether or anhydrous ketones. (Glock, Ch. Z. Repert. **36.** 315.)

Extracted from $HgCl_2$+Aq by volatile oils.

Mercuric hydrogen chloride (Chloromercuric acid), $HgCl_2$, $HCl = HHgCl_3$.

Decomp. by H_2O. (Boullay, A. ch. **34.** 243.)

Easily decomposed. (Neumann, **M. 10.** 236.)

$HgCl_2$, $2HCl+7H_2O$. Decomp. by H_2O. (Ditte, A. ch. (5) **22.** 551.)
$3HgCl_2$, $4HCl+14H_2O$. As above.
$2HgCl_2$, $HCl+6H_2O$. As above.
$4HgCl_2$, $2HCl+9H_2O$. As above.
$3HgCl_2$, $HCl+5H_2O$. As above.

Mercuric hydrazine chloride, $HgCl_2$, $2(N_2H_4, HCl)$.

Very sol. in H_2O. More sol. in hot alcohol than in cold; decomp. by HNO_3. (Curtius, J. pr. 1894, (2) **50.** 332.)

Mercuric nickel chloride, basic, $HgCl_2$, $6NiO$, $NiCl_2+20H_2O$, and $HgCl_2$, $7NiO$, $NiCl_2$.

(Mailhe, A. ch. 1902, (7) **27.** 369.)

Mercuric nickel chloride.

Deliquescent. (v. Bonsdorff.)

Mercuric nitrosyl chloride, $HgCl_2$, $NOCl$.

Sol. in H_2O without effervescence. (Sudborough, Chem. Soc. **59.** 659.)

Mercuric phosphoric chloride, $3HgCl_2$, $2PCl_5$.

Decomp. and dissolved by H_2O. (Baudrimont, A. ch. (4) **2.** 45.)

Mercuric potassium chloride, $2HgCl_2$, $KCl+2H_2O$.

Very easily sol. in warm H_2O. A clear solution at 18° is filled with crystals at 15°. Sl. sol. in alcohol. (v. Bonsdorff, Pogg. **17.** 122.)
$HgCl_2$, $KCl+H_2O$. Easily sol. in H_2O; sl. sol. in alcohol. (v. Bonsdorff, Pogg. **19.** 336.)
$HgCl_2$, $2KCl+H_2O$. As above.
Solubility determinations show that the double salts formed by mercuric and potassium chlorides at 25° are:
$2KCl$, $HgCl_2+H_2O$.
KCl, $HgCl_2+H_2O$. Can be recryst. without decomp.
KCl, $2HgCl_2+2H_2O$. Gives $HgCl_2$ on recryst. from H_2O. (Foote and Levy, Am. Ch. J. 1906, **35.** 237.)

Mercurous rhodium chloride.

See **Chlororhodite, mercurous.**

Mercuric rubidium chloride, $HgCl_2$, $RbCl$.

Sol. in H_2O.
$HgCl_2$, $2RbCl$. Sol. in H_2O and HCl+Aq. (Godeffroy, Arch. Pharm. (3) **12.** 47.)
$+2H_2O$. Sol. in H_2O. (Godeffroy.)
$2HgCl_2$, $RbCl$. Sol. in H_2O. (Godeffroy.)
Solubility determinations show that at 25° there exist five double mercuric rubidium chlorides with the following formulas:
$RbCl$, $5HgCl_2$. Gives $HgCl_2$ on recryst. from H_2O.
$3RbCl$, $4HgCl_2+H_2O$. Gives $RbCl$, $5HgCl_2$ on recryst from H_2O.
$RbCl$, $HgCl_2+H_2O$. Gives $3RbCl$, $4HgCl_2$ on recryst. from H_2O.
$3RbCl$, $2HgCl_2+2H_2O$. Gives $3RbCl$, $4HgCl_2$ on recryst. from H_2O.
$2RbCl$, $HgCl_2+H_2O$. Gives $3RbCl$, $4HgCl_2$ on recryst from H_2O.
(Foote and Levy, Am. Ch. J. 1906, **35.** 241.)

Mercurous silver chloride, $HgCl$, $AgCl$.

(Jones, J. Soc. Chem. Ind. 1893, **12.** 983.)
$2HgCl$, $AgCl$. Min. *Bordosite.* (Jones, J. Soc. Chem. Ind. 1893, **12.** 983.)
$3HgCl$, $AgCl$. (Jones, Chem. Soc. 1910, **97.** 338.)

Mercuric sodium chloride, $HgCl_2$, $NaCl$.

Sp. gr. at 16°/4° of aqueous solution containing 14.937% salt = 1.13310; containing 11.0736% = 1.09528. (Schönrock, Z. phys. Ch. 1893, **11.** 782.)
$+H_2O$. (Linebarger, Am. Ch. J. 1893, **15.** 344.)
$+1\frac{1}{2}H_2O$. Sol. in 0.33 pt. H_2O at 15°. (Schindler, Repert. **36.** 240.)
Extremely easily sol. in alcohol. (Voit.)
Sol. in 275 pts. ether. Ether dissolves the undecomposed salt out of H_2O solution. (Lassaigne, A. ch. **64.** 104.)
$HgCl_2$, $2NaCl$. Deliquescent. Very sol. in H_2O. (Voit, A. **104.** 354.)
$2HgCl_2$, $NaCl$. Decomp. by H_2O in dil. solution. Sol. in acetone and acetic ether. (Linebarger, Am. Ch. J. 1893, **15.** 344.)
Solubility determinations show that the only double salt formed by mercuric and sodium chlorides between 10.3° and 25° is $NaCl$, $HgCl_2+2H_2O$. Can be recryst. from H_2O. (Foote and Levy, Am. Ch. J. 1906, **35.** 237.)

Mercuric strontium chloride, basic, $SrCl_2$, $HgO+6H_2O$.

Decomp. by H_2O. (André, C. R. **104.** 431.)

Mercuric strontium chloride, $2HgCl_2$, $SrCl_2+2H_2O$.

Easily sol. in H_2O. (v. Bonsdorff.)
$3HgCl_2$, $SrCl_2+5$–$6H_2O$. Very sol. in H_2O. (Swan, Am. Ch. J. 1898, **20.** 632.)

Mercurous sulphur chloride.

See **Mercurous sulphochloride.**

Mercuric thallous chloride, $HgCl_2$, $TlCl$.

Easily sol. in H_2O. (Jörgensen, J. pr. (2) **6.** 83.)

Mercurous stannous chloride, Hg_2Cl_2, $SnCl_2$.

Decomp. by H_2O. (Capitaine, J. Pharm. **25.** 549.)

Mercuric yttrium chloride, $3HgCl_2$, YCl_3+9H_2O.

Deliquescent. Very sol. in H_2O. (Popp, A. **131.** 179.)

Mercuric zinc chloride, $HgCl_2, ZnCl_2$.

Very sol. in H_2O. (Harth, Z. anorg. 1897, **14.** 323.)

$2HgCl_2, ZnCl_2$. (Varet, C. R. 1896, **123.** 422.)

Mercuric zinc chloride ammonia, $HgCl_2, 4ZnCl_2, 10NH_3+2H_2O$.

Insol. in boiling H_2O, but decomp. thereby. (André, C. R. **112.** 995.)

$HgCl_2, 2ZnCl_2, 6NH_3+\frac{1}{2}H_2O$. As above. (André.)

Mercuric chloride ammonia, $HgCl_2, 12NH_3$

Sl. sol. in ammonia. (Franklin, Am. Ch. J. 1900, **23.** 300.)

Mercuric chloride cadmium oxide, $HgCl_2, CdO+H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 371.)

Mercuric chloride cobaltous oxide, $HgCl_2, 3CoO+\frac{1}{2}H_2O$.

(Mailhe, C. R. 1901, **132.** 1274.)

Mercuric chloride cupric oxide, $HgCl_2, 3CuO+H_2O$.

(Mailhe, Bull. Soc. 1901, (3) **25.** 791.)

Mercuric chloride hydrazine, $HgCl_2, N_2H_4$.

Very unstable. Decomp. by H_2O. Pptd. from alcohol solution by H_2O; very sol. in min. acids with decomp.

Easily sol. in HCl or HNO_3. Decomp. by alkalies. Somewhat sol. in acetic acid. (Hofmann, B. 1897, **30.** 2020.)

Mercuric chloride hydroxylamine, $HgCl_2, 2NH_2OH$.

Completely sol. in methyl and ethyl alcohol; insol. in ether; decomp. by H_2O and $NaOH+Aq$. Sol. in $NH_2OH,HCl+Aq$. (Adams, Am. Ch. J. 1902, **28.** 210.)

Mercuric chloride lead oxide, $HgCl_2, 2PbO+2H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 372.)

Mercuric chloride strontium chromate, $2HgCl_2, HCl, SrCrO_4$.

Sol. in H_2O without decomp. (Imbert, Bull. Soc. 1897, (3) **17.** 471.)

Mercuric chloroiodide, $2HgCl_2, HgI_2$.

Sol. in H_2O. (Liebig.)

$HgCl_2, HgI_2$. Sl. sol. in hot H_2O with partial decomp. More easily sol. in alcohol. (Köhler, B. **12.** 1187.)

Mercurous fluoride, Hg_2F_2.

Decomp. by H_2O with separation of Hg_2O.

Mercuric fluoride, HgF_2+2H_2O.

Decomp. by cold H_2O, with separation of HgO. Sol. in dil. HNO_3+Aq, and $HF+Aq$. (Finkener, Pogg. **110.** 628.)

Mercurous hydrogen fluoride, $Hg_2F_2, 4HF+4H_2O$.

Deliquescent. Easily sol. in H_2O. Sol. in dil. acids and dil. HF. (Böhm, Z. anorg. 1905, **43.** 327.)

Mercurous silicon fluoride.

See **Fluosilicate, mercurous.**

Mercurous fluoride ammonia, $Hg_2F_2, 2NH_3$.

Stable on air. (Finkener, Pogg. **110.** 142.)

Mercurous hydroxide, HgOH.

Nearly insol. in cold, sol. in hot H_2O. Sol. in $NaOH+Aq$. (Bhaduri, Z. anorg. 1897, **13.** 410.)

Mercurous iodamide, $Hg_2(NH_2)I$.

(Rammelsberg, Pogg. **48.** 184.)

Is a mixture of Hg and $Hg(NH_2)I$. (Barford.)

Mercurous iodide, Hg_2I_2.

Sol. in over 2375 pts. H_2O. (Saladin, J. chim. méd. **7.** 530.)

Solubility in $H_2O=2.6 \times 10^{-8}$ g.-equiv. per liter (calculated). (Bodländer, Z. phys. Ch. 1898, **27.** 58.)

Solubility in $H_2O=3 \times 10^{-10}$ mols. per litre at 25°. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

Sol. in $Hg(NO_3)_2+Aq$. (Stromann, B. **20.** 2815.)

Sol. in $KI+Aq$. Easily sol. in $Hg_2(NO_3)_2+Aq$. Sl. sol. in NH_4OH+Aq. Sol. in hot NH_4Cl+Aq, but less than HgI_2. Less sol. in NH_4NO_3 than in NH_4Cl+Aq. (Brett.)

Partially sol. with separation of Hg and formation of HgI_2, in cold $KI+Aq$, hot NaI, CaI_2, SrI_2, BaI_2, MgI_2, ZnI_2, and NH_4I+Aq; in warm NaCl, KCl and NH_4Cl+Aq, and slowly in hot $HCl+Aq$. (Boullay, A. ch. (2) **34.** 358.)

Decomp. by alkali chlorides+Aq. (Miahle, A. ch. (3) **5.** 177.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Not wholly insol. in alcohol, ether, or chloroform. (Maclagan, Rep. anal. Ch. **1884.** 378.)

Decomp. by boiling alcohol; 1000 g. boiling alcohol decomp. about 3.15 g. Hg_2I_2. (François, C. R. 1896, **121.** 890.)

Boiling alcohol decomp. Hg_2I_2 to Hg and HgI_2 which dissolves until 0.220 g. HgI_2 are contained in 100 g. alcohol. (François, C. R. 1896, **121.** 889.)

Insol. in cold ether. (François, J. Pharm. 1897, (6), **6.** 445.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3.** 345.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Phenol at 180° decomp. it into Hg and HgI_2 until a state of equilibrium is reached with

2.75 g. HgI_2 to 100 g. phenol, above which point HgI is sl. sol. (0.05 g. in 100 g.) in phenol-HgI_2 mixture. Decomp. by cold aniline more rapidly than by hot. Equilibrium is reached when 26.35 g. HgI_2 are present to 100 g. aniline at bpt. of aniline. Aniline containing more than 26 g. HgI_2 to 100 g. dissolves HgI in considerable quantity. (François, C. C. **1896**, I, 470.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sl. sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, **9.** 647.)

Mercuric iodide, HgI_2.

Sol. in 150 (?) pts. H_2O. (Würtz.)

1 l. H_2O at 17.5° dissolves 0.0403 g. HgI_2. (Bourgoin, A. ch. (6) **3.** 429.)

Sol. in about 6500 pts. H_2O. (Hager.)

According to calculation from electrical conductivity of HgI_2+Aq, HgI_2 is much less sol., 1 l. H_2O dissolving only 0.5 mg. HgI_2 at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

1 l. H_2O dissolves 0.054 g. HgI_2 at 22°. (Rohland, Z. anorg. 1898, **15.** 412.)

1 l. H_2O at 25° dissolves about 0.06 g. (Morse, Z. phys. Ch. 1902, **41.** 731.)

1 l. H_2O at 18° dissolves 4×10^{-6} mol. (Abegg, Z. Elektrochem. 1903, **9.** 553.)

Solubility in H_2O at 25° = 0.00013 mol. liter. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

1 l. H_2O dissolves 0.4 mg. HgI_2 at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1 l. H_2O at 18° dissolves 0.2 to 0.4 mg. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

The yellow modification is always deposited from solution even in the presence of an excess of the red form. (Gernez, C. R. 1903, **136.** 1323.)

Sol. in many acids, especially in HCl, and HI+Aq. Insol. in $HC_2H_3O_2$+Aq. (Berthemot.) Scarcely sol. in dil. HNO_3+Aq.

Not attacked by cold H_2SO_4, decomp. by hot. (Ditte, A. ch. 1879, (5) **17.** 124.)

Sat. solution in H_2SO_3+Aq contains at critical temp. (158.2°), 0.7% HgI_2. (Niggli, Z. anorg. 1912, **75.** 182.)

Sol. in hot $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, cold NH_4Cl, NH_4NO_3, or ammonium succinate+Aq. (Wittstein.)

Sol. in $HgCl_2$, $Hg(NO_3)_2$, or $Hg(C_2H_3O_2)_2$+Aq. Easily sol. in $Na_2S_2O_3$+Aq. Easily sol. in soluble iodides+Aq. More sol. in hot than in cold NaI or KI+Aq. When conc., 1 mol. KI in hot solution dissolves 3 mols. HgI_2, but a portion separates on cooling. BaI_2, SrI_2, MgI_2, and CaI_2 act in the same way. Easily sol. in cold, more sol. in hot ZnI_2+Aq, 2 mols. HgI_2 being dissolved to 1 mol. ZnI_2. In NH_4I+Aq, 3 mols. HgI_2 are dissolved to 2 mols. NH_4I. Abundantly sol. in hot KCl, NaCl, NH_4Cl+Aq, but separates out on cooling, and the trace remaining may be pptd. by H_2O, 2 g. KCl in solution dissolves 1.166 g. HgI_2. Sol. in $HgCl_2$+Aq, and very easily sol. in alcoholic solution of $HgCl_2$. (Boullay, A. ch. (2) **34.** 346.)

Solubility in MI+Aq at 25°.

Salt	In 10 ccm. of the solution	
	Millimols HgI_2	Millimols salt
NaI	4.12	7.94
	6.22	13.85
	9.45	22.25
KI	1.27	3.03
	1.80	3.90
	5.10	10.34
	7.00	15.54
	12.24	25.19
CaI_2	0.50	0.53
	2.61	2.52
	4.40	4.68
	4.58	4.84
	17.06	17.99
SrI_2	2.12	2.54
	3.20	3.55
	5.82	5.39
	6.94	6.08
BaI_2	0.59	0.99
	7.42	7.48
	8.98	9.78
	14.62	15.08

(Herz and Paul, Z. anorg. 1913, **82.** 434.)

Solubility of HgI_2+KI in H_2O.

% KI	% HgI_2	Solid phase
Temp. = 20°.		
50.9	19.3	KI
44.4	32.4	"
39	48	"
37.4	53.6	KI+$KHgI_3$
37.8	52.6	$KHgI_3$
35.1	52.2	"
35.5	51.2	$KHgI_3$, H_2O
26.7	50.3	$KHgI_3$+HgI_2
26.6	49.4	HgI_2
23.7	40.2	"
14.9	22.5	"
Temp. = 30°		
60.6	....	KI
40	53	KI+$KHgI_3$
39.6	52.7	$KHgI_3$
40	52.2	"
40.2	51.2	"
39.3	50.3	"
33.7	49.8	"
33	52	"
31.4	51.7	$KHgI_3$, H_2O
29.1	52.2	"

(Dunningham, Chem. Soc. 1914, **105.** 368.)

Very sol. in KSCN+Aq. (Philipp, Pogg. 1867, **131.** 93.)

Sol. in 1.09 pts. cryst. $Na_2S_2O_3$+Aq. (Eder and Ulm, M. 1882, **3.** 197.)

Very sol. in hot $CaCl_2$+Aq, less sol. in $BaCl_2$, KCl and NaCl+Aq. (Lea, Z. anorg. 1896, **12.** 341.)

Solubility in normal $Hg(NO_3)_2$+Aq= 48.0 g. per litre. (Morse, Z. phys. Ch. 1902, **41.** 731.)

Extremely sol. in cold conc. NH_4Br+Aq. (Grossmann, B. 1903, **36.** 1602.)

Sol. in alkali sulphites+Aq. (Barth, Z. phys. Ch. 1892, **9.** 215.)

Sol. in $Ca(OCl)_2$+Aq; sol. in KOH+Aq. (Melsens, A. ch. (3) **26.** 222.)

Sol. in liquid SO_2. (Walden and Centnerszwer, C. C. **1902,** I. 344.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in $SOCl_2$, S_2Cl_2, SO_2Cl_2, warm $AsCl_3$, PBr_3, warm $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

More sol. in alcohol than in H_2O. 1 l. H_2O containing 10% of 90% alcohol dissolves 0.08 g. HgI_2. 1 l. of alcohol of 80° B. dissolves 2.851 g. HgI_2, 1 l. absolute alcohol dissolves 11.86 g. HgI_2. (Bourgoin, A. ch. (6) **3.** 429.)

Sol. in 130 pts. cold, and 15 pts. hot 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 3.16 pts. at 19.5°; 100 pts. absolute ethyl alcohol dissolve 2.09 pts. at 19.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

0.00842 pt. is sol. in 1 pt. alcohol at 15°. (Gautier and Charpy, C. R. 1890, **111.** 647.)

100 g. methyl alcohol dissolve 3.7 g. HgI_2 at 19°; ethyl alcohol, 1.86 g.; propyl alcohol, 1.25 g.; isobutyl alcohol, at 22.5°, 0.51 g. (Timofeiew, Dissert. **1894.**)

At 15–20°, 100 g. methyl alcohol dissolve 3.24 g. HgI_2; ethyl alcohol, 1.42 g.; propyl alcohol, 0.826 g. (Rohland, Z. anorg. 1898, **15.** 412.)

Solubility of HgI_2 in ethyl alcohol+Aq at 25°.

A=g. alcohol in 100 g. alcohol+Aq.

HgI_2=millimols. HgI_2 in 100 cc. of the solution.

A	HgI_2	Sp. gr.
100	3.86	0.80325
95.82	2.56	0.80950
92.44	1.92	0.81536
86.74	1.38	0.82996
78.75	0.935	0.84654
67.63	0.45	0.87214

(Herz and Knoch, Z. anorg. 1905, **45.** 266.)

Solubility of HgI_2 in methyl alcohol+Aq at 25°.

P=g. alcohol in 100 g. alcohol+Aq.

HgI_2=millimols. HgI_2 in 10 cc. of the solution.

P	HgI_2	Sp. gr.
0	0.0013	....
47.06	0.0098	0.9187
64.00	0.0347	0.8834
78.05	0.0981	0.8519
100	0.571	0.8155

(Herz and Anders, Z. anorg. 1907, **52.** 165.)

Solubility of HgI_2 in ethyl alcohol+Aq at 25°.

P=g. alcohol in 100 g. alcohol+Aq.

HgI_2=millimols. HgI_2 in 10 cc. of the solution.

P	HgI_2	Sp. gr.
70.01	0.061	0.8636
100	0.386	0.8032

(Herz and Anders, Z. anorg. 1907, **52.** 170.)

At 15°, 1 pt. by weight is sol. in:—

24813 pts. H_2O.

30.8 pts. methyl alcohol of sp. gr. at 0.7990.

70.3 " ethyl " " " " " 0.8100.

121.0 " propyl " " " " " 0.8160.

(Rohland, Z. anorg. 1899, **18.** 328.)

Solubility of HgI_2 in mixtures of methyl and ethyl alcohol at 25°.

P=% methyl alcohol in the mixtures.

HgI_2=g. HgI_2 in 10 ccm. of the solution.

S 25°/4°=Sp. gr. of the sat. solution.

P	HgI_2	S 25°/4°
0	0.180	0.8038
4.37	0.193	0.8039
10.4	0.208	0.8046
41.02	0.232	0.8077
80.69	0.289	0.8131
84.77	0.296	0.8140
91.25	0.298	0.8146
100	0.316	0.8156

(Herz and Kuhn, Z. anorg. 1908, **58.** 164.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. HgI_2 in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.316	0.8156
23.8	0.304	0.8155
91.8	0.169	0.8101
93.75	0.167	0.8110
96.6	0.153	0.8108
100	0.142	0.8116

(Herz and Kuhn, Z. anorg. 1908, **60.** 158.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. HgI_2 in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.180	0.8038
8.1	0.173	0.8036(?)
17.85	0.165	0.8043
56.6	0.155	0.8075
91.2	0.152	0.8099
95.2	0.144	0.8108
100	0.142	0.8116

(Herz and Kuhn, Z. anorg. 1908, **60.** 161.)

Solubility in 100 pts. amyl alcohol equals:

0.66 pts. at 13°.
3.66 " " 71°.
5.30 " " 100°.
9.57 " " 133.5°.

(Laszcynski, B. 1894, **27.** 2287.)

Sp. gr. at 16°/4° of HgI_2+alcohol containing 1.8358% HgI_2=0.80718; containing 1.7119%=0.80597. (Schönrock, Z. phys. Ch. 1893, **11.** 770.)

Somewhat sol. in ether. Sol. in 77 pts. ether. (Saladin.) Sol. in 60 pts. ether. (Hager.)

Sol. in cold ether. (François, J. Pharm. 1897, (6) **6.** 445.)

Very sl. sol. in anhydrous ether. (Hampe.)

0.62 pt. is sol. in 100 pts. ether at 0°.
0.97 pt. is sol. in 100 pts. ether at 36°.

(Laszcynski, B. 1894, **27.** 2286.)

Solubility in ether=0.3% at ord. temp. (Marsh, Chem. Soc. 1910, **97.** 2299.)

Nearly insol. in ether. (Dunningham, Chem. Soc. 1914, **105.** 368.)

Data are given on the system HgI_2+KI+ether. (Dunningham.)

Solubility at 23° in chloroform=0.071%; in ether=0.551%; in acetone=2.005%: in ethyl alcohol=2%; in methyl alcohol=3.975%; in benzene=0.247%. (Beckmann and Stock, Z. phys. Ch. 1895, **17.** 130.)

Solubility in organic solvents at t°.

Solvent	t°	100 g. of the solvent dissolve g. HgI_2
Chloroform	61	0.163
Tetrachlormethane	75	0.094
Ethylene dichloride	85.5	1.200
Isobutyl chloride	69	0.328
Ethyl bromide	38	0.773
Methyl alcohol	66	6.512
Ethyl alcohol	78	4.325
Isopropyl alcohol	81	2.266
Isobutyl alcohol	ca. 100	2.433
Methyl formate	36–38	1.166
Ethyl formate	52–55	2.150
Methyl acetate	56–59	2.500
Ether	35	0.470
Acetone	56	3.249
Acetal	ca. 100	2.000
Chloral	96	...
Epichlorhydrin	ca. 100	6.113
Hexane	67	0.072
Benzene	80	0.825
Ethyl acetate	74–78	4.200

(Sulc, Z. anorg. 1900, **25.** 402.)

Solubility in organic solvents at 18–20°.
100 g. chloroform dissolve 0.040 g. HgI_2.
100 g. tetrachlormethane dissolve 0.006 g. HgI_2.
100 g. bromoform dissolve 0.486 g. HgI_2.
100 g. ethyl bromide dissolve 0.643 g. HgI_2.
100 g. ethyl iodide dissolve 2.041 g. HgI_2.
100 g. ethylene dibromide dissolve 0.748 g. HgI_2.

(Sulc, Z. anorg. 1900, **25.** 401.)

1 pt. ethylene bromide dissolves 0.00553 pts. HgI_2 at 15°. (Gautier and Charpy, C. R. 1890, **111.** 647.)

100 pts. methylene iodide CH_2I_2 dissolve 2.5 pts. HgI_2 at 15°, 16.6 pts. at 100°, and 58 pts. at 180°. (Retgers, Z. anorg. **3.** 252.)

1 l. sat. solution in CCl_4 at 15° contains 0.170 g. HgI_2. (Dawson, Chem. Soc. **1909, 95.** 874.)

Sol. in 340 pts. glycerine. (Fairley, Monit. Scient. (3) **9.** 685.)

100 pts. acetone dissolve 2.09 pts. HgI_2 at 25°. (Krug and M'Elroy, J. Anal. Ch. **6.** 84.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II, 1014.)

Solubility in 100 pts. acetone equals:

2.83 pts. HgI_2 at — 1°.
3.36 " " " 18°.
4.73 " " " 40°.
6.07 " " " 58°.

(Laszczynski, B. 1894, **27.** 2287.)

100 g. methyl acetate solution, sat. at 18°, contain 1.10 g. HgI_2. (Bezold, Dissert. **1906.**)

100 g. boiling methyl acetate slowly dissolve 2.3 g. HgI_2. (Schroeder and Steiner, J. pr. 1909, (2) **79.** 49.)

Solubility in ethyl acetate at t°.

Pts. sol. in 100 pts. ethyl acetate	t°
1.49	— 2
1.56	+17.5
1.64	21
2.53	40
3.19	55
4.31	76

(Laszczynski, B. 1894, **27.** 2286.)

100 g. ethyl acetate anhydrous, or sat. with H_2O at 18°, dissolve at 18°, 14.70 g. HgI_2. Solubility increases somewhat with temp. (Hamers, Dissert. **1906.**)

Solubility of HgI_2 in ethyl acetate+Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate +Aq.

HgI_2 = millimols. HgI_2 in 10 cc. of the solution.

P	HgI_2	Sp. gr.
4.39	0.0028	0.9973
96.76	0.412	0.9063
100	0.241	0.9011

(Herz and Anders, Z. anorg. 1907, **52.** 172.)

1 pt. is sol. in 68.03 pts. ethyl acetate at 18°. (Naumann, B. 1910, **43.** 316.)

Solubility in diethyl oxalate is 12.5% at bpt. and 2.5% at 100°. (Reinders, Z. phys. Ch. 1900, **32.** 507.)

Solubility in CS_2 at t°.

t°	100 pts. sat. solution contain pts. HgI_2
—10	0.107
— 5	0.141
0	0.173
+ 5	0.207
10	0.239
15	0.271
20	0.320
25	0.382
30	0.445

(Arctowski, Z. anorg. 1894, **6.** 267.)

Solubility in CS_2.

100 g. of the sat. solution contain at:

—86.5°	—93°	—116°
0.024	0.023	0.017 g. HgI_2.

(Arctowski, Z. anorg. 1896, **11.** 274.)

0.0028 pt. is sol. in 1 pt. CS_2 at 15°. (Gautier and Charpy, C. R. 1890, **111.** 647.)

1 l. sat. solution in CS_2 at 15° contains 3.127 g. HgI_2. (Dawson, Chem. Soc. **1909, 95.** 874.)

Very sol. in liquid methylamine. (Gibbs, J. Am. Chem. Soc. 1906, **28.** 1419.)

Abundantly sol. in methylamine. (Fitzgerald, J. phys. Chem. 1912, **16.** 633.)

Somewhat sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, **9.** 647.)

Sol. in $Sb(CH_3)_4I$+Aq.

Very sl. sol. in Na citrate+Aq. (Spiller.)

1 pt. C_6H_6 dissolves 0.00217 pts. HgI_2 at 15°. (Gautier and Charpy, C. R. 1890, **111.** 647.)

Solubility in 100 pts. benzene equals:

0.22 pts. at 15°.
0.88 " " 60°.
0.95 " " 65°.
1.24 " " 84°.

(Laszczynski, B. 1894, **27.** 2284.)

1 l. C_6H_6 dissolves 0.00493 mol. HgI_2 at 25°. (Sherrill, Z. phys. Ch. 1903, **43.** 735.)

100 g. boiling phenol dissolve 10 g. HgI_2. (François, C. R. 1895, **121.** 769.)

Sl. sol. in phenol with 20% H_2O. Not very sol. in acetic acid at 119°, in amyl acetate at 133°, in amyl bromide at 119°. Rather sol. in diethyl oxalate at 186°, in ethylene bromide at 131°, in amyl alcohol at 137°, in amyl iodide at 150°, in $CHBr_3$ at 151°, in iodobenzol at 190°, in oil of turpentine at 160°. Very sol. in benzaldehyde at 179°, in methylene iodide at 182°. (Reinders, Z. phys. Ch. 1900, **32.** 506.)

1000 pts. oil of bitter almonds dissolve 4 pts. HgI_2 at ord. temp.; 1000 pts. olive oil, 4 pts.; 1000 pts. poppy oil, 10 pts.; 1000 pts. nut oil, 15 pts.; 1000 pts. castor oil, 20 pts.; 1000 pts. lard oil, 4. 5 pts.; 1000 pts. vaseline, 2.5 pts.; 1000 pts. benzene, 4 pts. Sol. in phenol. (Mehn, Pharm. J. **3.** 327; B. **19.** 8 R.)

Solubility in aniline.

S = Temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5.9	12°	19.9	48.5°	33.0	128°
8.2	22.5	25.8	53.5	35.6	140
10.3	29	29.3	105	37.5	147
14.9	41.5	31.7	122	39.2	156
16.6	45	32.4	(55)		

(Staronka, Anz. Ak. Wiss. Krakau, **1910.** 372.)

Solubility of HgI_2 in aniline at t°.

t°	g. HgI_2 per 100 g. aniline	Solid phase
—6.5	23.35	$HgI, 2C_6H_5NH_2$
+0.4	28.69	"
17.8	42.85	"
21.1	47.55	"
26.9	55.47	"
30.1	62.05	"
36.2	75.80	"
42.9	96.49	"
46.8*	....	" $+HgI_2$(red)
48.8	128.1	HgI_2(red)
63.6	163[illegible]	"
70.82	184.1	"
76.2	201.6	"
95.9	246.7	"
108.*	....	HgI_2(red)$+HgI_2$(yellow)
115.7	281.8	HgI_2(yellow)
137.2	285.2	"
181.1	279	"
199.1	863.2	"

* Transition point.

(Pearce and Fry, J. phys. Ch. 1914, **18.** 667.)

Very sol. in boiling alcoholic solution of aniline. (Vohl, Dissert. **1871.**)

Abundantly sol. in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, **15.** 7.)

Sol. in benzonitrile (0.98 g. in 100 g. at 18°). 20 times more sol. by addition of 5 g. KI to 100 cc. benzonitrile. (Naumann, B. 1914, **47.** 1375.)

Sol. in pyridine. (Naumann, B. 1904, **37.** 4609.)

Solubility of HgI_2 in pyridine.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5	10°	34.6	107°	51.3	93.5°
9.8	42.5	38.0	103	51.6	96
15.14	66.5	43.0	97	52.7	108
19.3	83	46.7	88.5	53.2	109
26.3	102.5	48.5	89	55.4	122
29.6	107	50.6	89	57.9	135

(Staronka, Anz. Ak. Wiss. Krakau, **1910.** 372.)

Sp. gr. at 16°/4° of HgI_2+pyridine containing 10.43% HgI_2 = 1.1482; containing 7.99% = 1.1053. (Schönrock, Z. phys. Ch. 1893, **11.** 770.)

Solubility of HgI_2 in quinoline.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
4.7	100°	29.8	151°	43.0	165°
9.1	115.5	31.4	153	46.1	167
13.2	133.5	35.4	156	48.8	170
23.1	138	37.7	160	49.5	169.5
26.7	145	41.6	165	54.4	166.5

(Staronka, Anz. Ak. Wiss. Krakau, **1910.** 372.)

Mol. weight determined in pyridine, methyl- and ethyl-sulphide. (Werner, Z. anorg. 1897, **15.** 20.)

More or less sol. at high temp. in petroleum (bpt. 160–230°), bromnaphthalene, pyridine, toluidine and amyl alcohol. (Reinders, Z. phys. Ch. 1900, **32.** 503.)

Yellow modification.

100 g. of sat. solution in acetone at 25° contain 3.0 g. HgI_2. (Reinders, Z. phys. Ch. 1900, **32.** 514.)

Red modification.

Solubility in alcohol equals:

0.717–0.724 g. in 100 g. solution at 0°
1.044–1.084 g. " " " 25°
2.10–2.20 g. " " " 50°.

(Reinders, Z. phys. Ch. 1900, **32.** 522.)

100 g. of sat. solution in acetone at 25° contain 1.95 g. HgI_2. (Reinders, Z. phys. Ch. 1900, **32.** 514.)

HgI_2 is moderately sol. in abs. alcohol at its b.-pt. The solution has a decided yellow color. On cooling, yellow crystals separate out. They soon change to the red modification.

Readily sol. in hot amyl alcohol. Yellow crystals separate from the solution when cooled.

Readily sol. in allyl alcohol, forming a yellow solution, from which yellow crystals separate on cooling.

Sl. sol. in acetone, giving a yellow solution. On cooling yellow plates separate from the solution and rapidly turn red.

Sol in phenol at 150° C. Solution has yellow color and yellow crystals separate out on cooling.

Readily sol. in boiling benzene. Saturated solution is yellow. The yellow iodide separates out on cooling, and changes rapidly to the red.

Sol. in toluene giving yellow solution, from which yellow crystals separate on cooling. They rapidly change to red.

Readily sol. in naphthalene at temperatures above its transition point. Solution is yellow and on cooling yellow crystals separate out.

Readily sol. in hot pseudo-cumene giving a yellow solution. On cooling gives yellow crystals.

Readily sol. in ethyl iodide giving very

yellow solution, from which yellow crystals separate on cooling, which change to red rapidly.

Only sl. sol. in ethyl bromide, giving yellow solution from which yellow crystals separate on cooling, which change rather slowly to the red.

Sparingly sol. in isopropyl bromide.

Moderately sol. in isobutyl bromide, giving a pink solution from which yellow crystals separate on cooling, which change slowly to red.

Sl. sol. in ethylidene chloride. On sudden cooling at 18° the iodide crystallizes out in yellow plates, which quickly change to red.

Sparingly sol. in propyl chloride, giving a pink solution, from which yellow crystals separate on cooling.

Readily sol. in ethyl cyanide, giving a yellow solution. On cooling yellow crystals separate and rapidly change to red.

Moderately sol. in benzene cyanide, giving a deep yellow solution. On sudden cooling the solution deposits yellow crystals, which rapidly turn red.

Rapidly sol. in benzoic acid at high temperatures.

Sparingly sol. in ethyl acetate, giving yellow solution.

Sol. in ethyl propionate.

Very sol. in ethyl butyrate, giving a yellow solution. On cooling the iodide crystallized from the solution.

Sl. sol. in ethyl isobutyrate.

Readily sol. in methyl salicylate, giving a yellow solution.

Sparingly sol. in phenyl salicylate, giving yellow solution. On cooling yellow crystals separate out, which gradually change to red. (Kastle, Am. Ch. J. 1899, **22.** 474.)

Mercuromercuric iodide, $Hg_4I_6 = Hg_2I_2$, $2HgI_2$.

Insol. in H_2O or alcohol. Partially sol. in KI+Aq, in hot NaCl, and NH_4Cl+Aq, and in hot HCl+Aq, though very slowly. (Boullay, A. ch. (2) **34.** 345.

Mercury *per***iodide,** HgI_6.

Sol. in KI+Aq. Decomp. by cold H_2O or alcohol. (Jörgensen, J. pr. (2) **2.** 347.)

Mercuric hydrogen iodide (Iodomercuric acid), HI, $HgI_2 = HHgI_3$.

Crystallises from HI+Aq. (Boullay.)

Easily decomp. (Neumann, M. **10.** 236.)

$3HgI_2$, $2HI + H_2O$. (François, Dissert. **1901.**)

Mercuric nickel iodide, HgI_2, $NiI_2 + 6H_2O$.

Sol. in alcohol, ether, and acetone; not decomp. by H_2O. (Dobroserdoff, C. C. **1901,** II. 332.)

$2HgI_2$, $NiI_2 + 6H_2O$. Hydroscopic; decomp. by H_2O; sol. in acetone and ether. (Dobroserdoff, C. C. **1901,** II. 332.)

Mercuric potassium iodide, HgI_2, $KI + 1\frac{1}{2}H_2O$.

Deliquescent (v. Bonsdorff). Permanent; decomp. by H_2O into 2KI, HgI_2, and HgI_2 (Boullay); sol. in alcohol, ether, and conc. $HC_2H_3O_2$, but decomp. by other acids (Berthemot, J. Pharm. **14.** 186). Sp. gr. of sat. solution in H_2O = 2.4 to 3.1.

$+H_2O$. Sol. in H_2O with decomp. Can be cryst. from alcohol. Very sl. sol. in dry ether. Very sol. in wet ether. (Marsh, Chem. Soc. 1910, **97.** 2297.)

HgI_2, 2KI. Sol. in H_2O. (Thomsen and Bloxam, Chem. Soc. **41.** 379.)

Sat. solution of KI+HgI_2 in H_2O at 22.9° contains 8.66% K, 22.49% Hg and 52.48% I, corresponding to 0.22 mol. K, 0.11 mol. Hg and 0.45 mol. I. (Duboin, C. R. 1905, **141.** 385.)

Sp. gr. at 16°/4° of aqueous solution containing 12.2875% salt = 1.10148; containing 12.2371% = 1.1038; containing 7.9843% = 1.06491. (Schönrock, Z. phys. Ch. 1893, **11.** 782.)

Sol. in methyl acetate. (Bezold, Dissert. **1906.**)

Sol. in ethyl acetate. (Alexander, Dissert. **1899**; Hamers, Dissert. **1906.**)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Sol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

$+2H_2O$. Sol. in alcohol, ether and acetone; decomp. by H_2O. (Pawlow, C. C. **1901,** I. 363.)

Solubility determinations show that $KHgI_3$ and $KHgI_3 + H_2O$ are the only double salts formed at 20°–30°. See HgI_2+KI under HgI_2. (Dunningham, Chem. Soc. 1914, **105.** 368.)

Mercuric rubidium iodide, HgI_2, RbI.

Sol. in alcohol; decomp. by H_2O.

HgI_2, 2RbI. Very easily sol. in H_2O. (Grossmann, B. 1904, **37.** 1258.)

Very sol. in acetic acid and alcohol; decomp. by H_2O. Stable in aq. solution in the presence of an excess of RbI. (Erdmann, Arch. Pharm. 1894, **232.** 30.)

Mercuric silver iodide, HgI_2, 2AgI.

(Wegelius and Kilpi, Z. anorg. 1909, **61.** 416.)

Mercuric sodium iodide, HgI_2, NaI.

Deliquescent, and decomp. by much H_2O. (v. Bonsdorff, Pogg. **17.** 266.)

Sol. in alcohol; decomp. by H_2O.

HgI_2, 2NaI. Deliquescent; sol. in H_2O and alcohol. (Boullay.)

Sat. solution of NaI+HgI_2 in H_2O at 24.75° contains 4.59% Na, 25% Hg, and 58.25% I, corresponding to 0.20 mol. Na,

0.12 mol. Hg, and 0.45 mol. I. (Duboin, C. R. **1905, 141.** 385.)

$+4H_2O$. Extremely deliquescent. (Duboin, C. R. 1906, **143.** 314.)

Mercuric strontium iodide, HgI_2, SrI_2 (?).

Sol. in H_2O without decomp. (Boullay.)

$+8H_2O$. As Ca salt. (Duboin, C. R. 1906, **142.** 573.)

$2HgI_2, SrI_2$ (?). Decomp. by much H_2O into sol. HgI_2, SrI_2 and insol. HgI_2. (Boullay.)

Mercuric thorium iodide, $5HgI_2, ThI_4+18H_2O$.

Very deliquescent. Easily decomp. by H_2O. (Duboin, A. ch. 1909, (8) **16.** 282.)

$5HgI_2, 2ThI_4+21H_2O$. (Duboin.)

$2HgI_2, ThI_4+12H_2O$. (Duboin.)

Mercuric zinc iodide.

Deliquescent. Decomp. by H_2O. (v. Bonsdorff.)

Mercuric iodide ammonia, $HgI_2, 2NH_3$.

Decomp. by NH_3 giving NHg_2I and NH_4I. (François, C. R. 1900, **130.** 333.)

Stable only in the presence of excess of ammonia. Gives off NH_3 in the air. (François, J. Pharm. 1897, (6) **5.** 388; C. C. **1897,** I. 1088.)

Mercuric iodide hydrazine, HgI_2, N_2H_4.

Decomp. by H_2O. (Hofmann and Marburg, A. 1899, **305.** 215.)

Mercuric iodide rubidium bromide, $HgI_2, 2RbBr$.

Decomp. by H_2O.

Sol. in alcohol without decomp. (Grosmann, B. 1903, **36.** 1603.)

Mercuric iodide silver chloride, $HgI_2, 2AgCl$.

Insol. in H_2O. (Lea, Sill. Am. J. (3) **7.** 34.)

Mercury iodoantimonide, $Hg_3Sb_42HgI_2$.

Sol. in HNO_3 aqua regia and hot H_2SO_4; insol. in HCl. (Granger, C. R. 1901, **132.** 1116.)

Mercury nitride, Hg_3N_2.

Gradually decomp. by H_2O. Decomp. by conc. HNO_3, or HCl+Aq. (Hirzel, J. B. **1852.** 419.)

Not attacked by cold, but decomp. by hot dil. H_2SO_4.

Sol. in acids+Aq.

Sol. in ammoniacal solutions of ammonium salts.

Insol. in excess of KNH_3. (Franklin, Z. anorg. 1905, **46.** 18.)

Sol. in ammonia solutions of ammonium salts and in aq. acid solutions.

Very explosive. (Franklin, J. Am. Chem. Soc. 1905, **27.** 835.)

HgN_3.

See **Mercurous azoimide.**

HgN_6.

See **Mercuric azoimide.**

Mercurous oxide, Hg_2O.

Insol. in H_2O. Insol. in dil. HCl or HNO_3+Aq. Sol. in warm conc. $HC_2H_3O_2$+Aq.

Sol. in 150,000 pts. H_2O. (Bhaduri. Z. anorg. 1897, **13.** 410.)

Decomp. by H_2O or weak bases (Rose), $(NH_4)_2CO_3$+Aq (Wittstein), KNO_3+Aq (Rose), KI+Aq (Berthemot), or conc. NH_4Cl+Aq (Pagenstecher) into HgO and Hg, or $HgCl_2$, etc.

Sl. decomp. by alkali chlorides+Aq with formation of $HgCl_2$, which dissolves. (Miahle.)

Sl. sol. in alkali cyanides+Aq. (Jahn.)

Insol. in KOH, and NaOH+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol and ether.

Mercuric oxide, HgO.

Sol. in 20,000 to 30,000 pts. H_2O. (Bineau, C. R. **41.** 509.)

Sol. in 200,000 pts. H_2O. (Wallace, Ch. Gaz. **1858.** 345.)

Ordinary coarse HgO is sol. in H_2O to the extent of 50 mg. per l. at 25°, but when finely powdered the solubility increases to 150 mg. per l. (Hulett, Z. phys. Ch. 1901, **37.** 406.)

Red modification is:—

Sol. in 19,500 pts. H_2O at 25°; in 2,600 pts. H_2O at 100°. (Schick, Z. phys. Ch. 1903, **42.** 172.)

1 l. H_2O dissolves 50 mg. red modification of HgO at 25°. (Hulett, Z. phys. Ch. 1901, **37.** 406.)

Yellow modification is:—

Sol. in 19,300 pts. H_2O at 25°; in 2400 pts. at 100°. (Schick, Z. phys. Ch. 1903, **42.** 172.)

Sol. in acids. Insol in H_3PO_4 or H_3AsO_4+Aq. (Haack, A. **262.** 190.)

Scarcely attacked by $H_2C_2O_4$+Aq. (Millon, A. ch. (3) **18.** 352.)

Solubility of HgO in HF at 25°.

Hg = g.-atoms Hg in 1 l. of the solution.

HF normal	Hg
0.12	0.01258
0.24	0.0247
0.57	0.0629
1.11	0.1168
2.17	0.2586

(Jaeger, Z. anorg. 1901, **27.** 26.)

Solubility of HgO in HF is decreased by the addition of KF, which proves the non-existence of complex fluorides. (Jaeger.)
Insol. in H_3AsO_4, H_3PO_4 and in primary and secondary alkali salts of these acids. (Haack, A. 1891, **262.** 190.)
Sol. in hot NH_4Cl+Aq, less in NH_4NO_3+Aq. (Brett.)
Insol. in KOH, or NaOH+Aq.
Decomp. by alkali chlorides+Aq into $HgCl_2$, which dissolves. (Miahle, A. ch. (3) **5.** 177.)
Sol. in $Fe(NO_3)_3$, and $Bi(NO_3)_3$+Aq with pptn. of oxides. Sol. in KI+Aq. (Persoz.)
Very sol. in acid sulphites+Aq. (Barth, Z. phys. Ch. 1892, **9.** 192.)
Completely sol. in conc. $CaCl_2$, $BaCl_2$, $MgCl_2$, and $SrCl_2$+Aq. (André, C. R. 1887, **104.** 431.)
Solubility in Ag salts+Aq. 100 g. Ag_2SO_4 in aqueous solution dissolve 13 g. HgO. Solubility in $AgNO_3$+Aq is 15.6 : 100; in Ag acetate+Aq is 1.137:100. (Finci, Gazz. ch. it. 1911, **41.** (2) 545.)
Much less sol. in KCl and NaCl+Aq than in H_2O. (Schoch.)
Sol. in $U(NO_3)_3$, $Al(NO_3)_3$ and $Fe(NO_3)_3$+Aq. (Mailhe, A. ch. 1902, (7) **27.** 373.)
Very sl. sol. in cold $Hg(CN)_2$+Aq, abundantly sol. at 75° with evolution of HCN. (Barthe, J. Pharm. 1896, (6) **3.** 183.)
Sol. in cold or hot alcoholic NH_4SCN in large amounts. (Fleischer, A. 1875, **179.** 225.)
Completely sol. in KI+Aq. (Jehn, Arch. Pharm. 1873, **201.** 97.)
Solubility of red or yellow modification in N/50 KCl+Aq is about 25% greater than in pure H_2O. (Schick, Z. phys. Ch. 1903, **42.** 168.)
Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
Sol. in alcoholic solution of hydroxylamine hydrobromide below 0°. (Adams, Am. Ch. J. 1902, **28.** 216.)
Insol. in alcohol.
Sol. in trichloracetic acid+Aq. (Brand, J. pr. 1913, (2) **88.** 342.)
Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
When freshly pptd., is insol. in acetone+Aq. even on warming, but easily sol. if liquid is made alkaline by NaOH. Insol. in acetophenone even after long warming at 100°. Sol. in acetaldehyde and much H_2O and a little NaOH. (Auld and Hantzsch, B. 1905, **38.** 2680.)
Sol. in formamide. (Fischer, Arch. Pharm. 1894, **232.** 329.)
Very sol. in ethylene diamine. For 1 mol. HgO, 7–10 mols. ethylene diamine are necessary. (Traube and Löwe, B. 1914, **47.** 1910.)
Easily sol. in benzamide. (Dessaignes, A. ch. 1852, (3) **34.** 146.)
When freshly pptd., is sol. in picric acid+Aq. (Varet, C. R. 1894, **119.** 560.)
Sol. in alkaline solution of phenol disulphonic acid. (Lumiére and Chevrotier, C. R. 1901, **132.** 145.)
Sol. in nucleic acid+Aq when freshly pptd. (Schweckerath, Pat. **1899.**)
Sol. in gum arabic+Aq. (Peschier, J. Pharm. 1896, (6) **3.** 509.)

Mercuric oxybromide, $HgBr_2$, HgO.

(Andre, A. ch. (6) **3.** 123.)
$HgBr_2$, 2HgO. (André.)
$HgBr_2$, 3HgO. (*a*) *Yellow.* Insol. in cold, sl. sol. in hot H_2O. Easily sol. in alcohol. (Löwig.)
(*b*) *Brown.* Insol. in alcohol. (Rammelsberg, Pogg. **55.** 248.)
$HgBr_2$, 4HgO. (André.)
Insol. in ord. solvents. Decomp. by alkalies and acids. (Fischer and von Wartenburg, Ch. Z. 1902, **26.** 894.)
$2HgBr_2$, 7HgO. Readily decomp. by acids and alkalies. (Fischer and von Wartenburg.)

Mercurous oxychloride, Hg_2O, 2HgCl.

Min. *Eglestonite.*
Decomp. by hot HCl and by HNO_3. (Moses, Am. J. Sci, 1903, (4) **16.** 253.)

Mercuric oxychloride,

HgO, $HgCl_2$. Less sol. than $HgCl_2$, but not isolated. (Thümmel.) Decomp. by cold H_2O. (André, A. ch. (6) **3.** 118.)
HgO, $2HgCl_2$. Decomp. by warm H_2O or cold alcohol into 2HgO, $HgCl_2$. (Thümmel, Arch. Pharm. (3) **27.** 589.)
Decomp. by H_2O. Not decomp. by alcohol. (Arctowski, Z. anorg. 1895, **9.** 178.)
2HgO, $HgCl_2$. *Two modifications.*
A. Red. Insol. in H_2O; decomp. by alkali carbonates, or chlorides+Aq into 4HgO, $HgCl_2$.
Acted upon by cold alkali carbonates and alkali chlorides+Aq. (Schoch, Am. Ch. J. 1903, **29.** 335.)
Not decomp. by H_2O at ord. temp. (Thümmel.)
Very sl. sol. in cold, completely sol. in hot H_2O. (Haack, A. 1891, **262.** 189.)
A small amt. of HNO_3 converts it into a white powder; more HNO_3 dissolves it. (Haack, A. 1891, **262.** 189.)
B. Black. Not decomp. by alkali chlorides, or carbonates+Aq. (Thümmel.)
Not affected by boiling alkali carbonates or alkali chlorides+Aq. (Schoch, Am. Ch. J. 1901, **29.** 335.)
Insol. in cold and hot H_2O and alcohol.
Sol. in acid. (Van Nest, Dissert. **1909.**)
Not changed by H_2O. (Blaas, Miner. Mitt. (2) **2.** 177.)

Sol. in HNO_3 or HCl+Aq. (Blaas.)
Not changed by alcohol. (Blaas.)
$+\frac{1}{2}H_2O$. (Rây, A. 1901, **316.** 255.)
$3HgO$, $HgCl_2$. Decomp. by warm H_2O. (Thümmel.)
Not attacked by cold H_2O. (André.)
Ppt. (Tarugi, Gazz. ch. it. 1901, **31.** 313.)
Decomp. by H_2O. Not decomp. by alcohol. (Arctowski, Z. anorg. 1895, **9.** 178.)
Three modifications.
a. Prisms. Decomp. by boiling H_2O.
b. Brick-red, amorphous.
c. Yellow plates.
(Schoch, Am. Ch. J. 1903, **29.** 337.)
Yellow plates.
Decomp. by hot H_2O, Na_2CO_3 or NaOH+Aq. Sol. in $KHCO_3$+Aq. Insol. in cold dil. HNO_3. (Tarugi.)
$4HgO$, $HgCl_2$. Decomp. by H_2O. Not decomp. by alcohol. (Arctowski, Z. anorg. 1895, **9.** 178.)
Two modifications.
A. Yellow plates.
Easily sol. in acids. Insol. in alcohol and ether. Decomp. by KOH. (Dukelski, Z. anorg. 1906, **49.** 336.)
B. Brown, amorphous.
Easily sol. in acids. Decomp. by KOH. Insol. in alcohol and ether. (Dukelski, Z. anorg. 1906, **49.** 336.)
$5HgO$, $HgCl_2$. (Millon.)
Does not exist. (Thümmel.)
$6HgO$, $HgCl_2$. Does not exist. (T.)
$+H_2O$. Insol. in cold H_2O. (Roucher, A. ch. (3) **27.** 353.)
Does not exist. (T.)
$7HgO$, $4HgCl_2$. (Roucher.)
Does not exist. (T.)

Mercuromercuric oxychloride, Hg_2OCl.
Min. *Terlinguaite.*
Decomp. by HCl and HNO_3.
Slowly decomp. by cold acetic acid when powdered. (Hillebrand and Schaller, J. Am. Chem. Soc. 1907, **29.** 1190.)

Mercuric strontium oxychloride, HgO, $SrCl_2+6H_2O$.
Decomp. by H_2O. (André, C. R. **104.** 431.)

Mercuric oxyfluoride, HgO, HgF_2+H_2O.
Decomp. by H_2O. Sol. in dil. HNO_3+Aq. (Finkener.)

Mercuric oxyiodide, $3HgO$, HgI_2.
Decomp. by H_2O. Sol. in HI+Aq. (Weyl, Pogg. **131.** 524.)

Mercuric oxyphosphide, $Hg_5P_2O_4$.
Decomp. by H_2O. (Partheil and van Haaren, Arch. Pharm. 1900, **238.** 35.)

Mercuric oxyselenide, $2HgSe$, HgO.
Easily sol. in aqua regia. (Uelsmann, A. **116.** 122.)

Mercury phosphide, Hg_3P_2.
Insol. in H_2O, HNO_3, or HCl+Aq. Easily sol. in aqua regia. (Granger, C. R. **115.** 229.)
Hg_3P_4. (Granger, C. N. 1898, **77.** 229.)

Mercury phosphochloride, P_2Hg_3, $3HgCl_2+3H_2O$.
*See Di*mercuriphosphonium **mercuric chloride.**

Mercury phosphosulphide, $2HgS$, P_2S.
HgS, P_2S.
$2HgS$, P_2S_3. (Berzelius.)
$3HgS$, P_2S_3. (Baudrimont, C. R. **55.** 323.)
$2HgS$, P_2S_5. (Berzelius, A. **47.** 256.)

Mercuric selenide, HgSe.
Sol. in cold aqua regia when crystalline. When precipitated shows the same properties towards solvents as mercuric sulphide. (Reeb J. Pharm. (4) **9.** 173.)
Min. *Tilmannite.* Sol. only in aqua regia.

Mercuric selenochloride, $2HgSe$, $HgCl_2$.
Insol. in boiling HCl, HNO_3, or H_2SO_4+Aq. Easily sol. in aqua regia and a mixture of H_2SO_4 and conc. HNO_3+Aq. (Uelsmann, J. B. **1860.** 92.)

Mercurous sulphide, Hg_2S.
Insol. in H_2O, dil. HNO_3, hot NH_4OH, or $(NH_4)_2S$+Aq. Sol. in KOH+Aq with separation of Hg. (Rose.)
Does not exist; only mixtures of Hg and HgS are formed. (Barfoed, J. pr. **93.** 230.)
See also Baskerville, J. Am. Chem. Soc. 1903, **25.** 799.)
Not attacked by HNO_3 below 0°, but attacked by dil. HNO_3 and HCl+Aq when temp. is increased. Sol. in Na_2S or K_2S but Hg soon ppts. (Antony and Sestini, Gazz. ch. it. 1894, **24,** (1) 194.)

Mercuric sulphide, HgS.
Insol. in H_2O.
Pptd. as a brown coloration in presence of 20,000 pts. H_2O, and as a green coloration in presence of 40,000 pts. H_2O. (Lassaigne.)
Much less sol. in H_2O than Ag_2S or Cu_2S. (Bodländer, Z. phys. Ch. 1898, **27.** 64.)
1 l. H_2O dissolves 0.05×10^{-6} mols HgS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)
Sol. in cold conc., and in hot dil. HI+Aq or HBr+Aq. (Kekulé, A. Suppl. **2.** 101.) Very sl. decomp. by hot conc. HCl+Aq. Not attacked by hot HNO_3+Aq. Sol. in cold aqua regia.
Not attacked by 4-N HNO_3 or 4-N HNO_3 +4-N H_2SO_4 at ord. temp. even after many days. By action of a mixture of equal volumes of 4-N HNO_3 and conc. H_2SO_4, there was slight action on pptd. HgS after 14, more action after 62 days. If HgS is boiled with the 4-N acids, oxidation takes place most rapidly with 4-N HNO_3, then the mixture 66.7% 4-N H_2SO_4+33.3% 4-N HNO_3, then

33.3% 4-N H_2SO_4+66.7% 4-N HNO_3, and lastly 4-N H_2SO_4 alone. (Moore, J. Am. Chem. Soc. 1911, **33.** 1094.)

Cold conc. H_2SO_4 does not attack red or black HgS, but they are attacked by hot acid. (Berthelot, A. ch. 1898, (7) **14.** 198.)

Freshly pptd. HgS is insol. in dil. KCN+Aq. (Berthelot.)

Sol. in K_2S+Aq, but readily only in presence of free alkali. (Brunner, Pogg. **15.** 596.) Insol. in boiling KOH+Aq.

Sol. in KSH or NaSH+Aq. Very sl. sol. in cold yellow $(NH_4)_2S$+Aq. Insol. in KCN or $Na_2S_2O_3$+Aq. (Fresenius.)

Easily sol. in conc. Na_2S or K_2S+Aq, even in absence of KOH or NaOH. Insol. in $(NH_4)_2S$+Aq. Sol. in CaS, BaS, or SrS+Aq. Insol. in NaSH or KSH+Aq. (de Koninck, Z. angew. Ch. **1891.** 51.)

Solubility in NaSH is very small in comparison with that in Na_2S+Aq. (Knox, Trans. Faraday. Soc. 1908, **4.** 30.)

Solubility in BaS is practically equal to that in Na_2S. (Knox.)

All cryst. modifications are sol. in conc. K_2S and in conc. Na_2S+Aq. (Allen and Crenshaw, Am. J. Sci. 1912, (4) **34.** 368.)

Sol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. **16.** 2015.)

1 l. BaS_2H_2+Aq containing 50 g. Ba dissolves no HgS in the cold, but 50–60 g. at 40–50°.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in pyridine. (Schroeder, Dissert. **1901.**)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Exists in a colloidal state, sol. in H_2O. (Winnsinger, Bull. Soc. (2) **49.** 452.)

Min. *Cinnabar.* Insol. in H_2O, alcohol, dil. acids. or alkaline solutions.

Decomp. by hot dil. HNO_3+Aq. Not decomp. by HCl+Aq, but easily by hot H_2SO_4 or aqua regia. Easily sol. in $CuCl_2$+Aq. (Karsten.)

Sol. in a mixture of Na_2S and NaOH when present in the proportion of HgS : $2Na_2S$.

Sol. in pure Na_2S+Aq or in mixtures of Na_2S and NaSH+Aq. Insol. in cold NaSH+Aq, but sol. on warming with evolution of H_2S. (Becker, Sill. Am. J. (3) **33.** 199.)

Insol. in acetone. (Krug and M'Elroy.)

Cinnabar is easily sol. in 20% HBr+Aq. (Rising and Lenher, J. Am. Chem. Soc. 1896, **18.** 96.)

Sol. in S_2Cl_2. (Smith, J. Am. Chem. Soc. 1898, **20.** 291.)

Mercuric platinum sulphide.

See **Sulphoplatinate, mercuric.**

Mercuric potassium sulphide, K_2S, 2HgS.

Decomp. into its constituents by H_2O; decomp. by HCl, and HNO_3+Aq, and by hot KOH, and NH_4OH+Aq. (Schneider, Pogg. **127.** 488.)

K_2S, HgS+$5H_2O$. Decomp. by H_2O or alkalies. (Weber, Pogg. **97.** 76.)

+H_2O. (Ditte.)

+$7H_2O$. Sol. in K_2S+Aq. (Ditte, C. R. **98.** 1271.)

K_2S, 5HgS+$5H_2O$. Easily decomp. by H_2O. (Ditte.)

Mercuric sodium sulphide, HgS, Na_2S+$8H_2O$.

Decomp. by H_2O or alkalies.

5HgS, $2Na_2S$+$3H_2O$. Decomp. by H_2O. (Knox, Trans. Faraday Soc. 1908, **4.** 36.)

Mercuric sulphobromide, 2HgS, $HgBr_2$.

Insol. in H_2O. Not attacked by boiling HNO_3 or H_2SO_4. (Rose.)

Mercuric sulphochloride, 2HgS, $HgCl_2$.

Insol. in H_2O, cold or hot, dil. or conc. HNO_3, H_2SO_4, or HCl+Aq. (Rose, Pogg. **13.** 59.)

Decomp. by hot aqua regia.

By boiling with dil. HNO_3, H_2SO_4 and HCl, Hg and Cl go into solution. (Hamers, Dissert. **1906.**)

Insol. in H_2O and H_2SO_4. Partly sol. in HCl and HNO_3; easily sol. in aqua regia. (Alexander, Dissert. **1899.**)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) **17.** 356.)

3HgS, $HgCl_2$. Properties as the above comp. (Poleck and Goercki, B. **21.** 2415.)

4HgS, $HgCl_2$. As above. (P. and G.)

5HgS, $HgCl_2$. As above. (P. and G.)

Insol. in alkali sulphides and in fuming HNO_3; decomp. by NaOBr+Aq and by KOH. (Bodroux, C. R. 1900, **130.** 1399.)

Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides+Aq; slowly sol. in alkalies or alkali hydrosulphides+Aq. (Atterberg, J. B. **1873.** 258.)

Mercurous sulpho*tetra*chloride, Hg_2SCl_4.

Decomp. by H_2O with separation of S, $HgCl_2$ going into solution. (Capitaine, J. Pharm. **25.** 525.)

Mercuric sulphofluoride, 2HgS, HgF_2.

Decomp. by boiling H_2O. Not decomp. by hot HCl or HNO_3+Aq, but gives HF with hot H_2SO_4+Aq. (Rose, Pogg. **13.** 66.)

Mercury sulpho*di*imide, HgN_2S, NH_3.

Ppt. (Ruff, B. 1904, **37.** 1585.)

Mercuric sulphoiodide, HgS, HgI_2.

Ppt. (Rammelsberg, Pogg. **48.** 175.)

2HgS, HgI_2. (Palm, C. C. **1863.** 121.)

Insol. in min. acids with exception of aqua regia. (Hamers, Dissert. **1906.**)

Mercuric sulphoiodide ammonia, 2HgS, HgI_2, NH_3.

(Foerster, Ch. Z. 1895, **19.** 1895.)

Mercuric telluride, HgTe.

Min. *Coloradoite.* Sol. in boiling HNO_3+Aq with separation of H_2TeO_3.

Metastannic acid.

See **Stannic acid.**

Molybdatoiodic acid.

See **Molybdoiodic acid.**

Molybdenum, Mo.

Not attacked by HCl, HF, or dil. H_2SO_4+Aq. Sol. in conc. H_2SO_4. Very easily sol. in aqua regia. Oxidised by HNO_3+Aq either to molybdenum oxide, which dissolves in HNO_3, or, if HNO_3 is in excess, to molybdic acid, which remains undissolved.

Attacked by HNO_3+Aq containing 3–70% HNO_3, but only slowly by 70% acid, with formation of insol. white powder; much more vigorously by 50% acid, in which case a clear solution is formed. (Montemartini, Gazz. ch. it. **22.** 384.)

Not attacked by alkalies+Aq. (Bucholz, Scher. J. **9.** 485.)

With a sp. gr. 9.01, the metal is malleable and sol. in a mixture of HF and HNO_3; sol. in fused $KClO_3$. (Moissan, Bull. Soc. 1895, (3) **13.** 966.)

Ductile Mo is moderately quickly attacked by HNO_3, H_2SO_4 and HCl. (Fink, Met. Chem. Eng. 1910, **8.** 341.)

Not immediately attacked by cold dil. HNO_3. Not attacked by dil. and conc. H_2SO_4. Boiling dil. HCl+Aq does not attack; conc. dissolves traces by long heating. Sol. in aqua regia. (Lederer, Dissert. **1911.**)

Dil. HCl dissolves 20.3% Mo at 110° in 18 hrs. More slowly sol. in HCl (sp. gr. 1.15).

Insol. in dil. H_2SO_4 at 110°. Slowly sol. in conc. H_2SO_4 (sp. gr. 1.82) at 110°, rapidly sol. at 200°–250°.

Slowly sol. in conc. HNO_3 (sp. gr. 1.40), rapidly sol. in dil. HNO_3 (sp. gr. 1.15).

Rapidly sol. in hot aqua regia. Insol. in hot or cold HF. (Ruder, J. Am. Chem. Soc. 1912, **34.** 388.)

Insol. in KOH+Aq. Sol. in fused KOH. (Ruder, J. Am. Chem. Soc. 1912, **34.** 389.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Molybdenum acichloride.

See **Molybdenyl chloride.**

Molybdenum amide, $OH.MoO_2.NH_2$.

Very unstable. Insol. in abs. alcohol. (Fleck, Z. anorg. 1894, **7.** 353.)

Molybdenum amide nitride, $Mo_5N_{10}H_4$ = $4MoN_2$, $Mo(NH_2)_2$.

Not attacked by HCl, or dil. HNO_3+Aq. (Uhrlaub.)

Molybdenum amidochloride, $Mo_2(NH_2)_3Cl_3$.

Insol. in H_2O and dil. acids. (Rosenheim, Z. anorg. 1905, **46.** 317.)

Molybdenum amidochloride ammonia, $Mo_2(NH_2)_3Cl_3$, $10NH_3$.

Unstable in the air. (Rosenheim, Z. anorg. 1905, **46.** 319.)

Molybdenum boride, Mo_3B_4.

Moderately attacked by hot conc. acids and vigorously by hot aqua regia. (Tucker and Moody, Chem. Soc. 1902, **81.** 17.)

Molybdenum *di*bromide, $MoBr_2 = Mo_3Br_4Br_2$.

See **Bromomolybdenum bromide.**

Molybdenum *tri*bromide, $MoBr_3$.

Not decomp. by H_2O. Boiling conc. HCl, and cold dil. HNO_3+Aq do not attack appreciably. Dil. alkalies act slowly, but decomp. with separation of Mo_2O_3 on boiling. (Blomstrand, J. pr. **82.** 435.)

Molybdenum *tetra*bromide, $MoBr_4$.

Rapidly deliquescent, and easily sol. in H_2O. (Blomstrand, J. pr. **82.** 433.)

Molybdenum bromochloride, etc.

See **Bromomolybdenum chloride, etc.**

Molybdenum bronze.

See **Molybdate molybdenum oxide, sodium.**

Molybdenum carbide, Mo_2C.

Insol. in HNO_3. (Moissan, Bull. Soc. 1895, (3) **13.** 967.)

MoC. Does not decomp. H_2O even at 500–600°. Slowly attacked by hot HCl, HF and hot conc. H_2SO_4. Easily decomp. by HNO_3. Not attacked by NaOH+Aq or KOH+Aq. (Moissan and Hoffmann, C. R. 1904, **138.** 1559.)

Molybdenum carbonyl, $Mo(CO)_6$.

Quickly attacked by bromine. Sol. in ether or benzene. (Mond, Hirtz and Cowap, Chem. Soc. 1910, **97.** 808.)

Molybdenum *di*chloride, $MoCl_2 = Mo_3Cl_4Cl_2$.

See **Chloromolybdenum chloride.**

Molybdenum *tri*chloride, $MoCl_3$.

Insol. in H_2O or boiling conc. HCl+Aq. Easily sol., especially when heated, in HNO_3 +Aq. Sol. in H_2SO_4. Decomp. by NH_4OH, KOH, or NaOH+Aq.

Sl. sol. in alcohol. (Leichti and Kempe.)

Practically insol. in alcohol and ether. (Hampe, Ch. Z. 1888, **12.** 5.)

Molybdenum *tetra*chloride, $MoCl_4$.

Deliquescent. Hisses with little H_2O, but only partly sol. in more H_2O. Only sl. sol. in conc. HCl+Aq. Sol. in H_2SO_4 or HNO_3+Aq. Partly sol. in alcohol and ether. (Liechti and Kempe.)

Molybdenum *penta*chloride, $MoCl_5$.

Very deliquescent. Sol. in H_2O with extreme evolution of heat. Sol. in HCl, HNO_3, or H_2SO_4+Aq.

When freshly prepared, is incompletely sol. in H_2O, but after standing is easily sol. with hissing. (Kalischer, Dissert. **1902.**)

Sol. in a small amt. of conc. HCl. (Hampe, Ch. Z. 1888, **12.** 5.)

Sol. in absolute alcohol or ether. (Liechti and Kempe.)

Sol. in $CHCl_3$ and in CCl_4. Sol. with hissing in many organic solvents (ethers, alcohols, ketones, aldehydes, acids, acid esters, acid anhydrides, amines). Sol. in cinnamic aldehyde. (Kalischer, Dissert. **1902.**)

Molybdenum hydroxyl chloride, $Mo(OH)_2Cl_2$.

Easily sol. in H_2O. (Debray, C. R. **46.** 1101.)

Molybdenum *tetra*chloride phosphorus *penta*chloride, $MoCl_4$, PCl_5.

Sol. in H_2O.

$MoCl_4$, $2PCl_5$. Sol. in H_2O. (Cronander, Bull. Soc. (2) **19.** 500.)

Molybdenum phosphorus *penta*chloride, $MoCl_5$, PCl_5.

Easily decomp. (Smith and Sargent, Z. anorg. 1894, **6.** 385.)

Molybdenum phosphoryl chloride, $MoCl_5$, $POCl_3$.

Decomp. by H_2O; insol. in CS_2; sol. in C_6H_6 and $CHCl_3$.

Molybdenum *tri*chloride potassium chloride.

Efflorescent. Decomp. with H_2O. (Berzelius.)

$MoCl_3$, 3KCl. Very sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903,** II. 652.)

$+2H_2O$. Fairly easily sol. in cold H_2O without any apparent decomp. Decomp. in aqueous solution, slowly in the cold but rapidly on boiling. This decomp. is prevented by the presence of HCl.

Sl. sol. in conc. HCl. (Henderson, Proc. Chem. Soc. 1903, **19.** 245.)

Molybdenum rubidium chloride, Rb_2MoCl_5 $+H_2O$.

Sol. in H_2O. Nearly insol. in alcohol and ether. (Chilesotti, C. C. **1903,** II. 652.)

Molybdenum *penta*chloride nitrogen sulphide, $MoCl_5$, N_4S_4.

Decomp. in moist air. (Davis, Chem. Soc. 1906, **89,** (2) 1575.)

Molybdenum *hexa*fluoride, MoF_6.

Decomp. by a little H_2O with separation of blue oxide. Sol. in large amount of H_2O forming a colorless solution.

Absorbed by alkalies and NH_4OH+Aq. (Ruff, B. 1907, **40.** 2930.)

Molybdenum fluoride with MF.

See **Fluomolybdate, M.**

Molybdenum potassium *tri*fluoride (?).

Precipitate. Sol. in HCl+Aq.

Molybdenum potassium *tetra*fluoride (?).

Sl. sol. in H_2O. (Berzelius.)

Molybdenum *sesqui*hydroxide, $Mo_2O_6H_6$.

Difficultly sol. in acids. Insol. in KOH, NaOH, NH_4OH, or K_2CO_3+Aq. Somewhat sol. in $(NH_4)_2CO_3$+Aq, but pptd. on boiling. (Berzelius.)

Molybdenum hydroxide, Mo_3O_8, $5H_2O$.

Easily sol. in H_2O. Insol. in $CaCl_2$, NH_4Cl, or NaCl+Aq. Sl. sol. in alcohol. (Berzelius.)

Molybdenum *di*hydroxide, MoO_2, xH_2O.

Slowly and not abundantly sol. in H_2O, from which it is precipitated by NH_4Cl and other salts. Gelatinises by standing in closed vessels or by evaporating on the air. Sol. in the ordinary acids. Insol. in KOH, or NaOH +Aq. Sol. in alkali carbonates+Aq.

Molybdenum *di*iodide, MoI_2.

Insol. in H_2O and alcohol. Sl. attacked by cold H_2SO_4 or HNO_3. (Guichard, A. ch. 1901, (7) **23.** 567.)

Sl. decomp. H_2O at ordinary temp. Slowly sol. in H_2SO_4 and HNO_3. (Guichard, C. R. 1896, **123.** 822.)

Molybdenum *tetra*iodide (?).

Completely sol. in water. (Berzelius.)

Molybdenum nitride, Mo_5N_3, and Mo_5N_4. (Uhrlaub.)

See **Molybdenum amide.**

Mo_3N_2. (Rosenheim, Z. anorg. 1905, **46.** 317.)

Molybdenum ***mon*oxide,** MoO.

Known only as hydroxide. (Blomstrand, J. pr. **77.** 90.)

Molybdenum ***sesqui*oxide,** Mo_2O_3.

Insol. in acids or alkalies.
See **Molybdenum** ***sesqui*hydroxide.**

Molybdenum ***di*oxide,** MoO_2.

Insol. in HCl or HF+Aq. Sl. sol. in conc. H_2SO_4. HNO_3 oxidises to MoO_3. Not attacked by KOH+Aq. (Ullik, A. **144.** 227.)
Sl. sol. in $KHC_4H_4O_6$+Aq.

Molybdenum ***tri*oxide,** MoO_3.

Sol. in 500 pts. cold, and much less hot H_2O. (Bucholz.)
Sol. in 960 pts. hot H_2O. (Hatchett.)
Sol. in 570 pts. cold, and much less hot H_2O. (Dumas.)
Sol. in acids before ignition. Insol. in acids, but sl. sol. in acid potassium tartrate+Aq after ignition. Sol. in alkalies or alkali carbonates+Aq.
Sol. in NH_4OH+Aq.
See also **Molybdic acid.**
Min. *Molybdite.* Sol. in HCl+Aq.

Molybdenum oxide, Mo_2O_5.

Sol. in H_2SO_4 and HCl; only sl. sol. in H_2SO_4. (Klason, B. 1901, **34.** 151.)
$+3H_2O$. Sl. sol. in H_2O (2 g. in 1 l.). Insol. in NH_4Cl+Aq. Insol. in caustic alkalies, somewhat sol. in NH_4OH. Much more sol. in M_2CO_3+Aq and in $(NH_4)_2CO_3$+Aq. (Klason, B. 1901, **34.** 150.)
$Mo_4O_{10}+3H_2O$. (Smith and Oberholtzer, Z. anorg. 1893, **4.** 243.)
$Mo_4O_{11}+6H_2O$. Sol. in H_2O. (Bailhache, C. R. 1901, **133.** 1212.)
$Mo_5O_{14}+6H_2O$. Very sol. in H_2O. (Guichard, C. R. 1900, **131.** 419.)
Mo_7O_{20}. Sol. in H_2O. (Junius, Z. anorg. 1905, **46.** 447.)
$Mo_{20}O_{41}+21H_2O = Mo_2O_5, 18MoO_2+21H_2O$. Easily sol. in H_2O. Insol. in NH_4Cl+Aq. (Klason, B. 1901, **34.** 160.)
$Mo_{26}O_{77}+24H_2O = Mo_2O_5, 24MoO_3+24H_2O$. (Klason, B. 1901, **34.** 159.)
$3Mo_2O_3, 2Mo_7O_{24}+18H_2O$. Sol. in H_2O. (B.)
It is probable that the five blue oxides of molybdenum described by Klason (B. 34, 148, 158) and Bailhache are either the blue oxide Mo_5O_{14} prepared by the author or mixtures of this compd. with molybdenum trioxide. (Guichard, C. R. 1902, **134.** 173.)
Mo_5O_{12}. Not attacked by ammonia; easily oxidised by HNO_3+Aq. Not attacked by HCl or H_2SO_4+Aq. (Wöhler, A. **110.** 275.)
Formula is Mo_3O_8, according to Wöhler, but Muthmann (A. **238.** 108) has shown that correct formula is Mo_5O_{12}.
Not attacked by boiling alkalies, HCl, or dil. H_2SO_4+Aq. Sol. in conc. H_2SO_4, with subsequent decomp. Sol. in aqua regia, and Cl_2+Aq. (Muthmann.)
Mo_3O_8. Sol. in H_2O. (Muthmann, A. **238.** 108.)
Min. *Ilsemannite* (?).
$+5H_2O$. Moderately sol. in H_2O. (Marchetti, Z. anorg. 1899, **19.** 393.)
Mo_5O_7. (v. d. Pfordten, B. **15.** 1925.)

Molybdenum ***tri*oxide ammonia,** $MoO_3, 3NH_3$.

Unstable in air. Very sol. in H_2O with evolution of ammonia. (Rosenheim, Z. anorg. 1906, **50.** 303.)
$3MoO_3, NH_3+\frac{1}{2}H_2O$. True composition of commercial molybdic acid. (Klason, B. 1901, **34.** 156.)
$NH_4H_3Mo_5O_{12}$. Very sl. sol. in cold, easily sol. in hot H_2O with partial decomp. (Klason, B. 1901, **34.** 156.)
$3MoO_3, 3NH_3+7H_2O = (NH_4)_3H_3Mo_3O_{12}+4H_2O$. True composition of Rammelsberg's $3(NH_4)_2O, 7MoO_3+12H_2O$. (Klason, B. 1901, **34.** 155.)
$4MoO_3, NH_3+6H_2O$. Very sl. sol. in cold, very easily sol. in hot H_2O. An insol. modification with less H_2O gradually cryst. out. (Mylius, B. 1903, **36.** 639.)
$4MoO_3, 2NH_3+3H_2O$. (Klason, B. 1901, **34.** 156.)
$6MoO_3, 3NH_3+5H_2O$. Very sl. sol. in cold, more easily sol. in hot H_2O, with partial decomp. (Klason, B. 1901, **34.** 156.)
$12MoO_3, 3NH_3+12H_2O$. (Klason, B. 1901, **34.** 158.)
$12MoO_3, 3NH_3, 12H_2O+3MoO_3, 8H_2O$. Moderately sol. in boiling H_2O. (Klason.)
$15MoO_3, 3NH_3+6H_2O$. Insol. in H_2O. (Klason.)
$4MoO_3, MoO_2, 2NH_3+7H_2O$. Slowly sol. in H_2O; fairly stable, gradually decomp. by dil. acids. (Hofmann, Z. anorg. 1896, **12.** 280.)

Molybdenum ***tri*oxide ammonia hydrogen** ***per*oxide,** $18MoO_3, 14NH_3, 3H_2O_2+18H_2O$.

Sol. in H_2O. Sp. gr. of sat. solution = 1.486 at 17.4°. (Baerwald, B. 1884, **17.** 1206.)

Molybdenum oxybromide.

See **Molybdenyl bromide.**

Molybdenum oxychloride.

See **Molybdenyl chloride.**

Molybdenum oxyfluoride.

See **Molybdenyl fluoride.**

Molybdenum oxyfluoride *with* **MF.**

See **Fluoxymolybdate, M,** *and* **Fluoxyhypomolybdate, M.**

Molybdenum phosphide, Mo_2P_2.

Gradually sol. in hot HNO_3+Aq. (Wöhler and Rautenberg, A. **109.** 374.)

Molybdenum selenide, $MoSe_3$.

Not obtained pure. (Uelsmann, A. **116.** 125.)

Molybdenum silicide.

Sol. in HF; only very sl. sol. in other acids. (Warren, C. N. 1898, **78.** 319.)

$MoSi_2$. Insol. in all min. acids; sol. in a warm mixture of $HF+HNO_3$. (Defacqz, C. R. 1907, **144.** 1425.)

Insol. in min. acids; sol. in $HF+HNO_3$. Unattacked by 10-20% KOH+Aq. Decomp. by fused NaOH. (Hönigschmid, M. 1907, **28.** 1020.)

Not attacked by boiling HNO_3, aqua regia or HF. (Watts, Trans. Am. Electrochem. Soc. 1906, **9.** 106.)

Mo_2Si_3. (Vigouroux, C. R. **129.** 1238.)

Molybdenum *di*sulphide, MoS_2.

Insol. in H_2O. Easily sol. in aqua regia. Easily oxidised by HNO_3. Sol. in boiling H_2SO_4. Sl. attacked by KOH+Aq. (Berzelius.)

Min. *Molybdenite.* Sol. in HNO_3+Aq, with separation of MoO_3; sol. in aqua regia; very sl. sol. in H_2SO_4.

Molybdenum *tri*sulphide, MoS_3.

Somewhat sol. in H_2O, especially if hot, but pptd. by an acid. Difficultly sol. except when boiled with KOH+Aq. Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides+Aq; slowly sol. in alkalies or alkali hydrosulphides+Aq. (Atterberg, J. B. **1873.** 258.)

Molybdenum *tetra*sulphide, MoS_4.

Not decomp. by hot H_2O or acids.

Sl. sol. in cold alkali sulphides+Aq, but easily by boiling. (Berzelius.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Molybdenum *sesqui*sulphide, Mo_2S_3.

Insol. in HCl and H_2SO_4; sol. in hot conc. HNO_3 and aqua regia. (Guichard, C. R. 1900, **130.** 138.)

Molybdenum sulphide *with* MS.

See **Sulphomolybdate, M.**

Molybenum sulphochloride, $Mo_5S_8Cl_9$.

Insol. in H_2O and alkalies. Slowly sol. in conc. HNO_3. (Smith and Oberholtzer, Z. anorg. 1894, **5.** 67.)

Molybdenyl *mon*amide, NH_4MoO_4 or $MoO_2\langle^{OH}_{NH_2}+H_2O$.

(Rosenheim, Z. anorg. 1905, **46.** 318.)

Molybdenyl bromide, MoO_2Br_2.

Deliquescent, and sol. in H_2O with slight evolution of heat.

$Mo_2O_3Br_4$. Unstable in air. (Smith and Oberholtzer, Z. anorg. **4.** 236.)

Molybdenyl potassium bromide, $MoOBr_3$, 2KBr

(Weinland, Z. anorg. 1905, **44.** 109.)

$MoOBr_3$, $KBr+2H_2O$. (Weinland, Z. anorg. 1905, **44.** 110.)

Molybdenyl rubidium bromide, $MoOBr_3$, 2RbBr.

(Weinland, Z. anorg. 1905, **44.** 108.)

Molydenyl chloride, MoO_2Cl_2.

Sol. in H_2O and alcohol.

Abundantly sol. in abs. alcohol. Not very sol. in abs. ether. (Hampe, Ch. Z. 1888, **12.** 23.)

$+H_2O$. Composition settled by mol. wt. determinations. Dissociates in alcohol and in H_2O. (Vaudenberghe, Z. anorg. 1895, **10.** 52.)

Very hygroscopic. Sol. in acetone, ether and alcohol. (Vaudenberghe, *l. c.*)

$MoOCl_4$. Deliquescent. Sol. in little H_2O with violent action. More H_2O decomposes. (Püttbach, A. **201.** 123.)

Formula is $Mo_9O_8Cl_{32}$, according to Blomstrand (J. pr. **71.** 460).

$Mo_2O_3Cl_4$. (Püttbach, *l. c.*)

$Mo_2O_3Cl_6$. Deliquescent. Sol. in H_2O with very slight evolution of heat and subsequent formation of precipitate. (Blomstrand.)

Sol. in acids. (Püttbach, A. **201.** 129.)

$Mo_2O_3Cl_5$. Deliquescent, and sol. in H_2O. (Blomstrand.)

$Mo_3O_5Cl_8$. Insol. in HCl and cold H_2SO_4. Sol. in hot H_2SO_4 and HNO_3. (Püttbach, A. **201.** 123.)

$Mo_3O_3Cl_7$. Difficultly sol. in HCl. Easily sol. in HNO_3, and alkalies+Aq. (Püttbach.)

Molybdenyl potassium chloride, MoO_2Cl_2, $KCl+H_2O$.

(Weinland, Z. anorg. 1905, **44.** 97.)

$+2H_2O$. (Weinland, Z. anorg. 1905, **44.** 96.)

$6MoO_2Cl_2$, $2KCl+6H_2O$. (Weinland, Z. anorg. 1905, **44.** 97.)

$MoOCl_3$, $2KCl+2H_2O$. Sol. in H_2O. (Nordenskjöld, B. 1901, **34.** 1573.)

Ppt. (Henderson, Proc. Chem. Soc. 1903, **19.** 245.)

Molybdenyl rubidium chloride, MoO_2Cl_2, $RbCl+H_2O$.

MoO_2Cl_2, 2RbCl. (Weinland, Z. anorg. 1905, **44.** 95.)

$MoOCl_3$, 2RbCl. Sl. sol. in H_2O. Less sol. than K salt. (Nordenskjöld, B. **1901, 34.** 1573.)

Molybdenyl fluoride, MoO_2F_2.

Decomp. rapidly in moist air. (Schulze, J. pr. (2) **21.** 442.)

Very hydroscopic. Sol. in a little H_2O giving a blue solution; in more H_2O giving a colorless solution.

Sol. in $AsCl_3$, $SiCl_4$, SO_2Cl_2 and PCl_3. On warming these solutions, gas is evolved.

Insol. in toluene. Nearly insol. in ether, $CHCl_3$, CCl_4, and CS_2. Sol. in warm pyridine and in ethyl and methyl alcohol. (Ruff, B. 1907, **40.** 2934.)

$MoOF_4$. Very hydroscopic. Decomp. by H_2O and conc. H_2SO_4. Decomp. by alcohol. Sol. in ether and $CHCl_3$ with evolution of gas. Insol. in toluene. Very sl. sol. in benzene and CS_2. (Ruff, B. 1907, **40.** 2932.)

$Mo_2O_3F_4$. Deliquescent. Easily sol. in HF +Aq, not in H_2O. (Smith and Oberholtzer.)

Molybdenyl fluoride *with* **MF.**

See **Fluoxymolybdate, M,** *and* **Fluoxyhypomolybdate, M.**

Molybdenyl hydroxide, $MoO(OH)_3$.

2 g. are sol. in 1000 cc. H_2O; insol. in H_2O+NH_4Cl; only sl. sol. in NH_4OH and alkali carbonates+Aq. (Klason, B. 1901, **34.** 151.)

Molybdic acid, H_2MoO_4.

(Ullik, A. **144.** 217.)

Nearly insol. in H_2O. (Vivier, C. R. **106.** 601.)

Very sparingly sol. in cold H_2O, more sol. in hot H_2O. (Rosenheim and Bertheim, Z. anorg. 1903, **34.** 435.)

α-modification.

Solubility of MoO_3, H_2O (α-modification) in H_2O at t°.

1000 g. H_2O dissolve g. MoO_3.

t°	G. MoO_3	t°	G. MoO_3
14.8	2.117	42.0	3.446
15.2	2.131	45.0	3.661
24.6	2.619	52.0	4.184
25.6	2.689	60.0	4.685
30.3	2.973	70.0	4.231
36.0	3.085	80.0	5.212
36.8	3.295	....	...

(Rosenheim and Davidsohn, Z. anorg. 1903, **37.** 318.)

(β modification), MoO_3, H_2O. From MoO_3, $2H_2O$ at 60°–70°. (Rosenheim and Davidsohn.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Easily sol. in H_2SO_4. (Ruegenberg and Smith, J. Am. Chem. Soc. 1900, **22.** 772.)

H_4MoO_5. Sol. in H_2O and acids. (Millingk.)

Very sol. in H_2O. (Mylius, B. 1903, **36,** 638.)

Solubility of MoO_3, $2H_2O$ in H_2O.

1000 g. H_2O dissolve g. MoO_3 at t°.

t°	G. MoO_3	t°	G. MoO_3
18	1.066	59	11.258
23	1.856	60	12.057
30	2.638	66	17.274
40	4.761	70	20.550
48	6.360	74.4	20.904
50.2	6.873	75	20.920
54	7.855	79	21.064

(Rosenheim and Bertheim, Z. anorg. 1903, **34.** 430.)

Solubility of MoO_3, $2H_2O$ in ammonium salts +Aq at t°.

1000 g. of the solvent dissolve g. MoO_3.

Solvent	t°	G. MoO_3
10% $(NH_4)_2SO_4$	29.6	19.27
10% NH_4HSO_4	31.5	27.53
"	41.8	34.36
"	49.7	37.69

(Rosenheim and Davidsohn, Z. anorg. 1903, **37.** 315.)

H_6MoO_6 (?). Known only in solution.

$H_2Mo_2O_7$. Easily sol. in H_2O. (Ullik.)

$H_2Mo_4O_{13}$. Easily sol. in H_2O. (U.)

$H_2Mo_8O_{25}$. Easily sol. in H_2O. (U.)

Molybdic acid also exists in a colloidal modification, sol. in H_2O. (Graham, C. R. **59.** 174.)

Molybdates.

The normal molybdates of the alkali metals are easily sol. in H_2O, while the others are sl. sol. or insol. therein.

The *tri*molybdates are sl. sol. in cold, but very easily sol. in hot H_2O.

The *tetra*molybdates are easily sol. in H_2O.

Aluminum molybdate, $Al_{10}Mo_2O_{21}$.

Precipitate. (Gentele, J. pr. **81.** 414.)

Contains aluminum hydroxide and sulphate. (Struve, J. pr. **61.** 441.)

Aluminum ammonium molybdate.

See **Aluminicomolybdate, ammonium.**

Aluminum barium molybdate.

See **Aluminicomolybdate, barium.**

Ammonium molybdate, $(NH_4)_2MoO_4$.

Efflorescent through loss of NH_3; decomp. by H_2O into acid salt. (Svanberg and Struve.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

$(NH_4)_2Mo_2O_7$. Sol. in H_2O.

$+H_2O = NH_4HMoO_4$. Sol. in H_2O. Sol. in 2–3 pts. H_2O. (Brandes; Mauro, Gazz. ch. it. **18.** 120.)

$(NH_4)_6Mo_7O_{24}+4H_2O$. (Commercial ammonium molybdate.)

Not efflorescent. Sol. in H_2O. (Delafontaine, N. Arch. Sc. ph. nat. **23.** 17.)

According to Struve and Berlin = $(NH_4)_4Mo_5O_{17}+3H_2O$.

According to Marignac and Delffs = $(NH_4)HMoO_4$. The true composition of commercial ammonium molybdate is $(NH_4)_{10}Mo_{12}O_{41}$. (Junius, Z. anorg. 1905, **46.** 428.)

$+12H_2O$. More sol. than the above. (Rammelsberg, Pogg. **127.** 298.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. **6.** 184.)

$(NH_4)_{10}Mo_{12}O_{41}$. True formula for commercial ammonium molybdate (Sand and Eisenlohr, Z. anorg. 1907, **52.** 68.)

$+7H_2O$. (Junius, Z. anorg. 1905, **46.** 428.)

$(NH_4)_4Mo_5O_{17}+H_2O$. (Jean, C. R. **78.** 436.)

$(NH_4)_2Mo_2O_{19}+H_2O$. Very difficultly sol. in cold, easily sol. in hot H_2O. (Berlin, J. pr. **49.** 445.)

Easily sol. in NH_4OH+Aq. (Kämmerer, J. pr. (2) **6.** 358.)

$(NH_4)_2O$, $4MoO_3$. Practically insol. in cold, sl. sol. in hot H_2O. (Westphal, Dissert. **1995.**)

$+2H_2O$. Very difficultly sol. in cold, rather easily sol. in hot H_2O. (Berlin.)

100 cc. H_2O dissolve 3.5200 g. at 15°; sp. gr. = 1.03; 3.6711 g. at 18°; sp. gr. = 1.04; 4.5961 g. at 32°; sp. gr. = 1.05. (Wempe, Z. anorg. 1912, **78.** 258.)

$+2\frac{1}{2}H_2O$. (Junius, Z. anorg. 1905, **46.** 440.)

$(NH_4)_2O$, $8MoO_3+13H_2O$. (Rosenheim, Z. anorg. 1897, **15.** 188.)

$(NH_4)_2O$, $9MoO_3+17H_2O$. (Westphal, Dissert. **1895.**)

See also **Molybdenum *tri*oxide ammonia.**

Ammonium barium molybdate, $3(NH_4)_2O$, $3BaO$, $14MoO_3+12H_2O$.

(Westphal, Dissert. **1895.**)

Ammonium bismuth molybdate, $NH_4Bi(MoO_4)_2$.

(Riederer, J. Am. Chem. Soc. 1903, **25.** 914.)

Ammonium cadmium molybdate ammonia, $(NH_4)_2Cd(MoO_4)_2$, $2NH_3$.

Decomp. by H_2O.

Sol. in dil. NH_4OH+Aq. (Briggs, Chem. Soc. 1904, **85.** 674.)

Ammonium cerium molybdate, $(NH_4)_6CeMo_{14}O_{48}+24H_2O$.

Sol. in H_2O. (Barbieri, C. A. **1909.** 293.)

Ammonium chromic molybdate.

See **Chromicomolybdate, ammonium.**

Ammonium cobaltous molybdate, $3(NH_4)_2O$, $7MoO_3$, $3CoO$, $7MoO_3+xH_2O$.

$5[3(NH_4)_2O$, $7MoO_3]$, $7[3CoO$, $7MoO_3]+xH_2O$.

$2[3(NH_4)_2O$, $7MoO_3]$, $3[3CoO$, $7MoO_3]+xH_2O$.

$3[3(NH_4)_2O$, $7MoO_3]$, $5[3CoO$, $7MoO_3]+xH_2O$.

$3(NH_4)_2O$, $7MoO_3$, $5[3CoO$, $7MoO_3]+xH_2O$.

$9[2(NH_4)_2O$, $5MoO_3]$, $5[2CoO$, $5MoO_3]+118H_2O$.

$4(NH_4)_2O$, $2CoO$, $15MoO_3+20H_2O$. (Marckwald, Dissert. **1895.**)

Ammonium cobaltous molybdate ammonia, $(NH_4)_2Co(MoO_4)_2$, $2NH_3$.

Decomp. by H_2O.

Sol. in dil. NH_4OH+Aq. (Briggs, Chem. Soc. 1904, **85.** 674.)

Ammonium cobaltic molybdate.

See **Cobaltimolybdate, ammonium.**

Ammonium cupric molybdate, $(NH_4)_2O$, CuO, $5MoO_3+9H_2O$.

Sl. sol. in cold, sol. in boiling H_2O without decomp. (Struve.)

Ammonium cupric molybdate ammonia, $(NH_4)_2Cu(MoO_4)_2$, $2NH_3$.

Sol. in dil. NH_4OH+Aq.

Decomp. by H_2O. (Briggs, Chem. Soc. 1904, **85.** 673.)

Ammonium ferric molybdate, $3(NH_4)_2Mo_2O_7$, $Fe_2(MoO_4)_6+20H_2O$.

Sol. in H_2O. (Struve.)

See also **Ferricomolybdate, ammonium.**

Ammonium lanthanum molybdate, $(NH_4)_6La_2Mo_{14}O_{48}+24H_2O$.

Sol. in H_2O. (Barbieri, C. A. **1909.** 293.)

Ammonium lithium molybdate, $NH_4LiMoO_4+H_2O$.

(Traube, N. Jahrb. Miner. **1894,** I. 194.)

Ammonium magnesium molybdate, $(NH_4)_2O$, MgO, $2MoO_3+2H_2O = (NH_4)_2MoO_4$, $MgMoO_4+2H_2O$.

Easily sol. in H_2O. (Ullik, A. **144.** 344.)

Ammonium manganous molybdate, $2(NH_4)_2O$, MnO, $3MoO_3+5H_2O$.

Decomp. by boiling H_2O. (Marckwald, Dissert. **1895.**)

$(NH_4)_2O$, $2MnO$, $6MoO_3+16H_2O$. Decomp. by boiling H_2O. (Marckwald, Dissert. **1895.**)

$(NH_4)_2O$, $3MnO$, $6MoO_3+16H_2O$. Decomp. by boiling H_2O. (Marckwald, Dissert. **1895.**)
$3(NH_4)_2O$, $2MnO$, $12MoO_3+22H_2O$. (Marckwald, Dissert. **1895.**)

Ammonium manganic molybdate.
See **Permanganomolybdate ammonium.**

Ammonium mercuric molybdate.
Sol. in $HCl+Aq$. Sol. in boiling NH_4Cl+Aq, separating out on cooling. Sol. in hot $(NH_4)_2SO_3+Aq$. (Hirzel.)

Ammonium molybdenum molybdate, $(NH_4)_2O$, $2MoO_2$, $4MoO_3+9H_2O$.
Easily sol. in H_2O, but the solution soon becomes cloudy. (Rammelsberg, Pogg. **127.** 291.)

Ammonium neodymium molybdate, $(NH_4)_3NdMoO_{24}+12H_2O$.
Ppt. (Barbieri, C. C. **1911,** I. 1043.)

Ammonium nickel molybdate, $(NH_4)_2O$, $3NiO$, $9MoO_3+25H_2O$.
Very sl. sol. in cold, sol. in hot H_2O without decomp. (Marckwald, Dissert. **1895.**)
$3(NH_4)_2O$, $2NiO$, $10MoO_3+14H_2O$. Very sl. sol. in cold, sol. in hot H_2O without decomp. (Marckwald, Dissert. **1895.**)
$5(NH_4)_2O$, $3NiO$, $16MoO_3+16H_2O$. (Hall, J. Am. Chem. Soc. **1907,** 29, 702.)
$6(NH_4)_2O$, $3NiO$, $16MoO_3+29H_2O$. Very sl. sol. in cold, sol. in hot H_2O without decomp. (Marckwald, Dissert. **1895.**)
$8(NH_4)_2O$, $6NiO$, $31MoO_3+63H_2O$. Very sl. sol. in cold, sol. in hot H_2O without decomp. (Marckwald, Dissert. **1895.**)
$3(NH_4)_2O$, $9NiO$, $34MoO_3+120H_2O$. Very sl. sol. in cold, easily sol. in hot H_2O without decomp. (Marckwald, Dissert. **1895.**)

Ammonium nickelic molybdate.
See **Nickelimolybdate, ammonium.**

Ammonium nickel hydrogen molybdate, $(NH_4)_4H_6[Ni(MoO_4)_6]+5H_2O$.
See **Nickelomolybdate, ammonium hydrogen.**

Ammonium praseodymium molybdate, $(NH_4)_3PrMoO_{24}+12H_2O$.
Ppt. (Barbieri, C. A. **1911.** 1884.)

Ammonium samarium molybdate, $(NH_4)_3SmMoO_{24}+12H_2O$.
Ppt. (Barbieri, C. A. **1911.** 1884.)

Ammonium sodium molybdate, $7(NH_4)_2O$, $2Na_2O$, $21MoO_3+15H_2O$ (?).
Easily sol. in H_2O. (Delafontaine, J. pr. **95.** 136.)
$7(NH_4)_2O$, $3Na_2O$, $25MoO_3+30H_2O$ (?). (Delafontaine.)

$(NH_4, Na)_2O$, $3MoO_3+H_2O$. Sol. in H_2O. (Mauro, Gazz. ch. it. **11.** 214.)

Ammonium thorium molybdate.
See **Thoromolybdate, ammonium.**

Ammonium titanium molybdate.
See **Titanomolybdate, ammonium.**

Ammonium vanadium molybdate.
See **Vanadiomolybdate, ammonium.**

Ammonium zinc molybdate.
Sol. in H_2O. (Berzelius.)

Ammonium zirconium molybdate.
See **Zirconomolybdate, ammonium.**

Ammonium molybdate hydrogen *di*oxide, $18MoO_3$, $7(NH_4)_2O$, $3H_2O_2+11H_2O$.
Sol. in H_2O. (Bärwald, B. **17.** 1206.)

Barium molybdate, basic, $2BaO$, MoO_3+H_2O (?).
Insol. in H_2O. Sol. in dil. $HCl+Aq$ or HNO_3+Aq. (Heine, J. pr. **9.** 204.)

Barium molybdate, $BaMoO_4$.
Difficultly sol. in H_2O; sol. in dil. HCl, and HNO_3+Aq. (Svanberg and Struve.)
Sol. in 17,200 pts. H_2O at 23°. More sol. in NH_4NO_3+Aq than in H_2O. (Smith and Bradbury, B. **24.** 2930.)
$+3H_2O$. (Westphal, Dissert. **1895.**)
$BaMo_3O_{10}+3H_2O$. Sl. sol. in H_2O.
$Ba_3MoO_{24}+9H_2O$. Appreciably sol. in H_2O. (Jörgensen.)
According to Svanberg and Struve = $Ba_2Mo_5O_1$ $+6H_2O$.
$+12H_2O$ or $5BaO$, $12MoO_3+20H_2O$. (Junius, Z. anorg. 1905, **46.** 433.)
$+22H_2O$. Ppt. (Westphal, Dissert. **1895.**)
BaO, $4MoO_3+3\frac{1}{2}H_2O$. Ppt. (Wempe, Z. anorg. 1912, **78.** 320.)
$+12H_2O$. Ppt. (Rosenheim, Z. anorg. 1913, **79.** 299.)
$BaMo_9O_{28}+4H_2O$. Insol. in cold or hot H_2O or HNO_3+Aq. Extremely slightly decomp. by H_2SO_4, or $H_2SO_4+HNO_3$, or $HCl+Aq$. (Svanberg and Struve.)

Barium *para*molybdate, $5BaO$, $12MoO_3+10H_2O$.
Ppt. Sol. in excess of $BaCl_2+Aq$. (Junius, Z. anorg. 1905, **46.** 433.)

Barium *tetra*molybdate, $BaH_2(Mo_4O_{13})_2+17H_2O$.
Insol. in cold, apparently decomp. by hot H_2O, a small part dissolving, and the rest forming an insol. residue. (Ullik, A. **144.** 336.)

$+14H_2O$. Insol. in cold and hot H_2O. (Wempe, Z. anorg. 1912, **78.** 320.)
BaO, $8MoO_3+17H_2O$. (Felix, Dissert. **1912.**)

Barium chromic molybdate.
See **Chromicomolybdate, barium.**

Barium cobaltic molybdate.
See **Cobaltimolybdate, barium.**

Barium manganic molybdate.
See **Permanganomolybdate, barium.**

Barium nickelic molybdate.
See **Nickelimolybdate, barium.**

Barium nickel hydrogen molybdate, $Ba_2H_6[Ni(MoO_4)_6]+10H_2O$.
See **Nickelomolybdate, barium hydrogen.**

Barium vanadium molybdate.
See **Vanadiomolybdate, barium.**

Barium molybdate hydrogen *di***oxide,** 8BaO, $19MoO_3$, $2H_2O_2+13H_2O$.
Precipitate. (Bärwald.)

Bismuth molybdate, Bi_2O_3, $3MoO_3$.
Somewhat sol. in H_2O. Sol. in 500 pts. H_2O and in the stronger acids. (Richter.)

Bromomolybdenum molybdate.
See under **Bromomolybdenum comps.**

Cadmium molybdate, $CdMoO_4$.
Insol. in H_2O; sol. in NH_4OH+Aq, KCN+Aq, or acids. (Smith and Bradbury, B. **24.** 2390.)
CdO, H_2O, $8MoO_3+6H_2O$. Decomp. by boiling with H_2O. (Wempe, Z. anorg. 1912, **78.** 323.)

Cæsium molybdate, Cs_2O, $3MoO_3+H_2O$.
(Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 270.)
Cs_2O, $5MoO_3+3H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 270.)
$+3\frac{1}{2}H_2O$. Very sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)
$2Cs_2O$, $5MoO_3+5H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 271.)
$3Cs_2O$, $10MoO_3+3H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 271.)
Cs_2O, $16MoO_3+8H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 271.)
$3Cs_2O$, $10MoO_3+3H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 271.)

Cæsium *tetra***molybdate,** Cs_2O, $4MoO_3$.
Only sl. sol. in H_2O. (Muthmann, B. 1898, **31.** 1841.)
$+2H_2O$. Sl. sol. in H_2O. (Muthmann, B. 1898, **31.** 1841.)
$+3H_2O$. Easily sol. in cold or hot H_2O. (Wempe, Z. anorg. 1912, **78.** 317.)
$+5H_2O$. Very sol. in cold and hot H_2O. (Wempe, Dissert. **1911.**)
Cs_2O, MoO_3, Cs_2O, $3MoO_3+4.5H_2O$. Sol. in H_2O. (Wempe, Z. anorg. 1912, **78.** 317.)

Cæsium *para***molybdate,** $5Cs_2O$, $12MoO_3+11H_2O$.
Efflorescent. Easily sol. in H_2O. (Wempe, Z. anorg. 1912, **78.** 317.)

Calcium molybdate, $CaMoO_4$.
Insol. precipitate. (Ullik.)
Sl. sol. in H_2O; insol. in alcohol. (Smith and Bradbury, B. **24.** 2930.)
$+H_2O$. (Westphal, Dissert. **1895.**)
$+2H_2O$. (Westphal, Dissert. **1895.**)
$+6H_2O$. Difficultly sol. in cold, easily in hot H_2O. (Ullik, A. **144.** 231.)
$CaMo_4O_{13}+9H_2O$. Easily sol. in cold H_2O.
CaO, $2H_2O$, $12MoO_3+21H_2O$. Efflorescent. Sl. sol. in cold, easily sol. in hot H_2O. (Wempe.)

Calcium hydrogen *tetra***molybdate,** $CaH_2(Mo_4O_{13})_2+17H_2O$.
Sl. sol. in cold, easily sol. in hot H_2O with decomp. (Ullik.)
$+16H_2O$. Insol. in cold, difficultly sol. in hot H_2O. (Wempe, Z. anorg. 1912, **78.** 318.)

Cerium molybdate, $Ce_2(MoO_4)_3$.
Precipitate. Insol. in H_2O; sol. in acids. (Cossa, B. **19.** 536 R.)

Chromic molybdate.
Insol. in H_2O, but sol. in acids. Sol. in NH_4 molybdate+Aq. (Berzelius.)
See also **Chromicomolybdic acid.**

Chromic molybdate, *with* **M. molybdate.**
See **Chromicomolybdate. M.**

Cobaltous molybdate, $CoMoO_4$.
Decomp. by alkalies and strong acids. (Berzelius.)
$+H_2O$. Sl. sol. in pure, easily sol. in acidified H_2O. (Coloriano, Bull. Soc. (2) **50.** 451.)
CoO, $2MoO_3+2H_2O$. (Marckwald, Dissert. **1895.**)
$6\frac{1}{2}H_2O$. Sl. sol. in H_2O. (Marckwald.)
$CoMo_3O_{10}+10H_2O$. Very sl. sol. in cold, but very easily sol. in hot H_2O. (Ullik, W. A. B. **55, 2.** 767.)

Cobaltic potassium molybdate.
See **Cobaltimolybdate, potassium.**

Cobaltous sodium molybdate, Na_2O, 2CoO, $6MoO_3+18H_2O$.
(Marckwald, Dissert. **1895.**)
$2Na_2O$, CoO, $7MoO_3+20H_2O$. Sol. in cold H_2O without decomp. Decomp. on heating. (Marckwald.)

$3Na_2O, 2CoO, 12MoO_3+27H_2O$. (Marckwald.)
$3Na_2O, 3CoO, 14MoO_3+50H_2O$. Sol. in much cold H_2O. (Marckwald.)
$4Na_2O, 6CoO, 25MoO_3+68H_2O$. (Marckwald.)

Cobaltous molybdate ammonia, $CoMoO_4, 2NH_3+H_2O$.

Sol. in H_2O. (Sonnenschein, J. pr. **53.** 340.)

Cupric molybdate, basic, $4CuO, 3MoO_3+5H_2O$.

Insol. in H_2O. (Struve, J. B. **1854.** 350.)

Cupric molybdate, $CuMoO_4$.

Sl. sol. in H_2O; decomp. by acids and alkaline solutions.
$CuMo_3O_{10}+6\frac{1}{2}H_2O$. Easily sol. in cold H_2O. (Ullik, A. **144.** 233.)
$+9H_2O$. Very sl. sol. in cold, and extraordinarily easily sol. in hot H_2O. (Ullik.)

Cupric molybdate ammonia, $CuMoO_4, 2NH_3+H_2O$.

Gives off NH_3 at ord. temp. Decomp. by H_2O.
Sol. in dil. NH_4OH+Aq from which it can be cryst. (Briggs, Chem. Soc. 1904, **85.** 674.)
$CuMoO_4, 4NH_3$. Decomp. by H_2O. Sol. in dil. NH_4OH+Aq. (Jörgensen, Ch. Z. Repert. 1896, **20.** 225.)

Didymium molybdate, $Di_2(MoO_4)_3$.

Ppt. Insol. in H_2O. (Cossa, B. **19.** 536R.)
$Di_2O_3, 6MoO_3 + 3H_2O$ (?). Precipitate. (Smith.)

Glucinum molybdate, basic, $2GlO, MoO_3+3H_2O$.

Nearly insol. in H_2O. (Atterberg, J. B. **1873.** 258.)

Glucinum molybdate, GlO, MoO_3+2H_2O.

Sol. in H_2O with decomp. (Rosenheim, Z. anorg. 1897, **15.** 307.)
$GlMoO_4, MoO_3+xH_2O$. Easily sol. in H_2O. (Atterberg.)

Gold (auric) molybdate (?).

Sl. sol. in H_2O. Sol. in HCl, and HNO_3+Aq. (Richter.)

Hydroxylamine potassium molybdate. $MoO_4H_2(NH_3O)_3(NH_2OK)$.

Easily sol. in H_2O; pptd. by alcohol. (Hofmann, A. 1899, **309.** 324.)

Indium molybdate, $In_2(MoO_4)_3+2H_2O$.

Ppt. Insol. in H_2O.
Easily sol. in HCl. (Renz, B. 1901, **34.** 2765.)

Iron (ferrous) molybdate, $FeMoO_4$.

Insol. in H_2O. (Schultze, A. **126.** 55.)

Iron (ferric) molybdate, $Fe_2O_3, 4MoO_3+7H_2O$.

Nearly insol. in H_2O. Slowly sol. in cold, easily in hot HCl, or HNO_3+Aq. Dil. acids gradually dissolve out Fe_2O_3 in the cold. When ignited, difficultly sol. in all solvents. (Steinacker.)
$Fe_2O_3, 5MoO_3+16H_2O$. Very sl. sol. in H_2O. (Struve, J. B. **1854.** 346.)
$2Fe_2O_3, 7MoO_3+34H_2O$. Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 704.)

Ferric potassium molybdate, $Fe_2O_3, 3K_2O, 12MoO_3+20H_2O=3K_2Mo_2O_7, Fe_2(Mo_2O_7)_3+20H_2O$.

Sol. in H_2O. (Struve.)

Lanthanum molybdate, $LaH_3(MoO_4)_3=La_2O_3, MoO_3+3H_2O$. (?)

Precipitate. (Smith.)

Lead molybdate, $PbMoO_4$.

Insol. in H_2O. Sol. in warm HNO_3+Aq; decomp. by H_2SO_4; sol. in conc. $HCl+Aq$, or $KOH+Aq$.
Min. *Wulfenite.* As above.

Lithium molybdate, Li_2MoO_4.

Moderately sol. in cold, and only sl. more sol. in hot H_2O. (Ephraim, Z. anorg. 1909, **64.** 259.)
$+\frac{2}{3}H_2O$. Easily sol. in H_2O.
$5Li_2O, 5MoO_3+2H_2O$. 46.13 g. are present in 100 ccm. of the aqueous solution at 20°, and sp. gr. of the solution = 1.44. (Wempe, Z. anorg. 1912, **78.** 309.)
$Li_2O, 2MoO_3+5H_2O$. Sol. in cold, easily sol. in hot H_2O. (Ephraim, Z. anorg. 1909, **64.** 258.)
$Li_2O, 3MoO_3+H_2O$. Easily sol. in warm H_2O. (Wempe, Dissert. **1911.**)
$+4H_2O$. (Wempe.)
$+4\frac{1}{4}H_2O$. (Wempe.)
$+7H_2O$. Nearly insol. in cold, sol. in hot H_2O. (Ephraim, Z. anorg. 1909, **64.** 258.)
$2Li_2O, 3MoO_3$. Sl. sol. in H_2O. (Ephraim, Z. anorg. 1909, **64.** 258.)

Lithium *para***molybdate,** $3Li_2O, 7MoO_3+12H_2O$.

Sol. in H_2O. (Rosenheim, Z. anorg. 1897, **15.** 181.)
$+28H_2O$. Easily sol. in cold and hot H_2O. (Ephraim, Z. anorg. 1909, **64.** 258.)

Lithium *tetra***molybdate,** $Li_2O, 4MoO_3+7H_2O$.

Sol. in cold H_2O. (Ephraim, Z. anorg. 1909, **64.** 258.)
$Li_2O, H_2O, 8MoO_3+10H_2O$. Easily sol.

in hot H_2O. (Wempe, Z. anorg. 1912, **78.** 308.)

Li_2O, $3H_2O$, $16MoO_3+6\frac{1}{2}H_2O$. Easily sol. in warm H_2O. (Wempe, Z. anorg. 1912, **78.** 308.)

Lithium potassium molybdate, $KLiMoO_4+H_2O$.

(Traube, N. Jahrb. Miner, **1894,** I. 194.)

Magnesium molybdate, $MgMoO_4$.

Min. *Belonesia.*

Insol. in HCl+Aq. (Scacchi, Zeit. Kryst. 1888, **14.** 523.)

$+5H_2O$. Easily sol. in cold, but still more sol. in hot H_2O. (Delafontaine.)

Sol. in 12–15 pts. cold H_2O. (Brandes.)

$+7H_2O$. Easily sol. in hot or cold H_2O. (Ullik.)

$MgMo_3O_{10}+10H_2O$. Difficultly sol. in cold, very easily in hot H_2O. (Ullik.)

Magnesium ***para*****molybdate,** $Mg_3Mo_7O_{24}+20H_2O$.

Quite sol. in cold, more easily in hot H_2O. (Ullik.)

Magnesium ***tetra*****molybdate,** MgO, H_2O, $8MoO_3+19H_2O$.

Magnesium hydrogen ***tetra*****molybdate,** $MgH_2(Mo_4O_{13})_2+19H_2O$.

Easily sol. in cold H_2O. (Ullik, A. **144.** 335.)

Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+20H_2O$. Ppt. (Wempe, Z. anorg. 1912, **78.** 323.)

Magnesium hydrogen ***octo*****molybdate,** $MgH_2(Mo_8O_{25})_2+29H_2O$.

Very difficultly sol. in cold, very easily sol. in hot H_2O. (Ullik, W. A. B. **60, 2.** 314.)

Magnesium potassium molybdate, $MgMoO_4$, $K_2MoO_4+2H_2O$.

Slowly sol. in cold, easily in hot H_2O. (Ullik, A. **144.** 343.)

Manganous molybdate, $MnMoO_4+H_2O$.

Insol. in H_2O. Sl. sol. in pure, easily sol. in acidified H_2O. Decomp. by alkalies or alkali carbonates+Aq. (Coloriano, Bull. Soc. (2) **50.** 451.)

$+{}^5/_3H_2O$. (Marckwald, Dissert. **1895.**)

$+10H_2O$. (Marckwald.)

Manganic potassium molybdate.

See **Permanganomolybdate, potassium.**

Manganic silver molybdate.

See **Permanganomolybdate, silver.**

Mercurous molybdate, $Hg_2Mo_2O_7$.

Decomp. by H_2O. (Struve, J. B. **1754.** 350.)

Sol. in 500–600 pts. H_2O; decomp. by HNO_3+Aq. (Hatchett.)

Molybdenum molybdate.

See **Molybdenum oxides,** Mo_3O_7, Mo_4O_0, etc.

Neodymium molybdate, $Nd_2(MoO_4)_3$.

Very sl. sol. in H_2O.

1 pt. is sol. in 53790 pts. H_2O at 28°.

1 " " " " 32466 " H_2O " 75°.

(Hitchcock, J. Am. Chem. Soc. 1895, **17. 532.**)

Nickel molybdate, $NiMoO_4+{}^2/_3H_2O$, $+{}^3/_4H_2O$ and $+5H_2O$.

(Marckwald, Dissert. **1895.**)

NiO, $3MoO_3+18H_2O$. Sl. sol. in cold; easily sol. in hot H_2O. (Marckwald.)

5NiO, $14MoO_3+57H_2O$, and $+70H_2O$. Sl. sol. in cold; easily sol. in hot H_2O. (Marckwald.)

Nickel potassium molybdate, 3NiO, $5K_2O$ $16MoO_3+21H_2O$.

Can be cryst. from H_2O. (Hall, J. Am. Chem. Soc. 1907, **29.** 701.)

Nickelic potassium molybdate.

See **Nickelimolybdate, potassium.**

Nickel potassium hydrogen molybdate, $K_4H_6[Ni(MoO_4)_6]+5H_2O$.

See **Nickelomolybdate, potassium hydrogen.**

Nickel sodium molybdate, 2NiO, Na_2O, $6MoO_3+17H_2O$.

Sol. in cold H_2O without decomp. but decomp. on warming. (Marckwald, Dissert. **1895.**)

Nickel molybdate ammonia, $NiMoO_4$, $2NH_3$ $+H_2O$.

Decomp. by H_2O. (Sonnenschein, J. pr. **53.** 341.)

Potassium molybdate, K_2MoO_4.

Deliquescent in moist air. Very sol. in H_2O. Insol. in alcohol. (Svanberg and Struve, J. pr. **44.** 265.)

184.6 grams are sol. in 100 grams H_2O at 25°. (Amadori, C. A. **1912.** 2878.)

Solubility of $K_2MoO_4+K_2SO_4$ at 25°.

G. per 100 g. H_2O		G. per 100 g. H_2O	
K_2SO_4	K_2MoO_4	K_2SO_4	K_2MoO_4
0	184.6	1.50	99.49
0.46	180.7	2.13	45.89
0.72	177.	3.95	17.48
0.98	127.2	8.55	4.73
1.27	107.5	12.10	0

(Amadori, Att. acc. Linc. 1912, **21, I. 467,** 667.)

$+\frac{3}{4}H_2O$. Easily sol. in H_2O. (Wempe, Dissert. **1911.**)

K_2O, $8MoO_3+13H_2O$. Easily sol. in warm H_2O. (Wempe, Dissert. **1911.**)

K_2O, $10MoO_3+9H_2O$. Nearly insol. in hot and cold H_2O. 100 g. H_2O dissolve 0.682 g. at 100°. (Felix, Dissert. **1912.**)

$+15H_2O$. Sol. in H_2O. (Felix.)

$5K_2O$, $12MoO_3+8H_2O$. Sl. sol. in cold H_2O. (Junius, Z. anorg. 1905, **46.** 439.)

Potassium *tri*molybdate, $K_2Mo_3O_{10}$.

Difficultly sol. in cold, but much more easily in hot H_2O. When ignited is absolutely insol. in H_2O. (Svanberg and Struve.)

$+2H_2O$. (Junius, Z. anorg. 1905, **46.** 439.) Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+2\frac{3}{4}H_2O$. Easily sol. in H_2O. (Wempe, Dissert. **1911.**)

$+3H_2O$. Very sl. sol. in cold, more easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+11H_2O$. Practically insol. in H_2O. (Westphal, Dissert. **1895.**)

Potassium hydrogen *tetra*molybdate, $K_6H_4[H_2(Mo_2O_7)_6]+18H_2O$.

Sl. sol. in cold H_2O. Decomp. by boiling H_2O. (Rosenheim, Z. anorg. 1913, **79.** 298.)

$KHMo_4O_{13}+6H_2O$. Decomp. by H_2O. (Ullik.)

Potassium *para*molybdate, $K_6Mo_7O_{24}+4H_2O$.

Decomp. even by cold H_2O. (Delafontaine.)

Formula is $K_8Mo_9O_{31}+6H_2O$, according to Svanberg and Struve (?).

Potassium selenium molybdate.

See **Selenomolybdate, potassium.**

Potassium sodium molybdate, K_2MoO_4, $2Na_2MoO_4+14H_2O$.

Very easily sol. in cold, still more easily in hot H_2O. (Delafontaine.)

Potassium vanadium molybdate.

See **Vanadiomolybdate, potassium.**

Potassium zinc molybdate.

Sol. in H_2O. (Berzelius.)

Potassium molybdate hydrogen *di*oxide, $6K_2O$, $16MoO_3$, $4H_2O_2+13H_2O$.

Sol. in H_2O. (Bärwald, C. C. **1885.** 424.)

Potassium molybdate sulphocyanide, KSCN, $K_2Mo_3O_{10}+4H_2O$.

Decomp. by H_2O. Sol. in dil. HCl+Aq. (Péchard, C. R. 1894, **118.** 806.)

Praseodymium molybdate, $Pr_2(MoO_4)_3$.

Very sl. sol. in H_2O.

1 pt. is sol. in 65820 pts. H_2O at 23°.

1 " " " " 69800 " " " 75°.

(Hitchcock, J. Am. Chem. Soc. 1895, **17.** 530.)

Rubidium molybdate, Rb_2O, MoO_3.

Hygroscopic. (Ephraim, Z. anorg. 1909, **64.** 263.)

Rb_2O, $2MoO_3+2H_2O$. Easily sol. in H_2O. (Ephraim, Z. anorg. 1909, **64.** 263.)

$Rb_6Mo_7O_{24}+4H_2O$. Very sl. sol. in cold, much more easily sol. in hot H_2O. (Delafontaine, N. Arch. Sc. phys. nat. **30.** 233.) (Ephraim, Z. anorg. 1909, **64.** 263.)

$+4^2/_3H_2O$. (Wempe, Dissert. **1911.**)

$2Rb_2O$, $7MoO_3+5H_2O$. Very sl. sol. in cold, very easily sol. in hot H_2O. (Wempe.)

$5Rb_2O$, $7MoO_3+14H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 268.)

$3Rb_2O$, $8MoO_3+6H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 269.)

$5Rb_2O$, $12MoO_3+H_2O$. 100 cc. H_2O dissolve 1.941 g. at 24°. (Wempe, Z. anorg. 1912, **78.** 258.)

Rb_2O, $3MoO_3$. Insol. in H_2O. (Muthmann, B. 1898, **31.** 1839.)

$+H_2O$. (Muthmann, B. 1898, **31.** 1839.)

$+3H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$6\frac{1}{2}H_2O$. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 269.)

$2Rb_2O$, $3MoO_3+4H_2O$. Sl. sol. in cold, easily in hot H_2O. (Wempe, Dissert. **1911.**)

Rb_2O, $4MoO_3$. Difficultly sol. in cold, easily in hot H_2O. (Wempe, Z. anorg. 1912, **78.** 312.)

$+\frac{1}{2}H_2O$. Practically insol. in H_2O. Very sol. by addition of NH_3. (Ephraim and Herschfinkel, Z. anorg. 1909, **64.** 266.)

$+2.5H_2O$. Insol. in H_2O. (Ephraim, Z. anorg. 1909, **64.** 263.)

$+4H_2O$. Sol. in cold, more easily sol. in hot H_2O. (Wempe, Z. anorg. 1912, **78.** 312.)

Rb_2O, MoO_3, Rb_2O, $3MoO_3+5H_2O$. Sol. in cold or hot H_2O. (Wempe, Z. anorg. 1912, **78.** 312.)

Rb_2O, H_2O, $8MoO_3+3H_2O$. Difficultly sol. in cold, easily in hot H_2O. (Wempe, Z. anorg. 1912, **78.** 312.)

Rb_2O, $11MoO_3+5.5H_2O$. Ppt. (Ephraim, Z. anorg. 1909, **64.** 263.)

Rb_2O, $13MoO_3+4H_2O$. Ppt. (Ephraim.)

Rb_2O, $18MoO_3$. Ppt. (Ephraim.)

Samarium molybdate, $Sm_2(MoO_4)_3$.

Insol. in H_2O. (Cleve.)

Samarium sodium molybdate, $Na_2Sm_2(MoO_4)_4$.

Insol. in H_2O. Easily sol. in warm dil. HNO_3+Aq. (Cleve.)

Silver (argentous) molybdate, Ag_4O, $2MoO_3$.

Sol. in HNO_3+Aq. KOH+Aq dissolves MoO_3 and Ag_4O separates out. Not decomp. by dil. NH_4OH+Aq. (Wöhler and Rautenberg, A. **114.** 119.)

Does not exist. (Muthmann, B. **20** 983.)

Silver (argentic) molybdate, Ag_2MoO_4.

Somewhat sol. in H_2O; less when HNO_3 is present. (Richter.)

Very sl. sol. in pure H_2O; easily sol. in H_2O acidulated with HNO_3. (Struve and Svanberg.)

Sol. in KCN or NaOH+Aq. (Smith and Bradbury.)

Ag_2O, $2MoO_3$. Sl. sol. in H_2O. Sol. in KCN+Aq. (Junius, Dissert. **1905.**)

$2Ag_2O$, $5MoO_3$. Somewhat sol. in H_2O. (Svanberg and Struve, J. B. **1847-48.** 412.)

Ag_2O, $4MoO_3+6H_2O$. Sl. sol. in H_2O with decomp. (Wempe, Z. anorg. 1912, **78.** 322.)

Silver thorium molybdate.

See **Thoromolybdate, silver.**

Silver molybdate ammonia, Ag_2MoO_4, $4NH_3$.

Sol. in H_2O with rapid decomposition. (Widmann, Bull. Soc. (2) **20.** 64.)

Silver molybdate hydrogen *di*oxide, $13Ag_2O$, $2H_2O_2$, $32MoO_3$.

Ppt. (Bärwald, B. **17.** 1206.)

Sodium molybdate, Na_2MoO_4.

Anhydrous. Easily and completely sol. in H_2O.

$+2H_2O$. Sol. in H_2O.

$+10H_2O$. Efflorescent.

Solubility in H_2O at t°.

Solid phase	t°.	Per cent of anhydrous salt	Mols. H_2O to 1 mol. of anhydrous salt	Mols. of anhydrous salt to 100 mols. H_2O
Na_2MoO_4, 10_2HO	0	30.63	25.92	3.86
"	4	33.83	22.38	4.47
"	6	35.58	20.72	4.83
"	90	38.16	18.54	5.39
Na_2MoO_4, $2H_2O$	10	39.28	17.70	5.65
"	15.5	39.27	17.70	5.65
"	32.	39.82	17.30	5.78
"	51.5	41.27	16.28	6.14
"	100	45.57	13.67	7.32

(Funk, B. 1900, **33.** 3699.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$Na_2Mo_2O_7$. After ignition, very difficultly sol. in cold, and very slowly sol. in hot H_2O. (Svanberg and Struve.)

$+H_2O$. Easily sol. in H_2O.

$+3\frac{1}{2}H_2O$. Easily sol. in cold or hot H_2O. (Wempe, Dissert. **1911.**)

$+4H_2O$. Easily and completely sol. in cold H_2O. (Ullik.)

$+6\frac{1}{2}H_2O$. Sl. sol. in cold, very easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+7H_2O$. Difficultly sol. in cold H_2O, but more easily than the corresponding K salt. 100 pts. H_2O dissolve 3.878 pts. at 20° and 13.7 pts. at 100°. (Ullik, A. **144.** 244.)

$+9H_2O$. Easily sol. in cold, very easily sol. in hot H_2O. (Wempe.)

$+11H_2O$. (Junius, Z. anorg. 1905, **46.** 437.)

$2Na_2O$, $7MoO_3$. Easily sol. in cold, very easily sol. in hot H_2O. (Ott, Dissert. **1911.**)

$+20H_2O$. (Westphal, Dissert. **1895.**)

$+22H_2O$. Efflorescent. Easily sol. in H_2O. (Ullik, A. **144.** 219.)

Na_2O, $8MoO_3+\frac{1}{2}H_2O$. Very sol. in cold or hot H_2O (Wempe, Dissert. **1911.**)

$+4H_2O$. Insol. in H_2O. (Ullik, W. A. B. **60, 2.** 312.)

$+15H_2O$. (Rosenheim, Z. anorg. 1897, **15.** 188.)

Na_2O, $10MoO_3+6H_2O$. Very sl. sol. in H_2O. 100 g. H_2O dissolve 0.842 g. at 100°. (Felix, Dissert. **1912.**)

$+7H_2O$. (Felix.) Nearly insol. in hot and cold H_2O. (Rosenheim, Z. anorg. 1903, **37.** 323.)

$+12H_2O$. Difficultly sol. in H_2O.

$+21H_2O$. Abundantly but slowly sol. in cold H_2O. $=NaHNa_6O_{16}+10H_2O$. (Ullik.)

$5Na_2O$, $12MoO_3+8H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+20H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

$+36H_2O$. (Junius, Z. anorg. 1905, **46.** 436.)

$+44H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Wempe, Dissert. **1911.**)

Sodium *tetra*molybdate, $Na_2Mo_4O_{13}+6H_2O$.

Difficultly sol. in cold, easily in hot H_2O. (Ullik.)

100 cc. H_2O dissolve at 21°, 28.39 g. of the salt. Sp. gr. of the solution = 1.47. (Wempe, Z. anorg. 1912, **78.** 306.)

$+17H_2O$. (Felix, Dissert. **1912.**)

$Na_6H_4[H_2(Mo_2O_7)_6]+21H_2O$. Slowly sol. in cold, easily sol. in hot H_2O. (Rosenheim, Z. anorg. 1913, **79.** 298.)

$NaHMo_4O_{13}+8H_2O$. Very sol. in hot or cold H_2O. (Ullik, A. **144.** 333.)

$NaHMo_8O_{25}+4H_2O$. Insol. in H_2O. (Ullik.)

Sodium manganous molybdate, $2Na_2O$, MnO, $6MoO_3+19H_2O$.

(Marckwald, Dissert. **1895.**)

Sodium molybdate molybdenum oxide, $Na_2Mo_5O_{15}$.

Insol. in H_2O. Sol. in HNO_3 and aqua regia. Insol. in HCl and in H_2SO_4. Sol. in

alkalies. (Stavenhagen and Engels, B. 1895, **28.** 2280.)

Strontium molybdate, $SrMoO_4$.

Sl. sol. in H_2O. (Schultze.)
Sol. in 9600 pts. H_2O at 17°. (Smith and Bradbury, B. **24.** 2930.)
$SrO, 3MoO_3+\frac{1}{2}H_2O$. Scarcely sol. in cold, easily in hot H_2O. (Wempe, Dissert. **1911.**)
$SrO, H_2O, 8MoO_3+6H_2O$. Scarcely sol. in cold, easily in hot H_2O. (Wempe, Dissert. **1911.**)
$2SrO, 3H_2O, 20MoO_3+21H_2O$. Ppt. (Wempe, Z. anorg. 1912, **78.** 321.)

Thallous molybdate, Tl_2MoO_4.

Insol. in H_2O. Sol. in alkalies. Insol. in alcohol. (Oettinger, J. B. **1864,** 254.)
Sl. sol. in hot or cold H_2O. (Ullik, J. B. **1867,** 234.)
$8Tl_2O, 11MoO_3$. Sol. in hot H_2O. (Fleming, J. B. **1868,** 250.)
$3Tl_2O, 8MoO_3$. (Fleming.)

Thallous *tetra*molybdate, $Tl_2O, 4MoO_3+H_2O$.

Sl. sol. in H_2O with decomp. (Wempe, Z. anorg. 1912, **78.** 322.)

Thallous *para*molybdate, $5Tl_2O, 12MoO_3$.

Insol. in H_2O. Easily sol. in mineral acids and in alkali hydroxides and carbonates. (Junius, Z. anorg. 1905, **46.** 432.)

Tin (stannic) molybdate.

Insol. in H_2O. Sol. in dil. or conc. HCl+Aq, or in KOH+Aq. Not decomp. by HNO_3+Aq. (Berzelius.)

Uranous molybdate.

Precipitate. Sol. in HCl+Aq. Decomp. by KOH+Aq.
$U(MoO_4)_2$. (Lancien, C. C. **1908,** I. 1763.)

Uranyl molybdate, $(UO_2)MoO_4$.

Insol. in H_2O, methyl and ethyl alcohol, ether, acetic acid, $CHCl_3$, C_6H_6 and C_7H_8. Sol. in mineral acids. (Lancien, C. C. **1907,** I. 784.)
$2UO_3, 3MoO_3$ (?). Insol. in H_2O. Sol. in strong acids and $(NH_4)_2CO_3$+Aq. (Berzelius.)
$3UO_3, 7MoO_3$. Insol. in hot and cold H_2O. Insol. in NaOH, KOH, and NH_4OH+Aq. Sol. in all min. acids and decomp. by an excess of H_2O. Insol. in acetic acid. (Lancien, C. C. **1908,** I. 1763.)
$UO_3, 8MoO_3$. (Lancien.)
$+13H_2O$. Insol. in HNO_3. (Lancien.)

Ytterbium molybdate, $Yb_2O_3, 7MoO_3+6H_2O$.

Insol. in hot H_2O. (Cleve, Z. anorg. 1902, **32.** 152.)
$2Yb_2O_3, MoO_3$. Ppt. (Cleve.)

Yttrium molybdate.

Insol. in H_2O. Sol. in HNO_3+Aq. (Berlin.)

Zinc molybdate, $ZnMoO_4$.

Difficultly sol. in H_2O; easily in acids. (Schultze, A. **126.** 49.)
$+H_2O$. Sl. sol. in H_2O. Easily sol. in dil. acids. (Coloriano, Bull. Soc. (2) **50.** 451.)
$ZnMo_3O_{19}+10H_2O$. Very difficultly sol. in cold, but extraordinarily easily sol. in hot H_2O. (Ullik, W. A. B. **55, 2.** 767.)

Zinc *tetra*molybdate, $ZnMo_4O_{13}+8H_2O$.

Easily sol. in cold H_2O. (Ullik.)
$ZnO, H_2O, 8MoO_3+14H_2O$. Ppt. (Wempe, Z. anorg. 1912, **78.** 324.)

Zinc molybdate ammonia, $ZnMoO_4, 2NH_3+H_2O$.

(Sonnenschein, J. pr. **53.** 339.)

***Per*molybdic acid.**

See **Permolybdic acid.**

Molybdic sulphuric acid, MoO_3, SO_3.

Deliquescent. (Schultz-Sellack, B. **4.** 14.)
Very deliquescent. Very sol. in H_2O. (Muthmann, A. 1886, **238.** 126.)
$MoO_3, 3SO_3+2H_2O$ (?).

Molybdocyanhydric acid, $H_4Mo(CN)_8+6H_2O$.

Easily sol. in H_2O and abs. alcohol. Solutions are stable at ord. temp. (Rosenheim and Garfunkel, Z. anorg. 1910, **65.** 168.)

Cadmium molybdocyanide, $Cd_2Mo(CN)_8+8H_2O$.

Insol. in H_2O. (Rosenheim.)

Cadmium molybdocyanide ammonia, $Cd_2Mo(CN)_8, 4NH_3+2H_2O$.

(Rosenheim.)

Cupric molybdocyanide ammonia, $Cu_2Mo(CN)_8, 4NH_3+7H_2O$.

(Rosenheim.)

Potassium molybdocyanide, $K_4Mo(CN)_8+2H_2O$.

Very sol. in H_2O. (Rosenheim.)

Thallous molybdocyanide, $Tl_4Mo(CN)_8$.

Very sl. sol. in H_2O. (Rosenheim.)

Molybdoiodic acid, $HIO_3, H_2MoO_4+H_2O$.

Easily sol. in H_2O. (Blomstrand, J. pr. (2) **40.** 320.)
$I_2O_5, 2MoO_3+2H_2O$. Very sol. in H_2O. Insol. in cold, sol. in hot HNO_3. Sol. in alcohol. (Chrétien, A. ch. 1898, (7) **15.** 402.)

Ammonium molybdoiodate, NH_4IO_3, H_2MoO_4.

Somewhat more sol. than K salt. (Blomstrand.)

$(NH_4)_2O$, I_2O_5, $2MoO_3$. Very sl. sol. in cold H_2O. More sol. in hot H_2O. (Rosenheim and Liebknecht, A. 1899, **308.** 50.)

$+H_2O$. 1 l. H_2O dissolves 5.39 g. salt at 15°; 30.94 g. at 100°. More sol. in dil. HNO_3 +Aq. (Chretien, A. ch. 1898, (7) **15.** 409.)

$3(NH_4)_2O$, $(I_2O_5, 2MoO_3)_4+6H_2O$. (Chrétien.)

Barium molybdoiodate, BaO, I_2O_5, $2MoO_3+2H_2O$.

4.23 g. are sol. in 1 l. H_2O at ord. temp. (Chrétien.)

Cadmium molybdoiodate, acid, 3CdO, $(I_2O_5, 2MoO_3)_5+16H_2O$.

Sl. sol. in H_2O. (Chrétien.)

Calcium molybdoiodate, CaO, I_2O_5, $2MoO_3+6H_2O$.

1 l. H_2O dissolves 7.8 g. of the salt at 15°; 20.89 g. at 90°. (Chrétien.)

Cobaltous molybdoiodate, CoO, I_2O_5, $2MoO_3+6H_2O$.

5.11 g. are sol. in 1 l. H_2O at 15°; 22.27 g. at 100°. (Chrétien.)

Cobaltous molybdoiodate acid, CoO, $(I_2O_5, 2MoO_3)_5+18H_2O$.

Very sol. in H_2O. (Chrétien.)

Cupric molybdoiodate, CuO, I_2O_5, $2MoO_3+3H_2O$.

1 l. H_2O dissolves 10.63 g. of the salt at 15°; 25.55 g. at 100°. (Chrétien.)

Lithium molybdoiodate, Li_2O, I_2O_5, $2MoO_3+2\frac{1}{2}H_2O$.

197.83 g. are sol. in 1 l. H_2O at 15°. Sol. in dil. HNO_3+Aq. (Chrétien.)

Magnesium molybdoiodate, MgO, I_2O_5, $2MoO_3+6H_2O$.

1 l. H_2O dissolves 3.85 g. of the salt at 15°; 18.2 g. at 100°. (Chrétien.)

Manganous molybdoiodate, 3MnO, $(I_2O_5, 2MoO_3)_4+9H_2O$.

1 l. H_2O dissolves 17.05 g. of the salt at 15°; 55.05 g. at 100°. (Chrétien.)

Nickel molybdoiodate, NiO, I_2O_5, $2MoO_3+6H_2O$.

5.43 g. are sol. in 1 l. H_2O at 15°; 21.8 g. at 100°. (Chrétien.)

2NiO, $2I_2O_5$, $3MoO_3+23H_2O$. Easily sol. in H_2O. Not decomp. by acids. (Maass, Dissert. **1901.**)

Nickel molybdoiodate, acid, 2NiO, $(I_2O_5, 2MoO_3)_5+15H_2O$.

Very sol. in H_2O. (Chrétien.)

Potassium molybdoiodate, $KHO_2IO_2MoO_3OH$, or KIO_3, MoO_3+2H_2O.

Ppt. Sl. sol. in H_2O. (Blomstrand, J. pr. (2) **40.** 320.)

K_2O, I_2O_5, $2MoO_3$. Only sl. sol. in cold H_2O; sol. on long boiling. 4.48 grs. are sol. in 1 l. H_2O at 12°. (Compare Blomstrand: not identical.) (Rosenheim, A. 1899, **308.** 50.)

$+H_2O$. Sl. sol. in H_2O. 3.45 g. are sol. in 1 l. H_2O at 15°; 28.38 g. at 100°. More sol. in dil. HNO_3+Aq. (Chrétien, A. ch. 1898, (7) **15.** 404.)

Potassium molybdoiodate, acid.

$(I_2O_5, 2MoO_3)_6$, $4K_2O+7H_2O$.
$(I_2O_5, 2MoO_3)_3$, $2K_2O+13H_2O$.
$(I_2O_5, 2MoO_3)_2$, K_2O+4H_2O.
$(I_2O_5, 2MoO_3)_3$, K_2O+7H_2O.
$(I_2O_5, 2MoO_3)_4$, K_2O+5H_2O.
(Chrétien.)

Silver molybdoiodate, Ag_2O, I_2O_5, $2MoO_3+1\frac{1}{2}H_2O$.

Insol. in H_2O.

$4Ag_2O$, $4I_2O_5$, $3MoO_3$. Sol. in H_2O containing HNO_3. (Chrétien.)

Sodium molybdoiodate, Na_2O, I_2O_5, $2MoO_3+H_2O$.

Sl. sol. in H_2O. Sol. in HNO_3 with decomp. (Chrétien, C. R. 1896, **123.** 178.)

1 l. H_2O dissolves 6.97 g. of the salt at 15°; 22.75 g. at 90°.

1 l. HNO_3+Aq (1 : 10) dissolves 23.78 g. of the salt at ord. temp. (Chrétien, A. ch. 1898, (7) **15.** 410.)

$+2H_2O$. Only sl. sol. in cold H_2O; sol. on long boiling. 3.35 grams are sol. in 1 l. H_2O at 12°. (Rosenheim, A. 1899, **308.** 50.)

Strontium molybdoiodate, SrO, I_2O_5, $2MoO+3H_2O$.

Very sol. in H_2O. (Chrétien, A. ch. 1898, (7) **15.** 415.)

Strontium molybdoiodate, acid, 3SrO, $(I_2O_5, 2MoO_3)_4+15H_2O$.

1 l. H_2O dissolves 2.94 g. of the salt at 15°; 13.64 g. at 100°. (Chrétien.)

Uranyl molybdoiodate, $2UO_3$, $4I_2O_5$, $3MoO_3+3H_2O$. (Chrétien.)

Zinc molybdoiodate, ZnO, I_2O_5, $2MoO_3+5H_2O$.

1 l. H_2O dissolves 4.08 g. of the salt at 15°; 16.25 g. at 100°. (Chrétien.)

Zinc molybdoiodate acid, $ZnO, (I_2O_5, 2MoO_3)_3 + 16H_2O$.

Very sol. in H_2O. (Chrétien.)

Molybdoperiodic acid.

Ammonium molybdoperiodate, $5(NH_4)_2O, I_2O_7, 12MoO_3 + 12H_2O$.

Sol. in H_2O. (Blomstrand, Sv. V. A. H. Bih. **1892.** No. 6.)

$4(NH_4)_2O, I_2O_7, 8MoO_3 + 7H_2O$. Very sl. sol. in cold H_2O. (Blomstrand.)

Ammonium sodium ——, $2(NH_4)_2O, Na_2O, I_2O_7, 2MoO_3 + 10H_2O$.

Very sl. sol. in H_2O. (B.)

Barium sodium ——, $9BaO, Na_2O, 2I_2O_7, 24MoO_3 + 28H_2O$.

Very sl. sol. in H_2O. (B.)

Calcium ——, $5CaO, I_2O_7, 12MoO_3 + 26H_2O$.

Extremely sol. in H_2O. (Blomstrand.)

$4CaO, I_2O_7, 12MoO_3 + 21H_2O$. Less sol. in H_2O than above salt.

Lithium ——, $5Li_2O, I_2O_7, 12MoO_3 + 30H_2O$.

Not so efflorescent as Na salt. Sol. in H_2O. (B.)

$+18H_2O$.) (B.)

Manganous sodium ——, $2MnO, 3Na_2O, I_2O_7, 12MoO_3 + 32H_2O$.

Sol. in H_2O. (B.)

Potassium ——, $5K_2O, I_2O_7, 12MoO_3 + 12H_2O$.

Not efflorescent. (Blomstrand.)

Sodium ——, $5Na_2O, I_2O_7, 12MoO_3 + 34H_2O$.

Efflorescent. Very sol. in H_2O. (Blomstrand, Sv. V. A. H. Bih. **1892.** No. 6. 24.)

$+26H_2O$. Not efflorescent. Very sol. in H_2O. (Blomstrand.)

Sodium strontium ——, $Na_2O, 4SrO, I_2O_7, 12MoO_3 + 20H_2O$.

Sol. in H_2O. (B.)

Molybdophosphoric acid.

See **Phosphomolybdic acid.**

Molybdo*sub*phosphoric acid.

Sodium molybdo*sub*phosphate, $Na_2[P(Mo_2O_7)_3] + 8H_2O$.

Ppt. (Rosenheim, Z. anorg. 1913, **84.** 222.)

Molybdophosphorous acid.

Potassium molybdophosphite, $K_2[HP(Mo_2O_7)_3] + 11H_2O$.

Difficultly sol. in cold H_2O. (Rosenheim, Z. anorg. 1913, **84.** 219.)

Sodium molybdophosphite, $Na_2[HP(Mo_2O_7)_3] + 11H_2O$.

Sl. sol. in H_2O. (Rosenheim, Z. anorg. 1913, **84.** 218.)

Molybdophosphovanadic acid.

See **Phosphovanadiomolybdic acid.**

Molybdoselenious acid.

Ammonium molybdoselenite, $4(NH_4)_2O, 3SeO_2, 10MoO_3 + 4H_2O$.

More sol. in hot than cold H_2O; insol. in alcohol. (Péchard, A. ch. (6) **30.** 403.)

Ammonium potassium molybdoselenite, $2(NH_4)_2O, 2K_2O, 3SeO_2, 10MoO_3 + 5H_2O$.

Very sol. in H_2O; insol. in alcohol. (Péchard.)

Barium molybdoselenite, $4BaO, 3SeO_2, 10MoO_3 + 3H_2O$.

Sl. sol. in cold, easily in warm H_2O. (Péchard.)

Potassium molybdoselenite, $4K_2O, 3SeO_2, 10MoO_3 + 5H_2O$.

Very sol. in H_2O; insol. in alcohol. (Péchard.)

Sodium molybdoselenite, $4Na_2O, 3SeO_2, 10MoO_3 + 15H_2O$.

Very efflorescent, and sol. in H_2O; insol. in alcohol. (Péchard.)

Molybdosilicic acid.

See **Silicomolybdic acid.**

Molybdosilicovanadic acid.

See **Silicovanadiomolybdic acid.**

Molybdosulphuric acid.

Appreciably sol. in H_2O. (Hoffmann, Dissert. **1903.**)

Ammonium molybdosulphate, $(NH_4)_2O, 2MoO_3, SO_3 + 4H_2O$, and $+9H_2O$.

Decomp. by H_2O. (Weinland, Z. anorg. 1907, **54.** 261.)

$(NH_4)_2O, 2MoO_3, 3SO_3 + 10H_2O$. (Weinland.)

Ammonium molybdenyl molybdosulphate, $(NH_4)_2O, MoO_2, 7MoO_3, SO_3 + xH_2O$.

$1\frac{1}{2}(NH_4)_2O, MoO_2, 7MoO_3, SO_3 + 5H_2O$.

$2(NH_4)_2O, MoO_2, 7MoO_3, SO_3 + 14H_2O$. (Hoffmann, Dissert. **1903.**)

$3NH_3, MoO_2, 7MoO_3, SO_3 + 10H_2O$. Very sol. in H_2O. Very sl. sol. in NH_4 salts+Aq. Very stable toward alkali+Aq. (Péchard, C. R. 1893, **116.** 1441.)

$5NH_3$, MoO_2, $7MoO_3$, SO_3+8H_2O. (Péchard, C. R. 1893, **116.** 1441.)

Potassium molybdosulphate, K_2O, $2MoO_3$, SO_3+2H_2O.

K_2O, $2MoO_3$, SO_3+6H_2O.
K_2O, $2MoO_3$, $3SO_3+6H_2O$. (Weinland, Z. anorg. 1907, **54.** 260.)

Potassium molybdenyl molybdosulphate, K_2O, MoO_2, $7MoO_3$, SO_3+8H_2O.

(Hoffmann, Dissert. **1903.**)

Molybdosulphurous acid.

Ammonium molybdosulphite, $4(NH_4)_2O$, $3SO_2$, $10MoO_3+6H_2O$.

Sl. sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Péchard, A. ch. (6) **30.** 396.)
$3(NH_4)_2O$, $8MoO_3$, $2SO_2+5H_2O$. Sl. sol. in cold, easily sol. in warm H_2O. Easily decomp. by H_2O, and can be recryst. only in presence of an excess of sulphurous acid. (Rosenheim, Z. anorg. 1894, **7.** 177.)

Ammonium potassium molybdosulphite, $2(NH_4)_2O$, $2K_2O$, $3SO_2$, $10MoO_3+9H_2O$.

Sl. sol. in cold H_2O. Decomp. on warming. (Péchard.)

Barium molybdosulphite, $2BaO$, $5MoO_3$, $2SO_2+10H_2O$.

(Rosenheim, Z. anorg. 1897, **15.** 185.)

Cæsium molybdosulphite, $2Cs_2O$, $5MoO_3$, $2SO_2+6H_2O$.

Unstable. As K salt. (Rosenheim.)

Potassium molybdosulphite, $4K_2O$, $3SO_2$, $10MoO_3+10H_2O$.

Very sl. sol. in H_2O, but decomp. on warming. (Péchard.)
$2K_2O$, $5MoO_3$, $2SO_2+H_2O$. (Rosenheim.)

Rubidium molybdosulphite, $2Rb_2O$. $5MoO_3$, $2SO_2+\frac{1}{2}H_2O$.

As K salt. (Rosenheim.)

Sodium molybdosulphite, $4Na_2O$, $3SO_2$, $10MoO_3+12H_2O$.

Very sol. in cold H_2O; insol. in alcohol. (Péchard.)
$+16H_2O$. Very efflorescent. (Péchard.)
$2Na_2O$, $5MoO_3$, $2SO_2+8H_2O$. In dry state it gradually gives off SO_2 and soon effloresces. (Rosenheim.)

Strontium molybdosulphite, $2SrO$, $5MoO_3$, $2SO_2+12H_2O$.

(Rosenheim.)

Molybdotitanic acid.

See **Titanomolybdic acid.**

Molybdous acid.

Magnesium molybdite, $Mg_2Mo_3O_8=2MgO$, $3MoO_2$.

Not attacked by KOH, and HCl+Aq. (Muthmann, A. **238.** 108.)

Zinc molybdite, $Zn_2Mo_3O_8=2ZnO$, $3MoO_2$.

Easily sol. in aqua regia. (Muthmann, A. **238.** 108.)

Molybdovanadates.

See **Vanadiomolybdates.**

Neodymicotungstic acid.

Ammonium neodymicotungstate, $3(NH_4)_2O$, Nd_2O_3, $16WO_3+20H_2O$.

Difficultly sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc 1904, **26.** 1480.)

Barium neodymicotungstate, $6BaO$, Nd_2O_3, $16WO_3+17H_2O$.

Insol. in H_2O. (E. F. Smith.)

Neodymium.

See also under **Didymium.**

Neodymium bromide, $NdBr_3$.

(Matignon, C. R. 1905, **140.** 1638.)

Neodymium carbide, NdC_2.

Decomp. by H_2O; insol. in conc. HNO_3; decomp. by dil. HNO_3. (Moissan, C. R. 1900, **131.** 597.)

Neodymium chloride, $NdCl_3$.

100 g. H_2O dissolve 98.68 g. $NdCl_3$ at 13°; 140.4 g. at 100°.
Sp. gr. at 15°/4° of the solution sat. at 13° = 1.74. (Matignon, A. ch. 1906, (8) **8.** 249.)
44.5 g. are sol. in 100 g. abs. alcohol at 20°.
1.8 g. " " " " " pyridine at 15°.
Insol. in ether, $CHCl_3$, quinoline, toluidine, etc. Sl. sol. in aniline and in phenylhydrazine. (Matignon, A. ch. 1906, (8) **8.** 266.)
$+6H_2O$. Deliquescent.
At 13°, 100 pts. H_2O dissolve 246.2 pts. of the hydrated salt.
At 100°, 100 pts. H_2O dissolve 511 pts. of hydrated salt.
Sat. solution at 13° has a sp. gr. 15°/4° = 1.741. (Matignon, C. R. 1901, **133.** 289.)

Neodymium chloride ammonia, $NdCl_3$, $12NH_3$.

Decomposes on heating into $NdCl_3+NH_3$; $+2NH_3$; $+4NH_3$; $+5NH_3$; $+8NH_3$; and $+11NH_3$. (Matignon, C. R. 1906, **142. 1043.**)

Neodymium hydroxide.

Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, **26.** 49.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine. 100 ccm. of the solution contain 4.5 g. neodymium oxide. (Müller, Z. anorg. 1905, **43.** 322.)

Neodymium hydride, NdH_2 (?).

Slowly attacked by boiling H_2O. Sol. in acids with violent evolution of H_2. (Muthmann, A. 1904, **331.** 58.)

Neodymium iodide, NdI_3.

(Matignon, C. R. 1905, **140.** 1638.)

Neodymium nitride, NdN.

Decomp. in moist air with evolution of NH_3. (Muthmann, A. 1904, **331.** 59.)

Neodymium oxide, Nd_2O_3.

Easily sol. in acids. (v. Welsbach, M. **6.** 477.)

Neodymium oxychloride, NdOCl.

(Matignon, C. R. 1905, **140.** 1638.)

Neon, Ne.

Less sol. than argon in H_2O; sol. in liquid oxygen. (Ramsay, B. 1898, **31.** 3118.)

Absorption by H_2O at t°.

t°	Coefficient of absorption
0	0.0114
10	0.0118
20	0.0147
30	0.0158
40	0.0203
50	0.0317

(Antropoff, Roy. Soc. Proc. 1910, **83.** A, 480.)

Nickel, Ni.

Not attacked by H_2O. Very slowly sol. in dilute H_3PO_4, H_2SO_4, or HCl+Aq. (Tupputi, A. ch. **78.** 133.)

Very easily attacked by HNO_3+Aq, and difficultly by hot H_2SO_4. When pure, is converted into passive condition by conc. HNO_3. (Nicklès, C. R. **38.** 284.)

Very sl. attacked by cold acids, except HNO_3+Aq. (Tissier, C. R. **50.** 106.)

Not attacked by NaOH+Aq. (Venator, Dingl. **261.** 133.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Nickel amide, $Ni(NH_2)_2$.

Decomp. by H_2O; slowly sol. in min. acids. Insol. in liquid NH_3. (Bohart, J. phys. Chem. 1915, **19.** 560.)

Nickel antimonide, NiSb.

Insol. in HCl+Aq; easily sol. in HNO_3+Aq. (Christofle, **1863.**)

Min. *Breithauptite.* Insol. in acids; easily sol. in aqua regia.

Ni_3Sb_2. (Christofle.)

Nickel antimonide sulphide, $NiSb_2$, NiS_2 = NiSbS.

Min. *Nickel glance, Ullmannite.*

Decomp. by HNO_3+Aq; completely sol. in aqua regia with separation of S.

Nickel arsenide, NiAs.

Min. *Niccolite.* Sol. in conc. HNO_3+Aq with separation of As_2O_3; more easily sol. in aqua regia.

$NiAs_2$. Min. *Chloanthite, Rammelsbergite.* Sol. in HNO_3+Aq.

Ni_3As_2. Sol. in HNO_3 and in aqua regia. Readily attacked by fused alkali. (Granger, C. R. 1900, **130.** 915.)

Nickel arsenide sulphide, $NiAs_2$, NiS_2.

Min. *Gersdorffite.* Partly sol. in HNO_3+Aq with separation of S and As_2O_3; not attacked by KOH+Aq.

Nickel azoimide, basic, $Ni(OH)N_3$

Insol. in H_2O. (Curtius, J. pr. 1898, (2) **58.** 300.)

Nickel azoimide, NiN_6+H_2O.

Sol. in H_2O; insol. in alcohol and ether. (Curtius, J. pr. 1900, (2) **61.** 418.)

Nickel potassium azoimide, $Ni(N_3)_2$, KN_3 (?).

Sol. in H_2O. (Curtius, J. pr. 1898, (2) **58.** 302.)

Nickel boride, Ni_2B.

Attacked by HNO_3. Slowly sol. in hot HCl. (Jassoneix, C. R. 1907, **145.** 240.)

NiB. Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat. Not attacked by HCl. Easily attacked by HNO_3 and aqua regia; by H_2SO_4 only on heating. (Moissan, C. R. 1896, **122.** 425.)

NiB_2. (Jassoneix, C. R. 1907, **145.** 241.)

Nickel bromide, $NiBr_2$.

Deliquescent. Slowly sol. in H_2O.

Sat. $NiBr_2$+Aq contains at:

—21°	—6°	+19°	38°
47.1	51.7	56.6	58.9% $NiBr_2$,

58°	77°	98°	100°	140°
60.5	60.3	61.0	61.0	60.7% $NiBr_2$.

(Étard, A. ch. 1894, (7) **2.** 542.)

Somewhat hygroscopic. Nearly insol. in cold H_2O but begins to dissolve appreciably at 50°, and somewhat more rapidly at 90°, but even at that temp. 1 g. requires 1–2 hours for solution. HNO_3 does not appreciably hasten solution. (Richards and Cushman, Z. anorg. 1898, **16.** 169.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

$+3H_2O$. Deliquescent. Very sol. in H_2O, HCl+Aq, NH_4OH+Aq, alcohol, and ether. (Berthemot, A. ch. **44.** 389.)

$+6H_2O$. (Bolschakoff, C. C. **1897,** II. 331 and 726.)

$+9H_2O$. (Bolschakoff, C. C. **1897,** II. 726 and 331.)

Nickel stannic bromide.

See **Bromostannate, nickel.**

Nickel bromide ammonia, $NiBr_2$, $6NH_6$

Sol. in little H_2O, but decomp. by more. (Rammelsberg, Pogg. **55.** 243.)

Sol. in warm conc. NH_4OH+Aq; insol. in cold. (Richards and Cushmann, Z. anorg. 1898, **16.** 175.)

Nickel bromide cupric oxide, $NiBr_2$, $3CuO+4H_2O$.

Not decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 377.)

Nickel bromide hydrazine, $NiBr_2$, $2N_2H_4$.

Easily sol. in dil. acids and NH_4OH+Aq.

$NiBr_2$, $3N_2H_4$. Sol. in dil. acids. (Franzen, Z. anorg. 1908, **60.** 263–4.)

Nickel carbonyl, $Ni(CO)_4$.

Insol. in H_2O; not attacked by dil. acids or alkalies or conc. HCl+Aq. Easily sol. in conc. HNO_3+Aq and in aqua regia. Sol. in alcohol, benzene, and chloroform. (Mond, Langer, and Quincke, Chem. Soc. **57.** 749.)

Sol. in hydrocarbons, especially oil of turpentine. (Berthelot, C. R. 1891, **112.** 1346.)

Sol. in acetone, toluene, methyl and ethyl alcohol, etc. (Lenher and Loos, J. Am. Chem. Soc. 1900, **22.** 114.)

Nickel chloride, $NiCl_2$.

Anhydrous. Not immediately sol. in H_2O, but gradually dissolves on boiling or by addition of HCl+Aq. Deliquesces on air, and is then easily sol. in H_2O. Sol. in NH_4OH+Aq. Sol. in alcohol. Sol. in hot HCl+Aq only slowly.

Sp. gr. of $NiCl_2$+Aq containing:

5	10	15	20	25% $NiCl_2$.
1.0493	1.0995	1.1578	1.2245	1.3000

(B. Franz, J. pr. (2) **5.** 285.)

Sp. gr. of $NiCl_2$+Aq containing, in 1000 grms. H_2O, g. $NiCl_2+7H_2O$ at 23.1°:

128 g. (=½ mol.)	256	384	512
1.057	1.107	1.149	1.187
640	768	896	1024
1.220	1.249	1.276	1.301

Containing g. $NiCl_2$ (anhydrous):

65 g. (=½ mol.)	130	195	260	325	390
1.061	1.119	1.176	1.230	1.284	1.335

(Gerlach, Z. anal. **28.** 468.)

Sp. gr. of $NiCl_2$+Aq at room temp. containing:

11.449	22.69	30.40% $NiCl_2$.
1.1093	1.2264	1.3371

(Wagner, W. Ann. 1883, **18.** 269.)

Sp. gr. of $NiCl_2$+Aq at 25°.

Concentration of $NiCl_2$+Aq	Sp. gr.
1–normal	1.0591
½– "	1.0308
¼– "	1.0144
⅛– "	1.0067

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

100 pts. absolute alcohol dissolve at room temperature 10.05 pts. $NiCl_2$. (Bödtker, Z. phys. Ch. 1897, **22.** 511.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Solubility in glycol=16.1–16.3%. (de Coninck, C. C. **1905,** II. 1234.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Anhydrous $NiCl_2$ is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

$+H_2O$. (Baubigny.)

1 l. sat. HCl+Aq at 12° contains 40 g. $NiCl_2$ dissolved from $NiCl_2$, H_2O. (Ditte.)

$+2H_2O$. (Sabatier, Bull. Soc. (3) **1.** 88.)

$+6H_2O$. Deliquescent in moist, efflorescent in dry air; sol. in H_2O with evolution of heat. Sol. in 1.5 to 2 pts. H_2O. Easily sol. in alcohol. (Tupputi.)

1 l. H_2O dissolves 600 g. $NiCl_2+6H_2O$. (Ditte, A. ch. 1879, (5) **22.** 551.)

Sat. aq. solution contains at:

—17°	—16°	+10°	18°
29.7	31.0	37.3	38.5% $NiCl_2$,
38°	59°	78°	96°
41.9	45.0	46.6	46.7% $NiCl_2$.

(Étard, A. ch. 1894, (7) **2.** 539.)

Solubility of $NiCl_2+6H_2O$=37.53% $NiCl_2$ at 25°. (Foote, J. Am. Chem. Soc. **1912, 34.** 882.)

100 pts. absolute alcohol dissolve at room temperature 53.71 pts. $NiCl_2+6H_2O$. (Bödtker, Z. phys. Ch. 1897, **22.** 511.)

$+7H_2O$. 100 g. absolute alcohol dissolve 2.16 g. $NiCl_2+7H_2O$ at 17° and 1.4 g. at 3°. (de Bruyn, R. t. c. 1892, **11.** 156.)

Nickel hydrogen chloride, $3NiCl_2, 2HCl+1\frac{1}{2}H_2O$.

(Reitzenstein, Z. anorg. 1898, **18.** 270.)

Nickel rubidium chloride, $NiCl_2, 2RbCl$.

Easily sol. in H_2O and HCl+Aq. (Godeffroy, B. **8.** 9.)

Nickel thallic chloride, $NiCl_2, 2TlCl_3+8H_2O$.

Deliquescent. Can be cryst. from H_2O. (Gewecke, A. 1909, **366.** 221.)

Nickel tin (stannous) chloride, $NiCl_2, SnCl_2+6H_2O$.

Sol. in H_2O. (Jörgensen.)

Nickel tin (stannic) chloride.

See **Chlorostannate, nickel.**

Nickel chloride ammonia, $NiCl_2, 2NH_3$.

Sol. in H_2O, decomp. on boiling; insol. in alcohol.

$NiCl_2, 3NH_3+3H_2O$. (André, C. R. 1888, **106.** 937.)

$NiCl_2, 6NH_3$. Sol. in cold H_2O without decomp. Insol. in alcohol. Very sl. sol. in conc. NH_4OH+Aq.

Nearly insol. in a sat. solution of NH_4Cl in NH_4OH+Aq. (Sörensen, Z. anorg. 1894, **5.** 363.)

Nickel chloride cupric oxide, $NiCl_2, 3CuO+4H_2O$.

Not decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 377.)

Nickel chloride hydrazine, $NiCl_2, 2N_2H_4$.

Sol. in dil. acids and NH_3+Aq. (Franzen, Z. anorg. 1908, **60.** 262.)

$NiCl_2, 3N_2H_4$. Sol. in dil. acids. (F.)

Nickel fluoride, NiF_2.

Sol. in about 5000 pts. H_2O; insol. in alcohol and ether. Not attacked by HCl, HNO_3, or H_2SO_4 even when hot. (Poulenc, C. R. **114.** 1426.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

$+2H_2O$. Decomp. by pure H_2O. Sol. in H_2O acidulated with HF. (Berzelius.)

$+3H_2O$. (Clarke, Sill. Am. J. (3) **13.** 291.)

Nickel hydrogen fluoride, $NiF_2, 5HF+6H_2O$.

Easily sol. in H_2O and dil. acids. Sol. in NH_4OH+Aq with decomp. (Böhm, Z. anorg. 1905, **43.** 330.)

Nickel potassium fluoride, NiF_2, KF.

$+H_2O$. Sol. in H_2O. (Wagner, B. **19.** 896.)

NiF_2, 2KF. Sl. sol. in H_2O. Scarcely sol. in methyl or ethyl alcohol or benzene. (Poulenc, C. R. **114.** 747.)

Nickel potassium zirconium fluoride.

See **Fluozirconate, nickel potassium.**

Nickel manganic fluoride.

See **Fluomanganate, nickel.**

Nickel sodium fluoride, $NiF_2, NaF+H_2O$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Nickel stannic fluoride.

See **Fluostannate, nickel.**

Nickel titanium fluoride.

See **Fluotitanate, nickel.**

Nickel tungstyl fluoride.

See **Fluoxytungstate, nickel.**

Nickel vanadium fluoride.

See **Fluovanadate, nickel.**

Nickel zirconium fluoride.

See **Fluozirconate, nickel.**

Nickel fluoride ammonia, $5NiF_2, 6NH_3+8H_2O$.

Insol. in cold H_2O. Decomp. by hot H_2O. Easily sol. in dil. acids. (Böhm, Z. anorg. 1905, **43.** 334.)

Nickelous hydroxide, $4NiO_2H_2, H_2O$.

Very sl. sol. in H_2O. Sol. in acids. Insol. in KOH or NaOH+Aq. Somewhat difficultly sol. in $(NH_4)_2CO_3$ or NH_4OH+Aq, but easily sol. in presence of NH_4 salts. Sol. in NH_4 salts+Aq. Sol. in KCN+Aq. (Rodgers, **1834.**)

Sol. in boiling NH_4Cl+Aq.

NiO_2H_2.

Solubility in NH_4OH+Aq at 25°.

NH_3 norm.	G. Ni per l.	G. NiO_2H_2 per l.
1	0.084	0.00287
2	0.170	0.00579
3	0.257	0.00875
4	0.360	0.01227
4.911	2.580	0.0879
3.900	1.780	0.0607
2.101	0.835	0.0284
0.602	0.158	0.0054

The non-agreement of the results is due to the formation of different modifications of NiO_2H_2.

(Bonsdorff, Z. anorg. 1904, **41.** 185.)

Solubility in NH_4OH+Aq.
Conc. of Ni=0.014N in 1N NH_4OH+Aq.
" " " =0.036N " 2N NH_4OH+Aq.
(Starck, B. 1903, **36.** 3840.)

Sol. in hot NH_4F+Aq. (von Helmolt, Z anorg. 1893, **3.** 133.)

Insol. in methyl or amyl amine. (Wurtz.)

Not pptd. in presence of Na citrate. (Spiller.)

Not pptd. in presence of a large number of non-volatile organic substances, particularly $H_2C_4H_4O_6$. (Rose.)

Nickelonickelic hydroxide, Ni_3O_4, $2H_2O$.

Sol. in acids; insol. in H_2O and alkalies. (Dudley, J. Am. Chem. Soc. 1896, **18.** 901.)

Nickelic hydroxide, Ni_2O_3, $2H_2O$ (?).

(Wernicke, Pogg. **141.** 122.)

Ni_2O_3, $3H_2O$ (?). Sol. in acids as nickelous salts. Not attacked by boiling KOH or NaOH+Aq. Slowly sol. in $HC_2H_3O_2$+Aq. Sol. in NH_4OH, and NH_4 salts+Aq. (Odling.)

Nickel iodide, NiI_2.

Deliquescent and sol. in H_2O. (Erdmann, J. pr. **7.** 254.)

Sat. NiI_2+Aq contains at:

—23°	—6°	+11°	16°
51.8	54.3	57.8	59.0% NiI_2,
43°	80°	85°	90°
64.1	65.0	65.2	65.7% NiI_2.

(Étard, A. ch. 1894, (7) **2.** 546.)

$+6H_2O$. Deliquescent. Easily sol. in H_2O. (Erdmann.)

Nickel iodide ammonia, NiI_2, $4NH_3$.

(Rammelsberg, Pogg. **48.** 119.)

NiI_2, $6NH_3$. Decomp. by H_2O Sol. in warm dil. NH_4OH+Aq. Very sl. sol. in conc. NH_4OH+Aq. (Erdmann.)

Nickel iodide hydrazine, $NiI_2(N_2H_4)_2$.

Insol. in H_2O. Sol. in acids. (Franzen, Z. anorg. 1911, **70.** 150.)

Nickel *sub***oxide,** $Ni_3O_2+H_2O$.

Insol. in H_2O; sol. in HCl and H_2SO_4 and HNO_3; also in KCN+Aq. (Moore, C. N. 1895, **71.** 81.)

Nickelous oxide, NiO.

Insol. in H_2O. Sol. in conc. acids, except when crystalline, when it is scarcely attacked by acids. (Ebelmen, C. R. **33.** 256.)

Very sl. sol. in boiling NH_4Cl+Aq. (Demarçay.)

Very slowly sol. in NH_4OH+Aq. Insol. in KOH, and NaOH+Aq.

Sol. in min. acids, especially HCl+Aq, when warmed; insol. in $HC_2H_3O_2$, NH_4Cl, and NH_4SCN+Aq. Insol. in conc. NaOH+Aq. (Zimmerman, A. **232.** 324.)

1 l. solution containing 418.6 g. sugar and 34.3 g CaO dissolves 0.29 g. NiO. (Bodenbender, J. B. **1865.** 600.)

Min. *Bunsenite.*

Nickelonickelic oxide, Ni_3O_4.

Sol. in acids. (Baubigny, C. R. **87.** 1082.)

$+2H_2O$. Insol. in H_2O, and in alkalies+Aq. Sol. in acids. (Dudley, J. Am. Chem. Soc. 1896, **18.** 901.)

6NiO, $Ni_2O_3+H_2O$ (Schönbein, J. pr. **93.** 35.)

Nickelic oxide, Ni_2O_3.

Sol. in HNO_3, H_2SO_4 or HCl+Aq with decomp., also in NH_4OH and $(NH_4)_2CO_3$+Aq. (Winkelblech, A. **13.** 259.)

Nickel *peroxide*, Ni_3O_5 (?).

(Bayley, C. N. **39.** 81.)

Correct composition is Ni_2O_3. (Carnot, C. R. **108.** 610.)

Ni_4O_7 (?). (Wicke, Zeit. Ch. **1865.** 303.)

NiO_4. (Hollard, C. R. 1903, **136.** 230.)

Nickel oxychloride.

Sl. sol. in H_2O. (Berzelius.)

$NiCl_2$, 8NiO+$13H_2O$. (Raoult, C. R. **69.** 826.)

Nickel oxyiodide, NiI_2, 9NiO+$15H_2O$.

Insol. in H_2O. Sol. in HNO_3+Aq or acetic acid. Insol. in NH_4OH+Aq. Alcohol dissolves out NiI_2. (Erdmann.)

Nickel oxyselenide.

Almost insol. in boiling HCl; decomp. by HNO_3. (Fonzes-Diacon, C. R. 1900, **131.** 557.)

Nickel phosphide, Ni_2P.

Sol. in HNO_3+Aq and aqua regia; insol. in HCl+Aq. (Struve, J. pr. **79.** 321.)

Sol. in aqua regia and in HNO_3; sol. in fused alkali. (Granger, Bull. Soc. 1896, (3) **15.** 1089.)

Easily sol. in HNO_3. (Granger, C. N. 1898, **77.** 229.)

When prepared by heating phosphorus, copper and nickel in electric furnace, is insol. in all acids except a mixture of HNO_3 and HF. (Maronneau, C. R. 1900, **130.** 657.)

NiP_2. Sol. in HNO_3; decomp. by fused NaOH. (Jolibois, C. R. 1910, **150.** 107.)

NiP_3. Sol. in HNO_3; decomp. by fused NaOH. (J.)

Ni_2P_3. Insol. in HNO_3, HCl and aqua regia; stable in the air even when heated (Granger, Bull. Soc. 1896, (3) **15.** 1086.)

Ni_3P_2. Not attacked by HCl. Easily attacked by HNO_3. (Rose, Pogg. 1832, **24.** 232.)

Ni_2P_3. Sol. in HNO_3, aqua regia and in fused alkali. (Granger, C. R. 1896, **123.** 177.)

Nickel phosphosulphide, Ni_3PS_3.

Decomp. by hot H_2O or by aqua regia. Sl. attacked by HNO_3. (Ferrand, A. ch. 1899, (7) **17.** 417.)

Nickel ***semi*****selenide,** Ni_2Se.

Almost insol. in boiling HCl; decomp. by HNO_3. (Fonzes-Diacon, C. R. 1900, **131.** 557.)

Nickel selenide, NiSe.

Insol. in H_2O, dil. or conc. HCl+Aq; slowly sol. in HNO_3+Aq; easily in aqua regia. (Little, A. **112.** 211.)

Almost insol. in boiling HCl; decomp. by HNO_3. (Fonzes-Diacon, C. R. 1900, **131.** 557.)

$NiSe_2$. (Fonzes-Diacon.)

$\left.\begin{matrix}Ni_2Se_3\\Ni_3Se_4\end{matrix}\right\}$ Almost insol. in boiling HCl; decomp. by HNO_3. (Fonzes-Diacon.)

Nickel silicide, Ni_2Si.

Sol. in HF and aqua regia; insol. in cold H_2O; decomp. by steam at red heat; sol. in fused alkali carbonates. (Vigouroux, C. R. 1895, **121.** 687.)

Nickel ***semi*****sulphide,** Ni_2S.

Sol. in HNO_3+Aq, with residue of S. Difficultly sol. in conc. HCl+Aq; insol. in dil. HCl+Aq. (Arfvedson, Pogg. **1.** 65; Gautier, C. R. **108.** 1111.)

Does not exist. (Bornemann, C. A. **1908.** 1686.)

Nickel ***mono*****sulphide,** NiS.

Anhydrous. Insol. in H_2O, HCl, or H_2SO_4 +Aq. Sol. in HNO_3+Aq or aqua regia.

Min. *Millerite.*

$+xH_2O$. Insol. in H_2O, but decomp. by H_2O in contact with the air (Clermont and Guiot, C. R. **84.** 714), or by boiling with H_2O. (Geitner, A. **139.** 354.)

When pptd. with $(NH_4)_2S$, is somewhat sol. in H_2O. 1 l. H_2O dissolves 39.87×10^{-6} moles NiS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Very sl. sol. in dil. HCl+Aq, and still less in $HC_2H_3O_2$+Aq. (Fresenius.)

More sol. in HNO_3+Aq, and easily in aqua regia.

Somewhat sol. in NH_4OH+Aq or solutions of alkali sulphides. Insol. in NH_4SH+Aq. (Fresenius.)

Sol. at moment of formation in Na_2S but not in $(NH_4)_2S$+Aq. (Villiers, C. R. 1894, **119.** 1264.)

Sol. while yet moist in H_2SO_3+Aq. (Berthier.)

When recently pptd., sol. in KCN+Aq. (Haidlen.)

Pptd. in presence of non-volatile organic substances as tartaric acid, etc. (Rose.)

Sol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

Exists in a colloidal form in a very dil. solution. (Winnsinger, Bull. Soc. (2) **49.** 452.)

α modification:

Very sol. in 2N-HCl+Aq sat. with H_2S.

β modification:

0.033 g. is sol. in 1 l. 2N-HCl+Aq sat. with H_2S; very sol. in 2N-HCl+Aq.

γ modification:

Insol. in 2N-HCl+Aq sat. with H_2S. 0.013 g. is sol. in 2N-HCl+Aq. (Thiel, C. C. **1914,** I. 19.)

Nickel sulphide, Ni_3S_2.

(Bornemann, C. A. **1908.** 1686.)

Ni_3S_4. (Bornemann.)

Ni_6S_5. (Bornemann.)

Ni_4S_5. Min. *Polydymite.* Insol. in HCl+Aq. Sol. in HNO_3+Aq with separation of S.

Ni_5S_7. Min. *Beyrichite.* Sol. in HCl+Aq.

Nickel ***di*****sulphide,** NiS_2.

(Fellenberg, Pogg. **50.** 75.)

Does not exist. (Bellucci, C. A. **1909.** 293.)

Nickel potassium sulphide, 3NiS, K_2S.

Insol. in H_2O. (Schneider, J. pr. (2) **9.** 209.)

$K_2Ni_{11}S_{10}$. Not attacked by hot $(NH_4)_2S$; slowly attacked by HCl or cold aqua regia; quickly by hot aqua regia. HF and H_2SO_4 dissolve only on heating. Insol. in organic acids, alkalies and 12% HCl, also in KCN, $AgNO_3$ or $CuSO_4$+Aq. (Milbauer, Z. anorg. 1904, **42.** 447.)

Nickel telluride, Ni_2Te_3.

Min. *Melonite.* Sol. in HNO_3+Aq.

NiTe. (Fabre, C. R. **105.** 277.)

Nickelicotungstic acid.

Ammonium nickelicotungstate, $2(NH_4)_2O$, $2Ni_2O_3$, $8WO_3+14H_2O$.

(Rogers and Smith, J. Am. Chem. Soc. 1904, **26.** 1476.)

$3(NH_4)_2O$, Ni_2O_3, $16WO_3+22H_2O$. Very sl. sol. in H_2O. (Rogers and Smith.)

Barium nickelicotungstate, 19BaO, Ni_2O_3, $16WO_3$.

Ppt. Very insol. in H_2O. (E. F. Smith.)

Nickelimolybdic acid.

Barium nickelimolybdate, 3BaO, NiO_2, $9MoO_3+12H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 702.)

Potassium nickelimolybdate, $3K_2O$, NiO_2, $9MoO_3+6\frac{1}{2}H_2O$.

Very insol. even in hot H_2O. (Hall.)

Nickelomolybdic acid.

Ammonium hydrogen nickelomolybdate, $(NH_4)_4H_6[Ni(MoO_4)_6]+5H_2O$.

Sl. sol. in H_2O, easily in dil. acids. (Barbieri, C. A. **1915.** 897.)

Barium hydrogen nickelomolybdate, $Ba_2H_6[Ni(MoO_4)_6]+10H_2O$.

Ppt. (Barbieri.)

Potassium hydrogen nickelomolybdate, $K_4H_6[Ni(MoO_4)_6]+5H_2O$.

Sl. sol. in H_2O, easily in acids. (Barbieri.)

Silver hydrogen nickelomolybdate, $Ag_4H_6[Ni(MoO_4)_6]+3H_2O$.

Insol. in H_2O; sol. in NH_4OH, or HNO_3+Aq. (Barbieri.)

Nickelonickelous acid.

Potassium nickelonickelite, $K_2Ni_2O_4$ or K_2O, NiO, NiO_2.

(Hofmann and Hiendlmaier, B. 1906, **39.** 3186.)

Sodium nickelonickelite, $Na_2Ni_3O_6=Na_2O$, NiO, $2NiO_2$.

(Bellucci and Rubegni, C. C. **1907,** I. 794.)

Nickelous acid.

Barium *di*nickelite, BaO, $2NiO_2$.

Unstable; decomp. by cold H_2O; slowly and very rapidly by hot H_2O. (Dufau, C. R. 1896, **123.** 496.)

Niobium, Nb.

For niobium and its compounds, see columbium, Cb, and the corresponding compounds.

Nitramide, NH_2NO_2.

Decomp. by conc. H_2SO_4. Easily sol. in H_2O, alcohol, ether and acetone. Less sol. in benzol. Almost insol. in ligroin. (Thiele and Lachman, A. 1895, **288.** 297.)

Sol. in ether, insol. in petroleum ether. Very unstable; decomp. by hot H_2O. (Thiele and Lachman, B. 1894, **27.** 1909.)

Nitratochloroplatinamine comps.

See **Chloronitratoplatinamine comps.**

Nitratocobalt octamine comps.

See **Nitratooctamine cobaltic comps.**

Nitratooctamine cobaltic carbonate, $(NO_3)_2Co_2(NH_3)_8(CO_3)_2+H_2O$.

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. **22.** 2650.)

—— **chloride,** $(NO_3)_2Co_2(NH_3)_8Cl_4+4H_2O$.

(Vortmann and Blasberg, B. **22.** 2652.)

—— **iodide,** $(NO_3)_2Co_2(NH_3)_8I_4+2H_2O$.

(Vortmann and Blasberg.)

—— **nitrate.**

See **Octamine cobaltic nitrate.**

—— **sulphate,** $(NO_3)_2Co_2(NH_3)_8(SO_4)_2+2H_2O$.

$+4H_2O$. (Vortmann and Blasberg, B. **22.** 2652.)

Nitratoplatinamine nitrate, $(NO_3)_2Pt(NH_3NO_3)_2$.

Sl. sol. in cold, more easily in hot H_2O; easily sol. in dil. HNO_3+Aq. (Cleve.)

—— **nitrite,** $(NO_3)_2Pt(NH_3NO_2)_2$.

Easily sol. in H_2O. (Cleve.)

Nitratoplatin*di*amine chloride, $(NO_3)_2Pt(N_2H_6Cl)_2+H_2O$.

Moderately sol. in cold, very easily in hot H_2O.

—— **chloroplatinate,** $(NO_3)_2Pt(N_2H_6Cl)_2$, $PtCl_4+2H_2O$.

Ppt.

—— **chromate,** $(NO_3)_2Pt(N_2H_6)_2CrO_4$.

Nearly insol. in H_2O. (Cleve.)

—— ***di*chromate,** $(NO_3)_2Pt(N_2H_6)_2Cr_2O_7$.

Sl. sol. in H_2O.

—— **nitrate,** $(NO_3)_2Pt(N_2H_6NO_3)_2$.

Sol. in H_2O. Insol. in HNO_3+Aq.

—— **phosphate,** $NO_3Pt(N_2H_6)_2+H_2O$.

$$\begin{array}{c} \diagdown \ \diagup \\ PO_4 \end{array}$$

Very sl. sol. in H_2O. (Cleve.)

Nitrato*di*platin*di*amine nitrate, $(NO_3)_2Pt_2(N_2H_6)_4(NO_3)_4$.

Sol. in H_2O with decomp.

Nitratopurpureocobaltic bromide, $Co(NO_3)(NH_3)_5Br_2$.

Resembles the chloride in its properties. (Jorgensen, J. pr. (2) **23.** 227.)

Nitratopurpureocobaltic carbonate, $Co(NO_3)(NH_3)_5(CO_3)+H_2O$.

Less sol. in H_2O than other purpureocarbonates. (Vortmann and Blasberg, B. **22.** 2648.)

—— **chloride,** $Co(NO_3)(NH_3)_5Cl_2$.

Sl. sol. in cold H_2O, but more than nitrate; more easily sol. in hot H_2O, but is converted into roseo salt. Insol. in HCl+Aq or alcohol. (Jörgensen, J. pr. (2) **23.** 227.)

—— **mercuric chloride,** $Co(NO_3)(NH_3)_5Cl_2, HgCl_2$.

Not wholly insol. in H_2O. (Jörgensen.)

—— **chloroplatinate,** $Co(NO_3)(NH_3)_5Cl_2, PtCl_4$.

Ppt. Nearly insol. in cold H_2O. (Jörgensen.)

—— **chromate,** $Co(NO_3)(NH_3)_5CrO_4$.

Nearly insol. in H_2O. (Jörgensen.)

—— ***di*chromate.**

Sl. sol. in H_2O, but more easily than the neutral salt. (Jörgensen.)

—— **dithionate,** $Co(NO_3)(NH_3)_5S_2O_6$.

Very sl. sol. in cold, more easily in hot H_2O. (Jörgensen.)

—— **nitrate,** $Co(NO_3)(NH_3)_5(NO_3)_2$.

Sol. in 273 pts. H_2O at 16°. Much more sol. in hot H_2O containing HNO_3. (Jörgensen, J. pr. (2) **23.** 227.)

—— **cobaltic nitrite,** $3Co(NO_3)(NH_3)_5, 2Co(NO_2)_6+2H_2O$.

Very sl. sol. in H_2O. (Jörgensen, Z. anorg. **5.** 176.)

—— **diamine cobaltic nitrite,** $Co(NO_3)(NH_3)_5(NO_2)_4Co(NH_3)_2$.

Ppt. (Jörgensen.)

—— **oxalate,** $Co(NO_3)(NH_3)_5C_2O_4$.

Ppt.

—— **sulphate,** $Co(NO_3)(NH_3)_5SO_4+H_2O$.

Rather difficultly sol. in cold H_2O. (Jörgensen.)

Nitratopurpureorhodium chloride, $(NO_3)Rh(NH_3)_5Cl_2$.

Sl. sol. in cold H_2O, but more easily than the nitrate. (Jörgensen, J. pr. (2) **34.** 394.)

—— **dithionate,** $(NO_3)Rh(NH_3)_5S_2O_6+H_2O$.

Nearly insol. in cold H_2O. (Jörgensen.)

Nitratopurpureorhodium nitrate, $(NO_3)Rh(NH_3)_5(NO_3)_2$.

Very sl. sol. in cold H_2O. Insol. in alcohol. (Jörgensen.)

Nitric acid, HNO_3.

Miscible with H_2O. When HNO_3+Aq is distilled at 760 mm. pressure, an acid containing 68% HNO_3 is formed, which boils at 120.5° under 735 mm. pressure. By distilling at 150 mm. pressure the acid contains 67.6% HNO_3; at 70 mm. (b.-pt. 65–70°) the acid contains 66.7% HNO_3. The percentage of HNO_3 in the liquid obtained by passing dry air into HNO_3+Aq containing 64–68% HNO_3 varies with the temp.; the higher the temp. the greater the percentage of HNO_3. (Roscoe, Chem. Soc. **13.** 150.)

HNO_3+Aq of 1.51 sp. gr. contains 67% N_2O_5.
" 1.42 " " 54
" 1.35 " " 44.4
" 1.315 " " 38.6
(Dalton.)

HNO_3+Aq of 1.52 sp. gr. contains 88.82% N_2O_5.
" 1.522 " " 86.17% "
" 1.4 " " 41 "
(Mitscherlich.)

HNO_3+Aq of 1.298 sp. gr. contains 36.75% N_2O_5. (Kirwan.)

HNO_3+Aq of 1.298 sp. gr. contains 18%. (Davy.)

HNO_3+Aq of 1.298 sp. gr. contains 32–33%. (Berthollet.)

For Ure's table of sp. gr. of HNO_3+Aq, see Watt's Dict.. 1st ed.

Sp. gr. of HNO_3+Aq at 0° and 15°.

% HNO_3	% N_2O_5	Sp. gr. at 0°	Sp. gr. at 15°
100.00	85.71	1.559	1.530
99.84	85.57	1.559	1.530
99.72	85.47	1.558	1.530
99.52	85.30	1.557	1.529
97.89	83.90	1.551	1.523
97.00	83.14	1.548	1.520
96.00	82.28	1.544	1.5[illegible]
95.27	81.66	1.542	1.514
94.00	80.57	1.537	1.509
93.01	79.72	1.533	1.506
92.00	78.85	1.529	1.503
91.00	78.00	1.526	1.499
90.00	77.15	1.522	1.495
89.56	76.77	1.521	1.494
88.00	75.43	1.514	1.488
87.45	74.95	1.513	1.486
86.17	73.86	1.507	1.482
85.00	72.86	1.503	1.478
84.00	72.00	1.499	1.474
83.00	71.14	1.495	1.470
82.00	70.28	1.492	1.467
80.96	69.39	1.488	1.463
80.00	68.77	1.484	1.460
79.00	67.71	1.481	1.456
77.66	66.56	1.476	1.451
76.00	65.14	1.469	1.445
75.00	64.28	1.465	1.442
74.01	63.44	1.462	1.438

Sp. gr. of HNO_3, etc.—Continued.

% HNO_3	% N_2O_5	Sp. gr. at 0°	Sp. gr. at 15°
73.00	62.57	1.457	1.435
72.39	62.05	1.455	1.432
71.24	61.06	1.450	1.429
69.96	60.00	1.444	1.423
69.20	59.31	1.441	1.419
68.00	58.29	1.435	1.414
67.00	57.43	1.430	1.410
66.00	56.57	1.425	1.405
65.07	55.77	1.420	1.400
64.00	54.84	1.415	1.395
63.59	54.50	1.413	1.393
62.00	53.14	1.404	1.386
61.21	52.46	1.400	1.381
60.00	51.43	1.393	1.374
59.59	51.08	1.391	1.372
58.88	50.47	1.387	1.368
58.00	49.71	1.382	1.363
57.00	48.86	1.376	1.358
56.10	48.08	1.371	1.353
55.00	47.14	1.365	1.346
54.00	46.29	1.359	1.341
53.81	46.12	1.358	1.339
53.00	45.40	1.353	1.335
52.33	44.85	1.349	1.331
50.99	43.70	1.341	1.323
49.97	42.83	1.334	1.317
49.00	42.00	1.328	1.312
48.00	41.14	1.321	1.307
47.18	40.44	1.315	1.398
46.64	39.97	1.312	1.295
45.00	38.57	1.300	1.284
43.53	37.31	1.291	1.274
42.00	36.00	1.280	1.264
41.00	35.14	1.274	1.257
40.00	34.28	1.267	1.251
39.00	33.43	1.260	1.244
37.95	32.53	1.253	1.237
36.00	30.86	1.240	1.225
35.00	29.99	1.234	1.218
33.86	29.02	1.226	1.211
32.00	27.43	1.214	1.198
31.00	26.57	1.207	1.192
30.00	25.71	1.200	1.185
29.00	24.85	1.194	1.179
28.00	24.00	1.187	1.172
27.00	23.14	1.180	1.166
25.71	22.04	1.171	1.157
23.00	19.71	1.153	1.138
20.00	17.14	1.132	1.120
17.47	14.97	1.115	1.105
15.00	12.85	1.099	1.089
13.00	11.14	1.085	1.077
11.41	9.77	1.075	1.067
7.72	6.62	1.050	1.045
4.00	3.42	1.026	1.022
2.00	1.71	1.013	1.010
0.00	0.00	1.000	0.999

(Kolb, A. ch. (4) **10.** 140.)

Sp. gr. of HNO_3+Aq at 15°. a = %; b = sp. gr. if % is N_2O_5; c = sp. gr. if % is HNO_3.

a	b	c	a	b	c
1	1.007	1.006	51	1.372	1.323
2	1.014	1.012	52	1.378	1.329
3	1.021	1.018	53	1.385	1.335
4	1.027	1.024	54	1.390	1.341
5	1.034	1.029	55	1.396	1.346
6	1.040	1.035	56	1.401	1.356
7	1.047	1.040	57	1.407	1.358
8	1.053	1.045	58	1.413	1.363
9	1.061	1.051	59	1.418	1.369
10	1.069	1.057	60	1.423	1.374
11	1.076	1.064	61	1.427	1.380
12	1.083	1.070	62	1.432	1.386
13	1.091	1.077	63	1.436	1.390
14	1.098	1.083	64	1.440	1.395
15	1.104	1.089	65	1.445	1.400
16	1.112	1.095	66	1.449	1.405
17	1.120	1.100	67	1.452	1.410
18	1.126	1.106	68	1.457	1.414
19	1.134	1.112	69	1.461	1.419
20	1.141	1.120	70	1.466	1.422
21	1.149	1.126	71	1.470	1.427
22	1.156	1.132	72	1.474	1.430
23	1.165	1.138	73	1.478	1.435
24	1.172	1.145	74	1.482	1.439
25	1.180	1.151	75	1.486	1.442
26	1.187	1.159	76	1.490	1.445
27	1.195	1.166	77	1.494	1.449
28	1.202	1.172	78	1.499	1.452
29	1.211	1.179	79	1.503	1.456
30	1.218	1.185	80	1.507	1.460
31	1.225	1.192	81	1.511	1.463
32	1.232	1.198	82	1.515	1.467
33	1.240	1.204	83	1.519	1.470
34	1.248	1.210	84	1.523	1.474
35	1.255	1.218	85	1.527	1.478
36	1.264	1.225	86	1.530	1.481
37	1.271	1.230	87	...	1.484
38	1.280	1.236	88	...	1.488
39	1.286	1.244	89	...	1.491
40	1.295	1.251	90	...	1.495
41	1.304	1.257	91	...	1.499
42	1.312	1.264	92	...	1.503
43	1.318	1.270	93	...	1.506
44	1.325	1.276	94	...	1.509
45	1.332	1.284	95	...	1.512
46	1.340	1.290	96	...	1.516
47	1.346	1.298	97	...	1.520
48	1.352	1.304	98	...	1.523
49	1.360	1.312	99	...	1.526
50	1.366	1.316	100	...	1.530

(Kolb, calculated by Gerlach, Z. anal. **8.** 292.

Sp. gr. of HNO_3+Aq at 17.5°.

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
5	1.032	9	1.060	13	1.089
6	1.038	10	1.068	14	1.096
7	1.045	11	1.075	15	1.104
8	1.053	12	1.082	16	1.111

Sp. gr. of HNO_3, etc.—Continued.

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
17	1.118	40	1.294	63	1.434
18	1.125	41	1.301	64	1.438
19	1.132	42	1.308	65	1.442
20	1.140	43	1.315	66	1.447
21	1.147	44	1.323	67	1.451
22	1.115	45	1.330	68	1.456
23	1.163	46	1.338	69	1.460
24	1.170	47	1.345	70	1.465
25	1.178	48	1.352	71	1.469
26	1.186	49	1.358	72	1.472
27	1.194	50	1.364	73	1.476
28	1.201	51	1.371	74	1.480
29	1.209	52	1.377	75	1.484
30	1.217	53	1.383	76	1.488
31	1.224	54	1.389	77	1.492
32	1.232	55	1.394	78	1.496
33	1.239	56	1.400	79	1.500
34	1.247	57	1.406	80	1.504
[illegible]	1.255	58	1.412	81	1.508
36	1.263	59	1.416	82	1.512
37	1.271	60	1.421	83	1.516
38	1.279	61	1.426	84	1.519
39	1.287	62	1.430	85	1.523

(Hager, Comm. **1883.**)

Sp. gr. HNO_3+Aq at 17.5°.

% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.	% N_2O_5	Sp. gr.
10	1.068	40	1.293	70	1.465
15	1.104	50	1.361	80	1.500
20	1.140	60	1.417	85	1.514
30	1.217	..	...	..	...

(**Hager**, Adjumenta varia, Leipzig, **1876.**)

Sp. gr. of HNO_3+Aq at 15°.

% HNO_3	Sp. gr.	% HNO_3	Sp. gr.
1	1.00581	26	1.15869
2	1.01136	27	1.16660
3	1.01713	28	1.17371
4	1.02286	29	1.18073
5	1.02851	30	1.18830
6	1.03439	31	1.19552
7	1.04019	32	1.20276
8	1.04592	33	1.20635
9	1.05234	34	1.21300
10	1.05746	35	1.22013
11	1.06330	36	1.22675
12	1.06951	37	1.23347
13	1.07581	38	1.23980
14	1.08126	39	1.24510
15	1.08843	40	1.25235
16	1.09500	41	1.25850
17	1.10102	42	1.26475
18	1.10725	43	1.27125
19	1.11321	44	1.28895
20	1.12024	45	1.28450
21	1.12714	46	1.29110
22	1.13349	47	1.29780
23	1.13890	48	1.30443
24	1.14460	49	1.31101
25	1.15164	50	1.31722

(Squires, Pharm. Era, Jan. **1891.**)

Most accurate table.

Sp. gr. of HNO_3+Aq at 15°; H_2O at 4°=1.

Sp. gr.	% N_2O_5	% HNO_3	Kg. HNO_3 in 1 l.
1.000	0.08	0.10	0.001
1.005	0.85	1.00	0.010
1.010	1.62	1.90	0.019
1.015	2.39	2.80	0.028
1.020	3.17	3.70	0.038
1.025	3.94	4.60	0.047
1.030	4.71	5.50	0.057
1.035	5.47	6.38	0.066
1.040	6.22	7.26	0.075
1.045	6.97	8.13	0.085
1.050	7.71	8.99	0.094
1.055	8.43	9.84	0.104
1.060	9.15	10.68	0.113
1.065	9.87	11.51	0.123
1.070	10.57	12.33	0.132
1.075	11.27	13.15	0.141
1.080	11.96	13.95	0.151
1.085	12.64	14.74	0.160
1.090	13.31	15.53	0.169
1.095	13.99	16.32	0.179
1.100	14.67	17.11	0.188
1.105	15.34	17.89	0.198
1.110	16.00	18.67	0.207
1.115	16.67	19.45	0.217
1.120	17.34	20.23	0.227
1.125	18.00	21.00	0.236
1.130	18.66	21.77	0.246
1.135	19.32	22.54	0.256
1.140	19.98	23.31	0.266
1.145	20.64	24.08	0.276
1.150	21.29	24.84	0.286
1.555	21.94	25.60	0.296
1.160	22.60	26.36	0.306
1.165	23.25	27.12	0.316
1.170	23.90	27.88	0.326
1.175	24.54	28.63	0.336
1.180	25.18	29.38	0.347
1.185	25.83	30.13	0.357
1.190	26.47	30.88	0.367
1.195	27.10	31.62	0.378
1.200	27.74	32.36	0.388
1.205	28.56	33.09	0.399
1.210	28.99	33.82	0.409
1.215	29.61	34.55	0.420
1.220	30.24	35.28	0.430
1.225	30.88	36.03	0.441
1.230	31.53	36.78	0.452
1.235	32.17	37.53	0.463
1.240	32.82	38.29	0.475
1.245	33.47	39.05	0.486
1.250	34.13	39.82	0.498
1.255	34.78	40.58	0.509
1.260	35.44	41.34	0.521
1.265	36.09	42.10	0.533
1.270	36.75	42.87	0.544
1.275	37.41	43.64	0.556
1.280	38.07	44.41	0.568
1.285	38.73	45.18	0.581
1.290	39.39	45.95	0.593
1.295	40.05	46.72	0.605

Sp. gr. of HNO_3, etc.—Continued.

Sp. gr.	% N_2O_5	% HNO_3	Kg. HNO_3 in 1 l.
1.300	40.71	47.49	0.617
1.305	41.37	48.26	0.630
1.310	42.06	49.07	0.643
1.315	42.76	49.89	0.656
1.320	43.47	50.71	0.669
1.325	44.17	51.53	0 683
1.330	44.89	52.37	0.697
1.335	45.62	53.22	0.710
1.340	46.35	54.07	0.725
1.345	48.07	54.93	0.739
1.350	47.82	55.79	0.753
1.355	48.57	56.66	0.768
1.360	49.35	57.57	0.783
1.365	50.13	58.48	0.798
1.370	50.91	59.39	0.814
1.375	51.69	60.30	0.829
1.380	52.52	61.27	0.846
1.385	53.35	62.24	0.862
1.390	54.20	63 23	0 879
1.395	55.07	64.25	0.896
1.400	55.97	65.30	0.914
1.405	56.92	66.40	0 933
1.410	57.86	67.50	0.952
1.415	58.83	68.63	0.971
1.420	59.83	69.80	0.991
1.425	60.84	70.98	1.011
1.430	61.86	72.17	1.032
1.435	62.91	73.39	1.053
1.440	64.01	74.68	1.075
1.445	65.13	75.98	1.098
1.450	66.24	77.28	1.121
1.455	67.38	78.60	1.144
1.460	68.56	79.98	1.168
1.465	69.79	81.42	1.193
1.470	71.06	82.90	1.219
1.475	72.39	84.45	1.246
1.480	73.76	86.05	1.274
1.485	75.18	87.70	1.302
1.490	76.80	89.60	1.335
1.495	78.57	91.60	1.369
1.500	80.65	94.09	1.411
1.501	81.09	94.60	1.420
1.502	81.50	95.08	1.428
1.503	81.91	95.55	1.436
1.504	82.29	96.00	1.444
1.505	82.63	96.39	1.451
1.506	82.94	96.76	1.457
1.507	83.26	97.13	1.464
1.508	83.58	97.50	1.470
1.509	83.87	97.84	1.476
1.510	84.09	98.10	1.481
1.511	84.28	98.32	1.486
1.512	84.46	98.53	1.490
1.513	84.63	98.73	1.494
1.514	84.87	98.90	1.497
1.515	84.92	99.07	1.501
1.516	85.04	99.21	1.504
1.517	85.15	99.34	1.507
1.518	85.26	99.46	1.510
1.519	85.35	99.57	1.512
1.520	85.44	99.67	1.515

(Lunge and Rey, Z. f. angew. Ch. **1891.** 165.)

Sp. gr. of $N-HNO_3+Aq$ at 18°/4° = **1.0324.** (Loomis, W. Ann. 1896, **60.** 550.)

Sp. gr. (reduced to a vacuum) of HNO_3 from 78–100% concentration at 4°/4°, 14.2°/4° and 24.2°/4°.

% HNO_3	Sp. gr. 4°/4°	Sp. gr. 14.2°/4°	Sp. gr. 24.2°/4°
78.22	1.47129	1.45504	1.43964
79.14	....	1.46011	1.44372
79.59	1.47496	....	....
81.97	1.48391	1.46680	1.45092
84.90	1.49495	....	....
85.27	1.49581	....	....
85.80	....	1.47826	1.46224
87.55	1.50211	....	....
87.90	....	1.48491	1.46891
89.73	1.50898	1.49125	....
92.34	1.51804	1.49968	1.48264
94.04	1.51949	1.50149	1.48516
95.62	1.52192	1.50358	1.48677
96.64	1.52510	1.50632	1.48887
97.33	....	1.50911	1.49137
98.07	1.53212	1.51298	1.49543
99.97	1.54212	1.52236	1.50394

(Veley and Manley, Chem. Soc. 1903, **83.** 1016.)

Sp. gr. at 20° of HNO_3+Aq containing M g. mols. HNO_3 per liter.

M	0.025	0.05	0.075	0.10
Sp. gr.	1.000926	1.001798	1.002653	1.003496
M	0.25	0.5	0.75	1.0
Sp. gr.	1.008481	1.01686	1.02503	1.0336
M	2.0			
Sp. gr.	1.0670			

(Jones and Pearce, Am. Ch. J. 1907, **38.** 732.)

For sp. gr. of $HNO_3+H_2SO_4$, see under H_2SO_4.

Partition coefficient for HNO_3 between ether and H_2O is increased by the addition of nitrates. (Tanret, C. R. 1897, **124.** 464.)

The hydrates described by Erdmann do not exist. There are only two authentic hydrates, the mono- and the tri-hydrate. (Küster, Ch. Z. 1904, **28.** 132.)

The composition of the hydrates formed by HNO_3 at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by HNO_3 and of the conductivity and sp. gr. of HNO_3+Aq. (Jones, Am. Ch. J. 1905, **34.** 328.)

Dinitric acid, $H_2N_4O_{11} = 2N_2O_5, H_2O$.

Fumes on air. Miscible with H_2O, with evolution of much heat. (Weber, J. pr. **(2) 6.** 342.)

Nitrates.

All nitrates are sol. in H_2O except a few basic compounds. Most nitrates are insol. in

conc. HNO_3+Aq; many are sol. in alcohol; some are sol. in glycerine.

Aluminum nitrate, basic, $2Al_2O_3$, $3N_2O_5+3H_2O$.

Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 203.)

Basic aluminum nitrates containing 2 mols. or less of Al_2O_3 to one of N_2O_5 may be obtained sol. in H_2O, but the compounds containing more than 2 mols. Al_2O_3 are insol. in H_2O. (Ordway, *l. c.*)

$2Al_2O_3$, $N_2O_5+10H_2O$. (Ditte, C. R. **110.** 782.)

$Al_6O_{14}H_{10}$, HNO_3. Sol. in H_2O. (Schlumberger, Bull. Soc. 1895, (3) **13.** 59.)

Aluminum nitrate, $Al(NO_3)_3+9H_2O$.

Deliquescent. Very sol. in H_2O, HNO_3+Aq, or alcohol. (Berzelius.)

Melts in its crystal H_2O at 72.7°. (Ordway.

Sol. in 1 pt. strong alcohol. (Wenzel.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Ammonium nitrate, NH_4NO_3.

Deliquescent.

Sol. in 0.502 pt. H_2O at 18°. (Karsten.)
Sol. in 0.54 pt. H_2O at 10°. (Harris, C. R. 24. 816.)
Much more sol. is hot than cold H_2O. (Harris.)
Sol. in 2 pts. H_2O at 15.5° and 0.5 pt. boiling H_2O. (Fourcroy.)
Sol. in 1 pt. cold, and 0.5 pt. boiling H_2O. (Fourcroy.)
Sol. in 0.5 pt. H_2O at 18°. (Berzelius.)
Sol. in 2 pts. H_2O at 18°. (Abl.)

Decomp. by boiling H_2O.

Solubility in 100 pts. H_2O at t°.

t°	Pts. NH_4NO_3	t°	Pts. NH_4NO_3	t°	Pts. NH_4NO_3
0	97	24	205	48	351
1	101	25	210	49	358
2	105	26	216	50	365
3	109	27	221	51	372
4	113	28	226	52	379
5	117	29	232	53	387
6	121	30	238	54	395
7	125	31	244	55	402
8	130	32	250	56	410
9	134	33	256	57	418
10	139	34	262	58	425
11	143	35	268	59	433
12	148	36	274	60	441
13	152	37	280	61	449
14	157	38	286	62	457
15	161	39	292	63	465
16	166	40	298	64	473
17	170	41	304	65	481
18	175	42	311	66	490
19	180	43	317	67	499
20	185	44	324	68	508
21	190	45	331	69	517
22	195	46	337	70	526
23	200	47	344	..	...

(Mulder, Scheik. Verhandel. 1864. 95.)

100 pts. H_2O dissolve 183 pts. NH_4NO_3 at 19.5°. (Mulder.)

Solubility in H_2O at t°.

t°	Specific gravity of the saturated solution	Mols. of NH_4NO_3 soluble in 100 mols. of water
12.2	1.2945	34.50
20.2	1.3116	43.30
23.0	1.3159	46.57
25.0	1.3197	48.19
27.7	1.3257	51.67
28.0	1.3260	51.86
30.0	1.3299	54.40
30.2	1.3308	54.61
31.9	1.3348	57.20
32.1	1.3344	57.60
32.7	1.3356	57.90
34.0	1.3375	58.89
35.0	1.3394	59.80
35.1	1.3397	60.00
35.6	1.3408	60.62
36.0	1.3412	61.00
36.6	1.3420	.....
37.5	1.3432	62.90
38.0	1.3438	63.60
38.5	1.3440	64.10
39.0	1.3448	65.09
39.5	1.3460	65.88
40.0	1.3464	66.80

(Müller and Kaufmann, Z. phys. Ch. 1903, **42.** 499.)

Solubility in H_2O at t°.

t°	G. NH_4NO_3 per 100 g.		Solid phase
	solution	water	
0	54.19	118.3	NH_4NO_3, rhomb. β
12.2	60.53	153.4	"
20.2	65.80	192.4	"
25.0	68.17	214.2	"
30.0	70.73	241.8	"
32.1	71.97	256.9	NH_4NO_3, rhomb. β + rhomb. α
35	72.64	265.8	NH_4NO_3, rhomb. α
40	74.82	297.0	"
50	77.49	344.0	"
60	80.81	421.0	"
70	83.32	499.0	"
80	85.25	580.0	"
90	88.08	740.0	NH_4NO_3, rhomb. (?)
100	89.71	871.0	"

(Seidell's Solubilities 1st ed. 28. Calc. from Müller & Kauffmann, see above, and Schwarz, Ostwald's Lehrb., p. 425.)

100 g. NH_4NO_3+Aq contain:

54.19 g. NH_4NO_3 at 0°.
70.10 g. " " 30°.
84.03 g. " " 70°.

(de Waal, Dissert. Leiden, 1910.)

70.19 g. NH_4NO_3 are contained in 100 g. NH_4NO_3+Aq sat. at 30°. (Schreinemakers and de Baat, Arch. neer. Sc. 1911, (2) **15.** 415.)

60 pts. NH_4NO_3 mixed with 100 pts. H_2O lower the temperature from 13.6° to —13.6°, that is 27.2°, but if the initial temperature is 0° it will fall only to —16.7°, the freezing-point of the mixture. (Rüdorff, B. **2.** 68.)

Sp. gr. of NH_4NO_3+Aq at 18°.

Pts. NH_4NO_3	Pts. H_2O	Sp. gr.
80	1800	1.0180
80	900	1.0331
80	360	1.0743

(Thomsen and Gerlach, Z. anal. **28.** 520.)

Sp. gr. of NH_4NO_3+Aq at 15°.

% NH_4NO_3	Sp. gr.	% NH_4NO_3	Sp. gr.
5	1.0201	30	1.1304
10	1.0419	40	1.1780
20	1.0860	50	1.2279

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of NH_4NO_3+Aq at 17.5°.

% NH_4NO_3	Sp. gr.	% NH_4NO_3	Sp. gr.
1	1.0042	33	1.1454
2	1.0085	34	1.1502
3	1.0127	35	1.1550
4	1.0170	36	1.1598
5	1.0212	37	1.1646
6	1.0255	38	1.1694
7	1.0297	39	1.1742
8	1.0340	40	1.1790
9	1.0382	41	1.1841
10	1.0425	42	1.1892
11	1.0468	43	1.1942
12	1.0512	44	1.1994
13	1.0555	45	1.2045
14	1.0599	46	1.2096
15	1.0642	47	1.2147
16	1.0686	48	1.2198
17	1.0729	49	1.2249
18	1.0773	50	1.2300
19	1.0816	51	1.2353
20	1.0860	52	1.2407
21	1.0905	53	1.2460
22	1.0950	54	1.2514
23	1.0995	55	1.2567
24	1.1040	56	1.2621
25	1.1085	57	1.2674
26	1.1130	58	1.2728
27	1.1175	59	1.2781
28	1.1220	60	1.2835
29	1.1265	61	1.2888
30	1.1310	62	1.2942
31	1.1358	63	1.3005
32	1.1406	64	1.3059

(Gerlach, Z. anal. **27.** 310.)

Sp. gr. of NH_4NO_3+Aq.

% NH_4NO_3	Sp. gr. 16°/16°
0	1.000000
0.6419	1.000271
1.4101	1.000593
2.7501	1.001153
5.4890	1.002300
11.7981	1.004916
23.4480	1.009758
47.9500	1.019952

(Dijken. Z. phys. Ch. 1897, **24.** 107.)

Sp. gr. 20°/4° of a normal solution of NH_4NO_3 = 1.030435; of a 0.5-normal solution = 1.014505. (Haigh. J. Am. Chem. Soc. 1912, **34.** 1151.)

B.-pt. of NH_4NO_3+Aq containing pts. NH_4NO_3 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 445); L = according to Legrand (A. ch. (2) **59.** 426.)

B.-pt.	G	L	B.-pt.	G	L
101°	10	10	140°	682	770.5
102	20	20.5	141	719	.....
103	30	31.3	142	737	840.6
104	41	42.4	143	765	.....
105	52	53.8	144	793	915.5
106	63	65.4	145	823	.....
107	74	77.3	146	853	995.5
108	85	89.4	147	883	.....
109	96	101.9	148	914	1081.5
110	108	114.9	149	945	.....
111	120	128.4	150	977	1173.5
112	132	142.4	551	1009	.....
113	145	156.9	152	1043	1273
114	158	172	153	1079	.....
115	172	188	154	1116	1383
116	187	204.4	155	1155	.....
117	202	221.4	156	1196	1504
118	217	238.4	157	1238	.....
119	232	256.8	158	1281	1637
120	248	275.3	159	1325	.....
121	265	...	160	1370	1775
122	283	314	161	1417	...
123	301	...	162	1464	1923
124	319	354	163	1511	...
125	337	...	164	1558	2084
126	356	396	165	1606	...
127	376	...	166	1653	...
128	396	440.2	167	1700	...
129	417	...	168	1748	...
130	439	487.4	169	1796	...
131	461	...	170	1844	...
132	484	537.3	180	2400	∞
133	507	...	190	3112	...
134	530	590	200	4099	...
135	554	...	210	5618	...
136	578	645	220	8547	...
137	603	...	230	16950	...
138	629	705.5	240	∞	...
139	655	...	...	....	...

Very sol. in HNO_3+Aq. (Schulz, Zeit. Ch. **1869**. 531.)

Solubility of NH_4NO_3 in HNO_3.

Solution temp.	% by wt. NH_4NO_3	Solid phase
+8°	21.1	NH_4NO_3, $2HNO_3$ (solution in HNO_3)
23.0	28.7	"
28.5	34.5	"
29.5 *	38.8	(solution in NH_4NO_3)
27.5	44.6	"
27.0	45.8	"
23.5	49.4	"
23.0	5[illegible].0	"
17.5	54.0	"
16.5	54.3	"
4.0	45.8	NH_4NO_3, HNO_3 labile (solution in HNO_3)
9.5	49.4	"
11.0	51.7	"
11.5	52.7	"
12.0	54.3	"
12.0	54.7	"
11.5	57.6	(solution in NH_4NO_3)
11.5	54.0	NH_4NO_3 (labile)
14.5	54.3	"
17.0	54.7	stable
26.0	55.9	"
27.0	56.2	"
33.5	57.5	"
49.0	60.4	"
79.0	68.1	"

* Mpt. of NH_4NO_3, $2HNO_3$.

(Groschuff. Z. anorg. 1904, **40**. 6.)

Solubility of NH_4NO_3 in NH_4OH+Aq.

Grams of NH_4NO_3	Grams of NH_3	Molecules of NH_4NO_3 in 100 molecules $NH_4NO_3+NH_3$	Temperature at which the solutions are in equilibrium with the solid phase
......	......	100.	about 168°
0.7578	0.0588	74.2	109.8
0.6439	0.0665	67.3	94.0
4.2615	0.7747	53.8	68.8
0.7746	0.1857	47.0	35.9
0.9358	0.2352	45.9	33.3
0.7600	0.2607	38.3	0
0.9675	0.3515	36.9	−10.5
0.8308	0.3700	32.3	−30.0
0.9526	1.2457	13.9	−44.5
1.3918	4.4327	6.25	−60
0	100	0	about −80

(Kuriloff, Z. phys. Ch. 1898, **25**. 109.)

$NH_4NO_3+NH_4Cl$.

100 pts. H_2O dissolve 29.1 pts. NH_4Cl and 173.8 pts. NH_4NO_3. (Rüdorff, B. **6**. 484.)

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl until a state of equilibrium is reached. (Karsten.)

Addition of $KClO_3$ to NH_4Cl+Aq prevents pptn. of NH_4Cl, and dissolves any NH_4Cl that may have been pptd. (Margueritte, C. R. **38**. 306.)

See also under **Ammonium chloride.**

$NH_4NO_3+KNO_3$.

100 pts. H_2O dissolve:

	At 9° (1)	(2)	At 11° (3)	(4)	At 15° (5)	(6)
KNO_3...	20.2	40.6		26.0	46.2	
NH_4NO_3	....	88.8	143	....	130.4	161

2, Sat. at 11° with NH_4NO_3 and then at 9° with KNO_3; 5, sat. at 11° with NH_4NO_3 and then at 15° with KNO_3. (Mulder.)

Sol. in sat. HNO_3+Aq without causing ppt. (Karsten); with separation of KNO_3 (Rüdorff).

Composition of solution is dependent on the relative excess of the salts present. (Rüdorff.)

100 pts. H_2O dissolve 77.1 pts. $NaNO_3$ and 162.9 pts. NH_4NO_3 at 16°. (Rüdorff, B. **6**. 484.)

If a sat. solution of NH_4NO_3+Aq at 11° is sat. with $Ba(NO_3)_2$ at 9°, 100 pts. H_2O dissolve:

	At 11°		At 9°
NH_4NO_3....	143	101.3	...
$Ba(NO_3)_2$..	...	6.2	6.8

(Mulder.)

Solubility of $NH_4NO_3+AgNO_3$ in H_2O at t°.

t°	% $AgNO_3$	% NH_4NO_3	Solid phase
− 7.3°	47.1	0	Ice + $AgNO_3$, rhomb.
−10.7	44.52	8.43	"
−14.9	42.0	16.80	Ice + $AgNO_3$, NH_4NO_3 + $AgNO_3$ rb.
− 14.8	39.51	18.79	Ice + $AgNO_3$, NH_4NO_3
−18.7	15.99	37.30	Ice + $AgNO_3$, NH_4NO_3 + NH_4NO_3 β. rb.
−17.4	0	41.2	Ice + NH_4NO_3, β.rb.
0	50.36	19.59	$AgNO_3$, NH_4NO_3 + $AgNO_3$, rb.
18	55.36	22.06	"
30	58.89	23.42	"
55	63.32	26.12	"
109.6	67.9	32.1	"
0	22.13	44.87	$AgNO_3$, NH_4NO_3 + NH_4NO_3 β. rb.
18	27.07	49.22	"
30	29.76	52.50	"
40	32.68	52.22	$AgNO_3$, NH_4NO_3 + NH_4NO_3 α rb.
55	36.60	52.38	"
101.5	47.5	52.5	$AgNO_3$, NH_4NO_3 + NH_4NO_3, rbd.

(Schreinemakers and de Baat, Arch. néer. Sc. 1911 (2) **15**. 414.)

Solubility in NH_4NO_3 and $AgNO_3$ in H_2O at 30°.

Composition of the solution % NH_4NO_3	% $AgNO_3$	Solid phase
0	73.0	$AgNO_3$
6.59	69.08	"
15.62	63.27	"
23.40	58.84	$AgNO_3+AgNO_3, NH_4NO_3$
23.45	58.93	"
24.33	57.93	$AgNO_3, NH_4NO_3$
26.22	55.32	"
28.86	52.45	"
34.47	45.85	"
39.60	41.09	"
45.44	35 62	"
52.49	29 77	$NH_4NO_3+AgNO_3, NH_4NO_3$
52.11	29.86	"
52.89	29.66	"
54.12	27.75	NH_4NO_3
58.64	21.31	"
63.59	12.51	"
70.10	0	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, **65**. 572.)

Solubility of $NH_4NO_3+NaNO_3$ in H_2O at t°.

t°	g. per 100 g. H_2O NH_4NO_3	$NaNO_3$	Sp. gr.
0	0	73.33	1.354
	105.5	66	1.407
	118.4	0	1.264
15	0	83.9	1.375
	24.03	81.21	1.386
	42.81	79.34	1.392
	64.6	78.06	1.401
	110.9	75.81	1.417
	152.	75.35	1.428
	155.3	75.38	1.429
	156.1	60.76	1.405
	159	36.50	1.364
	160	27.79	1.350
	162.3	17.63	1.330
	167.4	0	1.298
30	0	96.12	1.401
	220.8	88.31	1.450
	232.6	0	1.329

(Fedotieff and Koltunoff, Z. anorg. 1914, **85**. 251.)

Solubility of $NH_4NO_3+(NH_4)_2SO_4$ in H_2O at 30°.

% NH_4NO_3	% $(NH_4)_2SO_4$	Solid phase
70.1	0	NH_4NO_3
67.63	2.38	"
66.93	3 46	$NH_4NO_3+(NH_4)_2SO_4, 3NH_4NO_3$
63.84	4 96	$(NH_4)_2SO_4, 3NH_4NO_3$
58.06	8.22	$(NH_4)_2SO_4, 3NH_4NO_3+(NH_4)_2SO, 2NH_4NO_3$
52.75	11.42	$(NH_4)_2SC_4, 2NH_4NO_3$
49.80	13.27	$(NH_4)_2SO_4, 2NH_4NO_3+(NH_4)_2SO_4$
37.20	19.48	$(NH_4)_2SO_4$
19.91	28.83	"
12.05	34.7	"
0	44.1	"

(Schreinemakers and Haenen, Chem. Weekbl. 1909, **6**. 51.)

Solubility of $NH_4NO_3+(NH_4)_2SO_4$ in H_2O.

Temp. = 0°

% NH_4NO_3	% $(NH_4)_2SO_4$	Solid phase
0	41.4	$(NH_4)_2SO_4$
5.61	37.89	"
29.58	41.64	$(NH_4)_2SO_4+(NH_4)_2SO_4, 2NH_4NO_3$
29.81	21.33	$(NH_4)_3SO_4, 2NH_4NO_3$
31.04	20.40	"
30.87	20.43	$(NH_4)_2SO_4, 2NH_4NO_3+(NH_4)_2SO_4, 3NH_4NO_3$
31.61	19.50	$(NH_4)_2SO_4, 3NH_4NO_3$
45.99	9.53	$(NH_4)_2SO_4, 3NH_4NO_3+NH_4NO_3$
49.12	6.00	NH_4NO_3
54.19	0	"

Temp. = 70°

% NH_4NO_3	% $(NH_4)_2SO_4$	Solid phase
0	47.81	$(NH_4)_2SO_4$
11.10	40.81	"
70.15	6.71	$(NH_4)_2SO_4+(NH_4)_2SO_4, 2NH_4NO_3$
71.58	5.82	$(NH_4)_2SO_4, 2NH_4NO_3$
73.48	5.14	$(NH_4)_2SO_4, 2NH_4NO_3+(NH_4)_2SO_4, 3NH_4NO_3$
76.01	3.96	$(NH_4)_2SO_4, 3NH_4NO_3$
80.25	2.68	"
81.01	2.45	$(NH_4)_3SO_4, 3NH_4NO_3+NH_4NO_3$
81.38	2.41	NH_4NO_3
84.03	0	"

(de Waal. Dissert. Leiden. **1910**.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

1 pt. NH_4NO_3 dissolves in 2.29 pts. alcohol of 66.8% at 25°. (Pohl, W. A. B. 6. 599.)
1 pt. NH_4NO_3 dissolves in 1.1 pt. boiling alcohol. (Wenzel.)

100 pts. absolute methyl alcohol dissolve 17.1 pts. at 20.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 g. absolute methyl alcohol dissolve 14.6 g. NH_4NO_3 at 14° and 16.3 g. at 18.5°. (Schiff and Monsacchi, Z. phys. Ch. 1896, **21.** 277.)

100 pts. absolute ethyl alcohol dissolve 3.8 pts. at 20.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 g. absolute ethyl alcohol dissolve 4.6 g. at 14°. (Schiff and Monsacchi, Z. phys. Ch. 1896, **21.** 277.)

Solubility of NH_4NO_3 in H_2O is decreased by presence of ethyl alcohol but increased by presence of methyl alcohol. NH_4NO_3 is only very sl. sol. in abs. ethyl alcohol and the solubility increases slowly with rise in temp.; it is more sol. in abs. methyl alcohol and the solubility increases rapidly with rise in temp. (Fleckenstein, Phys. Zeit. 1905, **6.** 419.)

Solubility in methyl alcohol+Aq. at 30°.

% by wt. H_2O	% by wt. alcohol	% by wt. NH_4NO_3
29.9	0	70.1
21.6	24.5	53.9
20.6	31.3	48.1
16.5	46.0	37.5
11.5	59.4	29.1
0	83.3	16.7

(Schreinemakers, Z. phys. Ch. 1909, **65.** 556.)

Solubility of NH_4NO_3 in ethyl alcohol+Aq. at 30°. Composition of sat. solution.

% by wt. H_2O	% by wt. alcohol	% by wt. NH_4NO_3
29.9	0	70.1
26.9	18.6	54.5
23.2	39.3	37.5
18.3	58.5	23.2
11.6	76.5	11.9
5.8	86.2	8.0
0	96.4	3.6

(Schreinemakers, Z. phys. Ch. 1909. **65.** 555.)

Solubility of NH_4NO_3 in alcohol.

t°	% NH_4NO_3	% Alcohol	% H_2O
0	54.19	0	45.81
"	42.69	12.70	44.61
"	1.96	97.93	0.11
30	70.10	0	29.90
"	59.83	10.60	29.57
"	8.06	85.30	6.64
"	3.60	96.51	0
70	84.03	0	15.97
"	72.37	11.12	16.51
"	61.11	22.87	16.02
"	41.25	44.64	14.11
"	24.71	67.23	8.06
"	7.51	92.49	0

(de Waal. Dissert. Leiden, 1910.)

Sp. gr. of alcoholic solution of NH_4NO_3 at 15°.

Pts. NH_4NO_3	Pts. alcohol	Sp. gr.
0	100	0.83904
2	98	0.84746
4	96	0.85604
6	94	0.86524

(Gerlach, Z. anal. **28.** 521.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Ammonium hydrogen nitrate, $NH_4H(NO_3)_2$.

Sol. in H_2O. (Ditte, C. R. **89.** 576, 641.)

Decomp. by H_2O. (Groschuff, B. 1904, **37.** 1487.)

Ammonium *di*hydrogen nitrate, $NH_4H_2(NO_3)_3$.

Sol. in H_2O. (Ditte.)

Solubility in H_2O.

Solution temp.	% by wt. NH_4NO_3	% by wt. HNO_3
—8.0	34.2	53.9
—2.5	34.8	54.8
+3.0	35.4	55.8
3.5	36.0	56.8
19.5	37.4	58.9
25.0	38.1	60.0
29.5 mpt.	38.8	61.2

(Groschuff, Z. anorg. 1904, **40.** 7.)

Ammonium cerous nitrate, $3NH_4NO_3$, $2Ce(NO_3)_3+12H_2O$.

Very deliquescent. Very sol. in H_2O and alcohol. (Holzmann, J. pr. **84.** 78.)

$+10H_2O$. Hygroscopic. Sol. in H_2O. (Drossbach, B. 1900, **33.** 3507.)

$2NH_4NO_3$, $Ce(NO_3)_3+4H_2O$. As above. (Marignac, A. ch. (4) **30.** 64.)

Solubility in H_2O.

100 g. H_2O dissolve at:

8.75°	25°	45°
235.5	296.8	410.2 g. anhydrous salt,

60°	65.06°
681.2	817.4 g. anhydrous salt.

(Wolff, Z. anorg. 1905, **45.** 98.)

Ammonium ceric nitrate, $2NH_4NO_3$, $Ce(NO_3)_4$.

Very sol. in H_2O without decomp. Sol. in HNO_3. (Meyer, B. 1900, **33.** 2137.)

Sol. in alcohol. (Meyer, Z. anorg. 1901, **27.** 369.)

Solubility in H_2O.

100 g. H_2O dissolve at t°:

25°	35.2°	45.3°
140.9	161.7	174.9 g. anhydrous salt,
64.5°	85.60°	122°
201.6	226.8	735.4 g. anhydrous salt.

(Wolff, Z. anorg. 1905, **45.** 94.)

$+1\frac{1}{2}H_2O$. Very deliquescent. (Holzmann, J. pr. **84.** 78.)

Ammonium cobalt nitrate.

Permanent. Sol. in H_2O. (Thenard.)

Ammonium copper nitrate, $2NH_4NO_3$, $Cu(NO_3)_2$.

Very sol. in H_2O.

Ammonium didymium nitrate, $2NH_4NO_3$, $Di(NO_3)_3+4H_2O$.

Somewhat deliquescent.

Ammonium gadolinium nitrate, $2NH_4NO_3$, $Gd(NO_3)_3$.

Deliquesces in the air. (Benedicks, Z. anorg. 1900, **22.** 407.)

Ammonium gold (auric) nitrate (Ammonium auronitrate), $NH_4Au(NO_3)_4$.

Extremely deliquescent.

$H(NH_4)_2Au(NO_3)_6$. (Schottländer, A. **217.** 312.)

Ammonium lanthanum nitrate, $2NH_4NO_3$, $La(NO_3)_3+4H_2O$.

Not deliquescent. Sol. in H_2O. (Marignac.)

Ammonium magnesium nitrate, $2NH_4NO_3$, $Mg(NO_3)_2$.

Slowly deliquescent. Sol. in 10 pts. H_2O at 12.5°, and much less hot H_2O. (Fourcroy.)

Ammonium mercurous nitrate, $4NH_4NO_3$, $Hg_2(NO_3)_2+5H_2O$.

Sol. in H_2O. (Pagenstecher, Repert. **14.** 188.)

Ammonium nickel nitrate.

Sol. in 3 pts. cold H_2O. (Thénard, Scher. J. **10.** 428.)

Ammonium praseodymium nitrate, $2NH_4NO_3$, $Pr(NO_3)_3+4H_2O$.

Sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 356.)

Ammonium silver nitrate, NH_4NO_3, $AgNO_3$.

Very sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26.** 357.)

Sol. in H_2O without decomp. (Schreinemakers and de Baat, Chem. Weekbl. 1910, **7.** 6.)

See also solubility of $NH_4NO_3+AgNO_3$ under NH_4NO_3.

Ammonium thorium nitrate, $(NH_4)_2Th(NO_3)_6$.

Sol. in strong HNO_3. (Meyer, Z. anorg. 1901, **27.** 383.)

$NH_4Th(NO_3)_5+5H_2O$. Sol. in HNO_3 of sp. gr. 1.25. (Meyer, Z. anorg. 1901, **27.** 382.)

Ammonium uranyl nitrate, NH_4NO_3, $UO_2(NO_3)_2$.

Decomp. by H_2O. Sol. in conc. HNO_3. (Meyer, B. 1903, **36.** 4057.)

Solubility in H_2O at t°.

t°	In 100 pts. by wt. of the solution: Pts. by wt. UO_2	Pts. by wt. NH_4	Pts. by wt. total salt	Solid phase
0.5	29.71	2.92	...	Double salt $+UO_2(NO_3)_2$
13.5	32.35	3.42	...	"
24.9 a	36.40	3.54	68.72	"
b	36.53	3.54	68.97	"
35.0	42.07	3.44	...	"
59.0	44.37	2.90	...	"
80.7 a	44.90	2.98	78.76	Double salt
b	45.01	2.98	78.79	"

Ammonium uranyl nitrate is decomp. by H_2O at temp. below 60°: above 60° it is sol. in H_2O without decomp. (Rimbach, B. **1904,** **37.** 475.)

Ammonium nitrate ammonia, $2NH_4NO_3$, $3NH_3$.

Known only as a solution of NH_3 in NH_4NO_3+Aq. (Troost, C. R. **94.** 789.)

NH_4NO_3, $3NH_3$. As above.

Ammonium nitrate mercuric chloride, NH_4NO_3, $2HgCl_2$.

Insol. in H_2O. Ether dissolves out $HgCl_2$. (Kosmann, A. ch. (3) **27.** 240.)

$2NH_4NO_3$, $HgCl_2$. Sol. in H_2O. (Hofmann and Marburg, A. 1899, **305.** 199.)

Ammonium nitrate sulphate, $2(NH_4)_2O$, N_2O_5, $2SO_3$, H_2O.

Very hydroscopic and sol. in H_2O. (Friedheim, Z. anorg. 1894, **6.** 297.)

$2NH_4NO_3$, $(NH_4)_2SO_4$. (de Waal, Dissert. **1910.**)

$3NH_4NO_3$, $(NH_4)_2SO_4$. (de Waal.)

See also solubility of $NH_4NO_3+(NH_4)_2SO_4$ under NH_4NO_3.

Ammonium nitrate *meta***tungstate,** NH_4NO_3, $2(NH_4)_2W_4O_{13}+4H_2O$.

Decomposes by recrystallising out of H_2O. (Marignac, A. ch. (3) **69.** 61.)

Antimony nitrate, Sb_4O_6, N_2O_5.

Decomp. by cold H_2O. (Bucholz.)

Aqueous solution sat. at 10° contains 30.4% salt. (Eller.)

Sol. in strong, less sol. in dil. HNO_3+Aq. (Peligot, A. ch. (3) **20.** 288.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Barium nitrate, $Ba(NO_3)_2$.

Sol. in H_2O with absorption of heat.

100 pts. H_2O at 0° dissolve 5.0 parts $Ba(NO_3)_2$. (Gay-Lussac, A. ch. **11.** 313.)

100 pts. H_2O at 0° dissolve 5.2 parts $Ba(NO_3)_2$. (Mulder.)

$Ba(NO_3)_2$+Aq sat. at 20° contains 8.57 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and has 1.0679 sp. gr. (Karsten); sat. at 20° has 1.064 sp. gr., and contains 7.94 pts. $Ba(NO_3)_2$ to 100 pts. H_2O. (Michel and Krafft.)

100 pts. H_2O dissolve pts. $Ba(NO_3)_2$ at t°.

t°	Pts. $Ba(NO_3)_2$	t°	Pts. $Ba(NO_3)_2$
0	5.00	52.11	17.97
14.95	8.18	73.75	25.01
17.62	8.54	86.21	29.57
37.87	13.67	101.65	35.18
49.22	17.07	...	...

(Gay-Lussac, A. ch. (2) **11.** 313.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Ba(NO_3)_2$	t°	Pts. $Ba(NO_3)_2$
0	5.0	52	17.7
1	5.1	53	18.1
2	5.3	54	18.4
3	5.5	55	18.7
4	5.7	56	19.0
5	6.0	57	19.3
6	6.2	58	19.6
7	6.4	59	20.0
8	6.6	60	20.3
9	6.8	61	20.6
10	7.0	62	20.9
11	7.3	63	21.0
12	7.5	64	21.6
13	7.7	65	21.0
14	7.9	66	22.3
15	8.1	67	22.6
16	8.3	68	22.9
17	8.5	69	23.3
18	8.8	70	23.6
19	9.0	71	23.9
20	9.2	72	24.3
21	9.5	73	24.9
22	9.7	74	25.0
23	9.9	75	25.4
24	10.1	76	25.7
25	10.4	77	26.0
26	10.6	78	26.4
27	10.8	79	26.7
28	11.1	80	27.0
29	11.3	81	27.4
30	11.6	82	27.7
31	11.8	83	28.1
32	12.1	84	28.4
33	12.3	85	28.8
34	12.6	86	29.1
35	12.8	87	29.5
36	13.1	88	29.8
37	13.4	89	30.2
38	13.7	90	30.6
39	14.0	91	30.9
40	14.2	92	31.3
41	14.5	93	31.7
42	14.8	94	32.0
43	15.1	95	32.4
44	15.4	96	32.7
45	15.6	97	33.1
46	15.9	98	33.5
47	16.2	99	33.8
48	16.5	100	34.2
49	16.8	101	34.5
50	17.1	101.9	34.8
51	17.4	...	....

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. **1864.** 50.)

Sat. $Ba(NO_3)_2$+Aq contains % $Ba(NO_3)_2$ at t°.

t°	% $Ba(NO_3)_2$	t°	% $Ba(NO_3)_2$
0.4	4.3	60.0	16.1
2.1	4.9	73.0	19.4
6.0	5.6	92.0	23.4
6.5	5.6	110.0	27.4
11.0	6.4	132.0	31.8
15.3	7.1	134.0	32.5
18.0	7.7	150.0	34.9
28.5	9.7	152.0	35.4
45.5	12.8	171.0	38.3
52.0	14.9	215.0	45.8

(Étard, A. ch. 1894, (7) **2**. 528.)

100 g. H_2O dissolve 8.54 g. $Ba(NO_3)_2$ at 17°. (Gmelin-Kraut, Handbuch der anorg. Chemie.)

100 g. H_2O dissolve 7.87 g. $Ba(NO_3)_2$ at 15°; 8.32 g. at 17°. (Euler, Z. phys. Ch. 1904, **49**. 315.)

1000 g. H_2O dissolve 0.72 gram-equivalents $Ba(NO_3)_2$ at 21.5°. (Euler, Z. phys. Ch. 1904, **49**. 312.)

10.30 g. anhydrous $Ba(NO_3)_2$ are sol. in 100 g. H_2O at 25°. (Parsons and Colson, J. Am. Chem. Soc. 1910, **32**. 1385.)

4.74 g. $Ba(NO_3)_2$ are contained in 100 g. $Ba(NO_3)_2$ sat. at 0°. (Coppadoro, Gazz. ch. it. 1911, **42**, I. 233.)

Solubility of $Ba(NO_3)_2$ in H_2O = 0.427 mol. l. at 30°. (Masson, Chem. Soc. 1911, **99**. 1136.)

Solubility of $Ba(NO_3)_2$ in H_2O at 30° = 10.33%. (Coppadoro, Gazz. ch. it. 1913, **43**. I. 240.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

9.1°	21.1°	35°
6.25	8.46	11.39 g. $Ba(NO_3)_2$.

(Findlay, Chem. Soc. 1914, **105**. 780.)

Sp. gr. of $Ba(NO_3)_2$+Aq at 19.5°.

% $Ba(NO_3)_2$	Sp. gr.	% $Ba(NO_3)_2$	Sp. gr.
1	1.009	6	1.050
2	1.017	7	1.060
3	1.025	8	1.069
4	1.034	9	1.078
5	1.042	10	1.087

(Calculated by Gerlach, Z. anal. 8. 286, from Kremers, Pogg. **95**. 110.)

Sp. gr. of $Ba(NO_3)_2$+Aq at 18°.

% $Ba(NO_3)_2$	Sp. gr.
4.2	1.0340
8.4	1.0712

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $Ba(NO_3)_2$+Aq at 17.5°.

% $Ba(NO_3)_2$	Sp. gr.	% $Ba(NO_3)_2$	Sp. gr.
1	1.0085	6	1.0510
2	1.0170	7	1.0600
3	1.0255	8	1.0690
4	1.0340	Sat. sol.	1.0690
5	1.0425	.	......

(Gerlach, Z. anal. **27**. 283.)

Sp. gr. of $Ba(NO_3)_2$+Aq at room temp.

% $Ba(NO_3)_2$	Sp. gr.
5.25	1.0507
2.98	1.0274

(Wagner, W. Ann. 1883, **18**. 264.)

Sp. gr. of $Ba(NO_3)_2$+Aq at 25°.

Concentration of $Ba(NO_3)_2$+Aq.	Sp. gr.
1/2 normal	1.0518
1/4 "	1.0259
1/8 "	1.0130

(Wagner. Z. phys. Ch. 1890, **5**. 35.)

$Ba(NO_3)_2$+Aq containing 6.08% $Ba(NO_3)_2$ has sp. gr. 20°/20° = 1.0517.

$Ba(NO_3)_2$+Aq containing 6.97% $Ba(NO_3)_2$ has sp. gr. 20°/20° = 1.0597.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19**. 279.)

Sp. gr. of $Ba(NO_3)_2$+Aq at 20° containing M g. mols. salt per liter.

M	0.01	0.025	0.05
Sp. gr.	1.002031	1.005224	1.010591
M	0.075	0.10	0.15
Sp. gr.	1.015671	1.021143	1.031770

(Jones and Pearce, Am. Ch. J. 1907, **38**. 708.)

Sp. gr. of sat. $Ba(NO_3)_2$+Aq at t°.

t°	g. $Ba(NO_3)_2$ sol. in 100 g. H_2O	Sp. gr.
0	5.2	1.043
10	7.0	1.056
20	9.2	1.073
30	11.6	1.087
40	14.2	1.104
50	17.1	1.121
60	20.3	1.137
70	23.6	1.146

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, **44**. 1565.)

Saturated $BaNO_3$+Aq contains:—
36.18 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101.1°. (Griffiths.)

35.2 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101.65°. (Gay-Lussac.)
34.8 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 101.9°. (Mulder.)
34.8 pts. $Ba(NO_3)_2$ to 100 pts. H_2O, and boils at 102.5°. (Kremers.)
Sat. $Ba(NO_3)_2$+Aq forms a crust at 101.1°; highest temp. observed was 101.5°. (Gerlach, Z. anal. **26**. 427.)

B. pt. of $Ba(NO_3)_2$+Aq containing pts. $Ba(NO_3)_2$ to 100 pts. H_2O.

B.-pt.	Pts. $Ba(NO_3)_2$
100.5°	12.5
101.0	26.0
101.1	27.5

(Gerlach, Z. anal. **26**. 440.)

Insol. in conc. HNO_3+Aq, and much less sol. in dil. HNO_3+Aq or HCl+Aq than in H_2O.

Solubility of $Ba(NO_3)_2$ in HNO_3+Aq at 30°.

Solid phase $Ba(NO_3)_2$

Sp. gr. of sat. solution	G. mol. per l.	
	HNO_3	$Ba(NO_3)_2$
1.0891	0.0000	0.4270
1.0811	0.1318	0.3282
......	0.2496	0.3268
1.0663	0.4995	0.2410
1.0619	0.7494	0.1785
1.0609	1.000	0.1353
1.0633	1.247	0.1056
1.0668	1.493	0.0847
1.0783	1.998	0.0598
1.1050	2.993	0.0334
1.1341	3.986	0.0218
1.1341	3.994	0.0223
1.1645	5.012	0.0147

(Masson, Chem. Soc. 1911, **99**. 1136.)

Less sol. in dil. $HC_2H_3O_2$+Aq than in dil. HCl+Aq.
Solubility in NH_4Cl+Aq is the same as in H_2O.
Less sol. in NH_4OH+Aq, $NH_4C_2H_3O_2$+Aq, or NH_4NO_3+Aq than in H_2O. (Pearson, Zeit. Ch. (2) **5**. 662.)
$Ba(NO_3)_2$ is sol. in about:
13.33 pts. H_2O at ord. temp., and 4.67 pts. at 100°.
14.67 pts. NH_4OH+Aq (conc.) at ord. temp., and 5.67 pts. at 100°.
16.50 pts. NH_4OH+Aq (1 vol. conc.+3 vols. H_2O) at ord. temp.
28.00 pts. HCl+Aq (1 vol. conc. HCl+4 vols. H_2O) at ord. temp.
29.00 pts. $HC_2H_3O_2$+Aq (1 vol. commercial $HC_2H_3O_2$+1 vol. H_2O) at ord. temp.
13.67 pts. NH_4Cl+Aq (1 pt. NH_4Cl+10 pts. H_2O) at ord. temp., and 4.67 pts. at 100°.
24.00 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3+10 pts. H_2O) at ord. temp.
17.33 pts. $NH_4C_2H_3O_2$+Aq (dil. NH_4OH neutralised by dil. $HC_2H_3O_2$) at ord. temp., and 4.33 pts. at 100°.
14.67 pts. $NaC_2H_3O_2$+Aq (dil. $HC_2H_3O_2$ neutralised by Na_2CO_3 and dil. with 4 vols. H_2O) at ord. temp., and 5.33 pts. at 100°.
17.33 pts. $Cu(C_2H_3O_2)_2$+Aq (see Stolba, Z. anal. **2**. 390) at ord. temp., and 6.00 pts. at 100°.
18.67 pts. grape sugar (1 pt. grape sugar +10 pts. H_2O) at ord. temp. (Pearson, Zeit. Ch. **1869**. 662.)
Sol. in sat. NH_4Cl+Aq without pptn. at first, but finally NH_4Cl is pptd. until a certain state of equilibrium is reached. (Karsten.)

Solubility in BaO_2H_2, $8H_2O$+Aq at 25°.

Sp. gr. 25°/25°	G. BaO as $Ba(OH)_2$ in 100 g. H_2O	G. $Ba(NO_3)_2$ in 100 g. H_2O
1.0797	0	10.30
1.1002	1.55	10.66
1.1210	3.22	11.04
*1.1448	5.02	11.48

* This solution is sat. with respect to both $Ba(OH)_2$, $8H_2O$ and $Ba(NO_3)_2$.

(Parsons. J. Am. Chem. Soc. 1910, **32**. 1385.)

See also under BaO_2H_2.

Solubility in $BaCl_2$+Aq at t°.

t°	Sat. solution contains	
	% $BaCl_2$	% $Ba(NO_3)_2$
—7	21.4	4.0
—1	23.0	4.0
+1.5	22.6	4.4
2	....	5.0
10	24.7	6.1
21	24.5	5.6
32	26.6	7.7
35	26.4	7.7
38	26.7	7.8
48	28.1	8.0
53	28.5	9.0
53	28.3	9.2
66	28.0	10.0
73	30.0	10.5
79	30.3	11.2
90	32.1	12.5
155	32.5	23.1
162	33.1	23.4
210	32.5	31.9

(Étard, A. ch. 1894, (7) **3**. 287.)

See also under $BaCl_2$.

$Ba(NO_3)_2+Pb(NO_3)_2$.

Very sl. sol. in sat. $Pb(NO_3)_2$+Aq. (Karsten.)

100 pts. sat. $Ba(NO_3)_2+Pb(NO_3)_2$+Aq contain 33.95 pts. of the two salts at 19-20°. (v. Hauer, J. pr. **98.** 137.)

Solubility of $Ba(NO_3)_2+Pb(NO_3)_2$ at 25°.

G. per l.		Sp. gr.
$Ba(NO_3)_2$	$Pb(NO_3)_2$	
102.2	0	1.079
54.9	17.63	1.088
86.5	49.80	1.108
79.7	68.10	1.119
77.0	97.20	1.140
69.8	130.7	1.163
66.0	177.3	1.198
57.5	247.7	1.252
25.9	334.3	1.294
28.8	429.7	1.376
0	553.8	1.459

(Fock, Z. Kryst. Min. 1897, **28.** 365, 397.)

100 ccm. $Ba(NO_3)_2+Pb(NO_3)_2$+Aq sat. at 17° contain 3.22 g. $Ba(NO_3)_2$ and 38.59 g. $Pb(NO_3)_2$ and solution has sp. gr. = 1.350. (Euler, Z. phys. Ch. 1904, **46.** 313.)

100 pts. sat. $Ba(NO_3)_2+Pb(NO_3)_2+Sr(NO_3)_2$+Aq contain 45.90 pts. of the three salts at 19–20°. (v. Hauer, l. c.)

$Ba(NO_3)_2+Sr(NO_3)_2$.

100 pts. sat. $Ba(NO_3)_2+Sr(NO_3)_2$+Aq contain 45.96 pts. of the two salts at 19–20°. (v. Hauer, *l. c.*)

$Ba(NO_3)_2+KNO_3$.

100 pts. H_2O dissolve:

	(Mulder) (1)		
KNO_3	29.7	28.8	...
$Ba(NO_3)_2$	....	5.4	8.9
		34.2	

	(Karsten) (2)	(Karsten) (3)	(Kopp) (4)	(Kopp) (5)
KNO_3	13.31	29.03	5.7	3.5
$Ba(NO_3)_2$	6.91	1.00	33.1	36.3
	20.22	30.03	38.8	39.8

1. Sat. $Ba(NO_3)_2$+Aq sat. with KNO_3 at 18.5°.
2. To sat. KNO_3+Aq, $Ba(NO_3)_2$+Aq was added.
3. To sat. $Ba(NO_3)_2$+Aq, KNO_3 was added.
4. Both salts in excess+Aq at 21.5°.
5. Both salts in excess+Aq at 23°.

1 l. of the solution contains 59.1 g. $Ba(NO_3)_2$ +124.2 g. KNO_3 = 183.35 g. mixed salts at 17°. Sp. gr. $Ba(NO_3)_2+KNO_3$+Aq = 1.120.

1 l. of the solution contains 88.7 g. $Ba(NO_3)_2$ +213.6 g. KNO_3 = 302.3 g. mixed salts at 30°. Sp. gr. $Ba(NO_3)_2+KNO_3$+Aq = 1.191. (Euler, Z. phys. Ch. 1904, **49.** 313.)

Solubility in KNO_3+Aq at 25°.

100 pts. of solution contain pts. KNO_3	pts. $Ba(NO_3)_2$	Solid phase
15.24	6.64	$Ba(NO_3)_2+2KNO_3$, $Ba(NO_3)_2$
14.69	6.60	"
14.79	6.62	"
16.30	5.49	$2KNO_3$, $Ba(NO_3)_2$
21.99	3.04	"
27.66	2.01	KNO_3+2KNO_3, $Ba(NO_3)_2$
27.81	2.09	"
27.94	1.92	"
27.64	2.05	"

These results show that a double salt of potassium and barium nitrates is formed at 25°.

(Foote, Am. Ch. J. 1904, **32.** 252.)

Solubility of $Ba(NO_3)_2+KNO_3$ at t°.

t°	% $Ba(NO_3)_2$	% KNO_3	Solid phase
9.1	6.25	0	$Ba(NO_3)_2$
	4.20	8.15	$Ba(NO_3)_2+2KNO_3$, $Ba(NO_3)_2$
	1.98	12.02	$2KNO_3$, $Ba(NO_3)_2$
	0.98	16.80	$2KNO_3$, $Ba(NO_3)_2+KNO_3$
	0	16.76	KNO_3
21.1	8.46	0	$Ba(NO_3)_2$
	7.47	2.12	"
	6.35	5.98	"
	6.06	8.47	"
	5.98	13.24	$Ba(NO_3)_2+2KNO_3$, $Ba(NO_3)_2$
	3.35	18.24	$2KNO_3$, $Ba(NO_3)_2$
	2.30	21.47	"
	1.76	24.86	$2KNO_3$, $Ba(NO_3)_2+KNO_3$
	0	24.77	KNO_3
35	11.39	0	$Ba(NO_3)_2$
	8.18	12.99	"
	8.08	17.48	"
	8.42	19.75	$Ba(NO_3)_2+2KNO_3$, $Ba(NO_3)_2$
	5.85	24.	$2KNO_3$, $Ba(NO_3)_2$
	5.02	26.05	"
	3.02	34.87	$2KNO_3$, $Ba(NO_3)_2+KNO_3$
	1.77	34.98	KNO_3
	0	35.01	"

(Findlay, Chem. Soc. 1914, **105.** 779.)

$Ba(NO_3)_2+NaNO_3$.

$Ba(NO_3)_2$ is sol. in sat. $NaNO_3$+Aq without separation.

100 pts. H_2O dissolve:

	(Karsten) At 18.75°		
$NaNO_3$	86.6	88.14	...
$Ba(NO_3)_2$	....	3.77	8.9

	(Kopp) At 20.2°		
$NaNO_3$	87.7	88.6	...
$Ba(NO_3)_2$	....	3.6	9.2

Solubility of $Ba(NO_3)_2+NaNO_3$ in H_2O at 0°.

% $NaNO_3$	% $Ba(NO_3)_2$	Solid phase
0	4.74	$Ba(NO_3)_2$
0.41	4.33	"
0.61	4.03	"
1.68	3.34	"
3.54	2.50	"
8.05	1.60	"
12.71	1.56	"
20.24	1.53	"
20.92	1.43	"
27.74	1.56	"
30.81	1.55	"
33.79	1.53	"
35.83	1.49	"
41.30	1.55	$Ba(NO_3)_2+NaNO_3$
41.68	0.51	$NaNO_3$
42.47	0	"

(Coppadoro, Gazz. ch. it, 1912, **42** (1) 233.)

Solubility of $Ba(NO_3)_2+NaNO_3$ in H_2O at 30°.

% $NaNO_3$	% $Ba(NO_3)_2$	Solid phase
0	10.33	$Ba(NO_3)_2$
2.33	8.58	"
7.09	5.28	"
12.07	3.89	"
14.41	3.54	"
17.87	3.20	"
19.06	3.07	"
23.55	2.81	"
41.22	2.27	"
48.22	2.11	$Ba(NO_3)_2+NaNO_3$
48.50	1.00	$NaNO_3$
49.16	0	"

(Coppadoro, Gazz. ch. it. 1913, **43**, I. 240.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

100 pts. hydrazine dissolves 81.1 pts. $Ba(NO_3)_2$ at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)

100 pts. anhydrous hydroxylamine dissolve 11.4 pts. $Ba(NO_3)_2$. (de Bruyn, R. t. c. 1892, **11.** 18.)

Insol. in absolute alcohol.

Solubility in dilute alcohol increases with the temp. (Gerardin, A. ch. (4) **5.** 145.)

Solubility in ethyl alcohol+Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Ba(NO_3)_2$ in the solution
0	0	9.55
10.25	9.5	7.63
18.60	17.5	6.02
25.05	23.7	5.25
40.20	38.8	3.53
58.00	57.0	1.85
78.70	78.2	0.62
90.10	89.9	0.18
99.40	99.39	0.005

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** 37.)

Completely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. **143.** 314.)

Solubility in organic solvents.

Solvent	% $Ba(NO_3)_2$ in the solution at 25°
Methyl alcohol	0.50
Ethyl alcohol	0.005
Acetone	0.005
Ether	very small
Paracetaldehyde	" "

(D'Ans and Siegler, Z. phys. Ch. 1913, **82. 44.**)

Solubility in phenol+Aq at 25°.

Concentration of the phenol Mol./Liter	Solubility of $Ba(NO_3)_2$ Mol./Liter
0.000	0.3835
0.045	0.3785
0.082	0.3746
0.146	0.3664
0.310	0.3492
0.401	0.3400
0.501	0.3299
0.728 (sat.)	0.3098

(Rothmund and Wilsmore, Z. phys. Ch. 1902, **40.** 620.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. in acetone. (Eidmann, C. C. **1899**, II. 1014.)

Barium mercurous nitrate, $2BaO, 2Hg_2O, 3N_2O_5$.

Decomp. by H_2O. Sol. in hot dil. HNO_3+Aq and hot $Hg_2(NO_3)_2$+Aq, from which it crystallises on cooling. (Städeler, A. **87.** 129.)

Barium potassium nitrate, $Ba(NO_3)_2, 2KNO_3$.

Ppt. (Wallbridge, Am. Ch J. 1903, **30.** 154.)

Solubility determinations show that the only double salt formed by barium and potassium nitrates at 25° is $Ba(NO_3)_2, 2KNO_3$.

See $Ba(NO_3)_2+KNO_3$ under $Ba(NO_3)_2$. (Foote, Am. Ch. J. 1904, **32.** 252.)

Barium nitrate ***meta*****tungstate,** $2Ba(NO_3)_2, BaW_4O_{13}+6H_2O$.

Efflorescent. Sol. in warm H_2O. (Péchard, A. ch. (6) **22.** 198.)

Bismuth nitrate, basic, $Bi_2O_3, N_2O_5+2H_2O$.

Sol. in a large amount of H_2O. Sol. in HNO_3+Aq. (Heintz.)

Sol. in 135 pts. H_2O at 90–93°. (Ruge, J. B. **1862.** 163.)

$+\frac{1}{2}H_2O$. Sol. in much H_2O. (Yvon, C.R. **84. 1161.**)

$+H_2O$. (Ruge.)

$2Bi_2O_3, N_2O_5$. Not acted upon by H_2O. (Ditte, C. R. **84.** 1317.)

$+H_2O$. (Yvon.)

$Bi_2O_3, 2N_2O_5+H_2O$. (Ruge.)

$11Bi_2O_3, 5N_2O_5+16H_2O$. Not decomp. by H_2O. (Yvon.)

$5Bi_2O_3, 4N_2O_5+8H_2O$. Ppt. Not attacked by H_2O. (Schulten, Bull. Soc. 1903, (3) **29.** 722.)

$5Bi_2O_3, 5N_2O_5+9H_2O$. Sol. in H_2O with decomp. (Schulten.)

$6Bi_2O_3, 5N_2O_5+8H_2O$, and $+9H_2O$. (Rutten, Z. anorg. 1902, **30.** 368.)

At 25° the salt $Bi_{12}O_{13}(NO_3)_{10}, 9H_2O$ is in equilibrium with HNO_3+Aq from 0.03–0.32–N; the salt $BiO(NO_3), H_2O$ is in equilibrium with HNO_3+Aq from 0.425–0.72–N.

At 50° the salt $Bi_4O_5(NO_3)_2, H_2O$ is in equilibrium with HNO_3+Aq from 0.057–0.285–N; the salt $Bi_{12}O_{13}(NO_3)_{10}, 9H_2O$ is in equilibrium with HNO_3+Aq from 0.285–0.446–N.

At 75° the salt $Bi_4O_5(NO_3)_2, H_2O$ is in equilibrium with HNO_3+Aq from 0.109–0.314–N. (Allan, Am. Ch. J. 1901, **25.** 314.)

Bismuth nitrate, $Bi(NO_3)_3$.

Permanent. Decomp. by little H_2O with separation of a basic salt. This decomposition is prevented by slight excess of HNO_3, and then the salt is completely sol. in a large amount of H_2O. (Rose.)

Sol. in dil. HNO_3+Aq. Not decomp. by H_2O in presence of $HC_2H_3O_2$ or $\frac{1}{500}$ pt. NH_4NO_3. (Löwe, J. pr. **74.** 341.)

Completely sol. in HNO_3+Aq containing 83 g. HNO_3 per liter. (Ditte.)

Solubility of $Bi(NO_3)_3$ in 2.3N–HNO_3+Aq. =2.04 g. at Bi per l.; in 0.922N–HNO_3+Aq. =2.23 g. at Bi per l. (Dubrisay, C. R. 1911, **153.** 1077.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Krug and M'Elroy.)

Solubility of $Bi(NO_3)_3$ in 6.67% acetone+2.3N–HNO_3+Aq=1.89 g. at Bi per l.; in 6.67% acetone+0.922N–HNO_3+Aq.=2.17 g. at Bi per l.; in 13.33% acetone+0.922N–HNO_3+Aq=2.08 g. at Bi per l. (Dubrisay, C. R. 1911, **153.** 1077.)

When $Bi(NO_3)_3$ is mixed with mannite (dulcite, sorbite) in proportion to the mol. wts. and H_2O is added, a clear solution is obtained which is not pptd. by addition of much H_2O. These solutions are more stable the greater the proportion of mannitol. (Vanino and Hunser, Z. anorg. 1901, **28.** 211.)

$+1\frac{1}{2}H_2O$. (Ditte.)

$+5H_2O$. If treated with increasing amts. of H_2O, the amt. of Bi which dissolves decreases, and when 1 pt. is treated with 50,000 pts. H_2O, no Bi goes into solution. (Antony and Gigli, Gazz. ch. it. 1898, **28.** 245.)

48.66	pts.	are	sol.	in	100	pts.	acetone	at	0°.
41.70	"	"	"	"	100	"	"	"	19°.

(Laszczynski, B. 1894, **27.** 2287.)

$+5\frac{1}{2}H_2O$. (Yvon, C. R. **84.** 1161.)

$+10H_2O$. Melts in crystal H_2O with decomp. at 74°. (Ordway.)

Bismuth cæsium nitrate, $Bi(NO_3)_3, 2CsNO_3$.

Ppt. (Wells, Am. Ch. J. 1901, **26.** 277.)

Bismuth cobalt nitrate, $2Bi(NO_3)_3, 3Co(NO_3)_2+24H_2O$.

100 cc. sat. solution in HNO_3+Aq (sp. gr. 1.325) contain 54.67 g. hydrated salt. (Jantsch Z. anorg. 1912, **76.** 321.)

Bismuth magnesium nitrate, $2Bi(NO_3)_3, 3Mg(NO_3)_2+24H_2O$.

Deliquescent. Effloresces in dry air. Decomp. by H_2O. (Urbain and Lacombe, C. R. 1903, **137.** 569.)

100 cc. sat. solution in HNO_3+Aq (sp. gr. 1.325) contain 41.69 g. hydrated salt. (Jantsch Z. anorg. 1912, **76.** 321.)

Bismuth manganous nitrate, $2Bi(NO_3)_3, 3Mn(NO_3)_2+24H_2O$.

Deliquescent. Effloresces in dry air. Decomp. by H_2O. (Urbain and Lacombe, C. R. 1903, **137.** 569.)

100 cc. sat. solution in HNO_3+Aq (sp. gr. 1.325) contain 65.77 g. hydrated salt. (Jantsch Z. anorg. 1912, **76.** 321.)

Bismuth nickel nitrate, $2Bi(NO_3)_3, 3Ni(NO_3)_2 + 24H_2O$.

Deliquescent. Effloresces in dry air. Decomp. by H_2O. (Urbain and Lacombe, C. R. 1903, **37.** 569.)

100 cc. sat. solution in HNO_3+Aq (sp. gr. 1.325) contain 46.20 g. hydrated salt at 16°. (Jantsch.)

Bismuth zinc nitrate, $2Bi(NO_3)_3, 3Zn(NO_3)_2 + 24H_2O$.

Deliquescent. Decomp. by H_2O. (Urbain and Lacombe, C. R. 1903, **137.** 569.)

100 cc. sat. solution in HNO_3+Aq (sp. gr. 1.325) contain 57.51 g. hydrated salt at 16°. (Jantsch.)

Cadmium nitrate, basic, $Cd(OH)NO_3+H_2O$.

Decomp. by H_2O, or ordinary alcohol. (Klinger, B. **16.** 997.)

$12CdO, N_2O_5+11H_2O$. Sl. sol. in H_2O; more sol. in H_2O than basic sulphate. (Habermann, **5.** 432.)

$5CdO, 2N_2O_5+8H_2O$. Decomp. by cold H_2O. (Rousseau and Tite, C. R. **114.** 1184.)

Cadmium nitrate, $Cd(NO_3)_2$.

Deliquescent, and very sol. in H_2O.

See +4, and $9H_2O$.

Sp. gr. of aqueous solution containing:

5	10	15	20	25%	$Cd(NO_3)_2$,
1.0528	1.0978	1.1516	1.2134	1.2842	
30	35	40	45	50%	$Cd(NO_3)_2$.
1.3566	1.4372	1.5372	1.6474	1.7608	

(Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $Cd(NO_3)_2$+Aq at 18°.

% $Cd(NO_3)_2$	1	5	10	15
Sp. gr.	1.0069	1.0415	1.0869	1.136
% $Cd(NO_3)_2$	20	25	30	35
Sp. gr.	1.1903	1.25	1.3125	1.3802
% $Cd(NO_3)_2$	40	45	48	
Sp. gr.	1.459	1.543	1.5978	

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of $Cd(NO_3)_2$+Aq at room temp. containing:

7.81	15.71	22.36%	$Cd(NO_3)_2$.
1.0744	1.1593	1.2411	

(Wagner, W. Ann. 1883, **18.** 265.)

Sp. gr. of $Cd(NO_3)_2$+Aq.

% $Cd(NO_3)_2$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0492	17.57	0.99912	0.99904
...	21.14	0.99839	...
0.100	18.00	...	0.99945
0.249	17.34	1.0008	1.0007
...	20.22	1.0002	...
0.464	18.00	...	1.0025
0.952	18.00	...	1.0065

(Wershofen, Z. phys. Ch. 1890, **5.** 493.)

Sp. gr. of $Cd(NO_3)_2$+Aq at 25°.

Concentration of $Cd(NO_3)_2$+Aq.	Sp. gr.
1–normal	1.0954
1/2– "	1.0479
1/4– "	1.0249
1/16– "	1.0119

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. of $Cd(NO_3)_2$+Aq at 18°/4°.

% $Cd(NO_3)_2$	54.027	43.716	30.879
Sp. gr.	1.711	1.515	1.321
% $Cd(NO_3)_2$	21.353	14.899	8.683
Sp. gr.	1.204	1.134	1.074

(de Muynck, W. Ann. 1894, **53.** 561.)

$Cd(NO_3)_2$+Aq containing 7.89% $Cd(NO_3)_2$ has sp. gr. 20°/20° = 1.0673.

$Cd(NO_3)_2$ + Aq containing 12.14% $Cd(NO_3)_2$ has sp. gr. 20°/20° = 1.1070.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sat. $Cd(NO_3)_2$+Aq boils at 132°.

Almost entirely insol. in conc. HNO_3+Aq. (Wurtz.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in alcohol.

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

$+4H_2O$. M.-pt. of $Cd(NO_3)_2+4H_2O$ = 59.5°. (Ordway; Tilden, Chem. Soc. **45.** 409.)

Solubility in H_2O.

Solubility in H_2O at t°.

t°	% $Cd(NO_3)_2$ in the solution	Mols. H_2O to 1 mol. $Cd(NO_3)_2$
0	52.31	11.96
18	55.90	10.34
30	58.40	9.34
40	61.42	8.24
59.5 mpt.	76.54	4.00

(Funk, B. 1899, **32.** 105.)

Sat. solution of $Cd(NO_3)_2+4H_2O$ in H_2O at 0° contains 52.3% $Cd(NO_3)_2$; at 18°, 55.9% $Cd(NO_3)_2$. (Mylius, Z. anorg. 1912, **74.** 411.)

Sol. in liquid NH_3. (Johnson and Wilsmore, Elektroch. Z. 1908, **14.** 227.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+9H_2O$. Solubility in H_2O.

Sat. solution contains at:

−13°	−1°	+1°
37.37	47.33	52.73% $Cd(NO_3)_2$.

Cryohydrate is formed at —16°. (Funk, Z. anorg. 1899, **20.** 416.)

The composition of the hydrates formed by $Cd(NO_3)_2$ at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by $Cd(NO_3)_2$ and of the conductivity and sp. gr. of $Cd(NO_3)_2$+Aq. (Jones, Am. Ch. J. 1905, **34.** 308.)

Cadmium uranyl nitrate, $Cd(NO_3)_2$, $(UO_2)(NO_3)_2+30H_2O$.

Sol. in H_2O and acids. Insol. in alcohol and alkalies+Aq. (Lancien, C. C. **1912,** I. 208.)

Cadmium nitrate ammonia, $Cd(NO_3)_2$, $6NH_3+H_2O$.

(André, C. R. **104.** 987.)

Cadmium nitrate cupric oxide, $Cd(NO_3)_2$, $CuO+5H_2O$.

Ppt. (Mailhe, C. R. 1902, **134.** 235.)

Cadium nitrate cupric oxide, $Cd(NO_3)_2$, $3CuO+5H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 383.)

Cadmium nitrate hydrazine, $Cd(NO_3)_2$, $3N_2H_4$.

Decomp. by hot H_2O. Sol. in warm NH_4OH. (Franzen, Z. anorg. 1908, **60.** 282.)

Cæsium nitrate, $CsNO_3$.

100 pts. H_2O dissolve 10.58 pts. $CsNO_3$ at 3.2°. Sl. sol. in absolute alcohol. (Bunsen.)

Solubility of $CsNO_3$ in H_2O at t°.

t°	G. $CsNO_3$ per 100 g. Solution	G. $CsNO_3$ per 100 g. Water	t°	G. $CsNO_3$ per 100 g. Solution	G. $CsNO_3$ per 100 g. Water
0	8.54	9.33	60	45.6	83.8
10	12.97	14.9	70	51.7	107.0
20	18.7	23.0	80	57.3	134.0
30	25.3	33.9	90	62.0	163.0
40	32.1	47.2	100	66.3	197.0
50	39.2	64.4	106.2	68.8	220.3

(Berkeley, Trans. Roy. Soc. 1904, **203.** A, 213.)

100 g. H_2O dissolve 26.945 g. $CsNO_3$ at 25°. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1148.)

Sp. gr. 20°/4° of a normal solution of $CsNO_3$ =1.140905; of a 0.5 normal solution= 1.07001. (Haigh.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Solubility in glycol=8% at ord. temp. (de Coninck, Belg. Acad. Bull. **1905,** 359.)

Cæsium hydrogen nitrate.

$CsNO_3$, HNO_3. Sol. in H_2O. (Wells, Am. Ch. J. 1901, **26.** 273.)

$CsNO_3$, $2HNO_3$. (W.)

Cæsium cerium nitrate, $Cs_2Ce(NO_3)_6$.

Sol. in H_2O; very sl. sol. in HNO_3. (Meyer, Z. anorg. 1901, **27.** 371.)

Sol. in HNO_3. (Meyer, B. 1900, **33.** 2137.)

Cæsium ferric nitrate, $CsNO_3$, $Fe(NO_3)_3+7H_2O$.

Deliquescent. (Wells, Am. Ch. J. 1901, **26.** 276.)

Cæsium silver nitrate, $CsNO_3$, $AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26.** 357.)

Cæsium thorium nitrate, $Cs_2Th(NO_3)_6$.

Decomp by H_2O; sl. sol. in HNO_3. (Meyer, Z. anorg. 1901, **27.** 384.)

Cæsium uranyl nitrate, $Cs(UO_2)(NO_3)_3$.

Decomp. by H_2O. Sol. in conc. HNO_3. (Meyer, B. 1903, **36.** 4057.)

Decomp. by H_2O at low temp., so that the solid phase in contact with the solution consists of the double salt and $CsNO_3$. At 16.1° 100 pts. by wt. of the solution in H_2O contain 31.39 pts. UO_2 and 6.59 pts. Cs. (Rimbach, B. 1904, **37.** 477.)

Calcium nitrate, basic, $Ca(NO_3)_2$, $CaO_2H_2+2\frac{1}{2}H_2O$.

Decomp. by H_2O. (Werner, A. ch. (6) **27.** 570.)

$+H_2O$. As above. (Rousseau and Tite, C. R. **114.** 1184.)

Calcium nitrate, $Ca(NO_3)_2$.

Deliquescent. Very sol. in H_2O with evolution of much heat.

100 pts. H_2O at 0° dissolve 84.2 pts. $Ca(NO_3)_2$. (Poggiale.)

100 pts. H_2O at 0° dissolve 93.1 pts. $Ca(NO_3)_2$. (Mulder.)

Sol. in 0.25 pt. cold H_2O with reduction of temp. Sol. in all proportions in boiling H_2O. (Berzelius.)

Sol. in 2 pts. cold, and 0.6667 pt. boiling H_2O. (Fourcroy.)

Sat. $Ca(NO_3)_2$+Aq at 12.5° contains 33.8%. (Hassenfratz, A. ch. **28.** 29.)

Solubility in H_2O.

100 g. of the solution contain at:

55°	80°	90°	100°
78.16	78.20	78.37	78.43 g. $Ca(NO_3)_2$,

125°	147.5°	151° (bpt. of sat. solution at 760 mm.)
78.57	78.80	79.00 g. $Ca(NO_3)_2$.

The anhydrous salt is the stable solid phase above 51.3°. (Bassett and Taylor, Chem. Soc. 1912, **101.** 580.)

100 g. sat. $Ca(NO_3)_2$+Aq contain 77.3 g. $Ca(NO_3)_2$ at 25°. (Taylor and Henderson, J. Am. Chem. Soc. 1915, **37.** 1692.)

See also +2, 3, and $4H_2O$.

Sp. gr. of $Ca(NO_3)_2$+Aq at room temp. containing:

17.55	30.10	40.13% $Ca(NO_3)_2$.
1.1714	1.2739	1.3857

(Wagner, W. Ann. 1883, **18.** 270.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 17.5°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
1	1.009	35	1.328
5	1.045	40	1.385
10	1.086	45	1.447
15	1.129	50	1.515
20	1.174	55	1.588
25	1.222	60	1.666
30	1.272	..	...

(Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 17.5°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
10	1.076	40	1.368
20	1.163	50	1.483
30	1.261	60	1.605

(Gerlach, Z. anal. **27.** 283.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 18°.

% $Ca(NO_3)_2$	Sp. gr.	% $Ca(NO_3)_2$	Sp. gr.
6.25	1.0487	37.5	1.3546
12.5	1.1016	50.0	1.5102
25.0	1.2198	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 24.65°. a = no. of g. × ½ mol. wt. dissolved in 1000 g. H_2O; b = sp. gr. if a is $Ca(NO_3)_2$, $4H_2O$, ½ mol. wt. = 118; c = sp. gr. if a is $Ca(NO_3)_2$, ½ mol. wt. = 82.

a	b	c	a	b	c
1	1.056	1.059	6	1.243	1.286
2	1.104	1.112	7	1.270	1.323
3	1.145	1.160	8	1.294	...
4	1.181	1.205	9	1.316	...
5	1.213	1.246	10	1.336	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 25°.

Concentration of $Ca(NO_3)_2$+Aq.	Sp. gr.
1-normal	1.0596
1/2 "	1.0300
1/4 "	1.0151
1/8 "	1.0076

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

$Ca(NO_3)_2$+Aq containing 7.15% $Ca(NO_3)_2$ has sp. gr. 20°/20° = 1.0554.

$Ca(NO_3)_2$+Aq containing 7.91% $Ca(NO_3)_2$ has sp. gr. 20°/20° = 1.0613.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Sp. gr. of $Ca(NO_3)_2$+Aq at 20° containing M g. mols. of salt per liter.

M	0.0125	0.025	0.05	0.125
Sp. gr.	1.001846	1.003166	1.00604	1.01523
M	0.25	0.5	0.75	
Sp. gr.	1.03074	1.06011	1.08874	
M	1.00	1.50		
Sp. gr.	1.11751	1.17375		

(Jones and Pearce, Am. Ch. J. 1907, **38.** 704.)

Saturated $Ca(NO_3)_2$+Aq containing 351.2 pts. $Ca(NO_3)_2$ to 100 pts. H_2O boils at 151° (Legrand); 152° (Kremers).

Forms a crust at 141°, and contains 333.5 pts. $Ca(NO_3)_2$ to 100 pts. H_2O; highest temp. observed, 151°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Ca(NO_3)_2$+Aq containing pts. $Ca(NO_3)_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 447); L = according to Legrand (A. ch. (2) **59.** 436).

B.-pt.	G	L	B.-pt.	G	L
101°	10	15	127	215.5	...
102	20	25.3	128	222.5	197.0
103	30	34.4	129	230	...
104	40	42.6	130	237.5	209.5
105	50	50.4	131	245	...
106	60	57.8	132	253	222.2
107	70	64.9	133	261.5	...
108	80	71.8	134	270	235.1
109	89	78.6	135	278.5	...
110	98	85.3	136	287	248.1
111	106.5	91.9	137	296	...
112	114.5	98.4	138	305	261.3
113	122.5	104.8	139	314.5	...
114	130	111.2	140	324	274.7
115	137.5	117.5	141	333.5	...
116	144	123.8	142	343.5	288.4
117	150.5	130	143	354	...
118	157	136.1	144	364.5	302.6
119	163.5	142.1	145	375	...
120	170	148.1	146	386	317.4
121	176	...	147	397.5	...
122	182.5	160.1	148	409	333.2
123	189	...	149	420.5	...
124	195.5	172.2	150	432.5	351.2
125	202	...	151	444.5	362.2
126	208.5	184.5	151.97	455.68	...

Sat. $Ca(NO_3)_2$+Aq boils at 132°. (Ordway, Sill. Am. J. (2) **27.** 14.)

Conc. HNO_3 precipitates $Ca(NO_3)_2$ from its aqueous solution. (Mitscherlich, Pogg. **18.** 159.)

Very sol. in conc. HNO_3. (Rawson, J. Soc. Chem. Ind. 1897, **16.** 113.)

Solubility in HNO_3+Aq at 25°.

100 g. of the solution contain		Solid phase
G. $Ca(NO_3)_2$	G. HNO_3	
57.98	0.00	
54.82	3.33	
52.96	5.87	
51.58	7.21	
47.82	11.27	
45.59	13.71	$Ca(NO_3)_2+4H_2O$
40.70	19.65	
38.17	22.80	
34.46	28.81	
32.84	32.63	
32.50	33.52	
33.44	35.63	
29.05	41.66	$Ca(NO_3)_2+3H_2O$
27.79	45.70	
31.09	40.56	
26.07	45.70	
17.41	55.48	
12.25	62.05	$Ca(NO_3)_2+2H_2O$
9.34	65.69	
8.52	67.20	
5.06	71.12	
2.53	74.77	
1.05	78.56	
0.54	80.83	$Ca(NO_3)_2$
0.36	85.83	
0.01 (about)	90.90	
0.00	96.86	

These results show that the hydrates of $Ca(NO_3)_2$ which are stable at 25° in contact with HNO_3+Aq are $Ca(NO_3)_2+4H_2O$, $+3H_2O$ and $+2H_2O$.

(Bassett and Taylor, Chem. Soc. 1912, **101.** 582.)

Sol. in glacial $HC_2H_3O_2$. (Persoz.)

Sol. in sat. KNO_3+Aq with elevation of temp. and pptn. of a portion of KNO_3. (Fourcroy and Vauquelin, A. ch. **11.** 135.)

Solubility of $Ca(NO_3)_2+NaNO_3$ at t°.

t°	% $Ca(NO_3)_2$	% $NaNO_3$	Solid phase
9	47.51	9.51	$Ca(NO_3)_2, 4H_2O$
	46.08	12.56	" $+NaNO_3$
	26.67	23.32	$NaNO_3$
	11.76	34.26	"
25	54.58	7.25	$Ca(NO_3)_2, 4H_2O$
	53.22	10.70	"
	52.73	12.08	" $+NaNO_3$
	52.40	11.58	$NaNO_3$
	37.31	19.48	"
	26.91	24.98	"
	14.61	36.12	"

(Kremann and Rothmund, Z. anorg. 1914, **86.** 373.)

Solubility of $Ca(NO_3)_2+CaS_2O_3$ at t°.

t°	% $Ca(NO_3)_2$	% CaS_2O_3	Solid phase
9	46.02	5.46	$Ca(NO_3)_2, 4H_2O$
	45.68	6.81	" $CaS_2O_3, 6H_2O$
	27.92	10.46	$CaS_2O_3, 6H_2O$
	10.49	22.81	"
	...	29.33	"
25	54.03	4.27	$Ca(NO_3)_2, 4H_2O$
	50.25	9.10	"
	45.92	13.	" $+CaS_2O_3, 6H_2O$
	42.93	13.83	$CaS_2O_3, 6H_2O$
	32.01	17.09	"
	19.51	23.78	"
	8.15	29.85	"

(Kremann and Rothmund, Z. anorg. 1914, **86.** 373.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in 0.8 pt. alcohol (Macquer); 1 pt. boiling alcohol. (Bergmann.)

Dry $Ca(NO_3)_2$ is sol. in 7 pts. alcohol at 15° and 1 pt. boiling alcohol. (Bergmann.)

Sp. gr. of $Ca(NO_3)_2$+alcohol.

% $Ca(NO_3)_2$	Sp. gr. 20°/20°
0	0.7949
4.96	0.8278
6.47	0.8383

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 284.)

Solubility in ethyl alcohol+Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Ca(NO_3)_2$ in the solution
*0	0	82.5
*25.1	5.8	77.0
*50.1	15.2	69.52
*60.1	20.4	66.08
*63.9	22.4	64.94
70.4	26.5	62.3
72.0	27.39	61.96
73.4	28.5	61.15
75.3	29.9	60.3
*84.9	35.9	57.7
*99.1	48.1	51.4

* Metastable solutions.

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** **43.**)

Solubility of $Ca(NO_3)_2$, $2C_2H_5OH$ in C_2H_5OH +Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Ca(NO_3)_2$ in the solution
98.1	60.2	38.6
94.1	54.6	41.9
85.8	42.5	50.97
80.5	35.8	55.3
75.3	29.9	60.28

(D'Ans and Siegler, *l. c.*)

See also under $+4H_2O$.

Solubility in organic solvents.

Solvent	% $Ca(NO_3)_2$ in the solution at 25°
Methyl alcohol	65.5
Ethyl alcohol	52.0
Propyl alcohol	36.5
Isobutyl alcohol	25.0
Amyl alcohol	13.3
Acetone	58.5

(D'Ans and Siegler, *l. c.*)

Sol. in 1.87 pts. ether-alcohol (1 : 1). (Fresenius, Z. anal. **32.** 191.)

Ether ppts. $Ca(NO_3)_2$ from its alcoholic solution. Easily sol. in boiling amyl alcohol. (Browning, Sill. Am. J. **143.** 53.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methylal. (Eidmann, C. C. **1899,** II. 1014.)

1 g. $Ca(NO_3)_2$ is sol. in 1.44 g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution =1.313. (Naumann, B. 1909, **42.** 3795.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+2H_2O$. Solubility in H_2O.

100 g. of the solution contain at:

49°	51°
77.49	78.05 g. $Ca(NO_3)_2$.

Solutions in stable equilibrium with the dihydrate can only exist between the limits of temp. 48.4° and 51.3°. (Bassett and Taylor, Chem. Soc. 1912, **101.** 580.)

$+3H_2O$. Solubility in H_2O.

100 g. of the solution contain at:

40°	45°	50°	51°
70.37	71.45	73.79	74.73 g. $Ca(NO_3)_2$.

Mpt. of $Ca(NO_3)_2+3H_2O$ = 51.1°.

(Bassett and Taylor, *l. c.*)

$+4H_2O$. $Ca(NO_3)_2+4H_2O$ melts in its crystal H_2O at 44°. (Tilden, Chem. Soc. **45.** 409.)

Solubility in H_2O at t°.

100 g. of the solution contain g. $Ca(NO_3)_2$ at t°.

t°	G. $Ca(NO_3)_2$
—26.7	43.37
—10.0	47.31
0.0	50.50
+5.0	51.97
10.0	53.55
15.0	54.94
20.0	56.39
25.0	57.98
30.0	60.41
35.0	62.88
40.0	66.21
42.4	68.68
42.5	68.74
42.7	mpt. of $Ca(NO_3)_2+4H_2O$
42.45	71.70

(Bassett and Taylor, *l. c.*)

Solubility of α and β modifications in H_2O at t°.

α modification is the stable form.

t°	G. $Ca(NO_3)_2$ in 100 g. of solution	Solid phase
0	50.17	α $Ca(NO_3)_2+4H_2O$
22.2	56.88	α "
25.0	57.90	α "
30.0	60.16	α "
30.0	61.57	β "
34.0	63.66	β "
35.0	62.88	α "
38.0	64.34	α "
38.0	66.65	β "
39.0	67.93	β "
[1] 39.6	69.50	β "
[2] 39.0	75.34	β "
40.0	66.21	α "
[1] 42.7	69.50	α "
[2] 42.4	71.70	α "

[1] mpt. of hydrate.
[2] reflex pt.

(Taylor and Henderson, J. Am. Chem. Soc. 1915, **37.** 1692.

Sp. gr. of solution sat. at 18° = 1.548, containing 54.8% $Ca(NO_3)_2$. (Mylius, B. 1897, **30.** 1718.)

Solubility in ethyl alcohol+Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Ca(NO_3)_2$ in the solution
0	0	57.5
18.3	3.5	56.1
39.2	8.1	55.2
59.2	14.1	52.9
80.4	22.3	50.2
90.4	29.4	49.0
99.4	31.1	49.7
99.4	31.2	52.0
99.4	29.5	56.2
60.1	28.3	58.9
60.1	27.8	60.0
60.1	27.3	60.7
60.1	26.5	62.3

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** 42.)

Calcium nitrate hydrazine, $Ca(NO_3)_2$, $2N_2H_4$ $+H_2O$.

Ppt. (Franzen, Z. anorg. 1908, **60.** 288.)

Calcium nitrate tungstosilicate, $Ca_2W_{12}SiO_{40}$, $Ca(NO_3)_2$.

$+13H_2O$ and $+15H_2O$. Decomp. by H_2O. (Wyrouboff, Chem. Soc. 1897, **72.** (2) 176.)

Cerous nitrate, $Ce(NO_3)_3+6H_2O$.

Not very deliquescent. (Jolin.)

Very sol. in H_2O; sol. in 2 pts. alcohol. (Vauquelin.)

Sol. in acetone. (Eidmann, C. C. **1899.** II. 1014; Naumann, B. 1904, **37.** 4328.)

Ceric nitrate, $Ce(NO_3)_4$.

Deliquescent. Decomp. by hot H_2O. (Berzelius.)

Sol. in alcohol. (Dumas.)

Basic compounds containing 12 mols. or less CeO_2 to 1 mol. N_2O_5 may be obtained, which are sol. in H_2O. (Ordway.)

Cerous cobaltous nitrate, $2Ce(NO_3)_3$, $3Co(NO_3)_2+24H_2O$.

Deliquescent. Easily forms supersaturated solutions. (Lange, J. pr. **82.** 129.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 103.3 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Ceric cobaltous nitrate, $CeCo(NO_3)_6+8H_2O$.

Decomp. by H_2O when heated; sol. in cold H_2O; sl. sol. in HNO_3. (Meyer, Z. anorg. 1901, **27.** 376.)

Cerous magnesium nitrate, $2Ce(NO_3)_3$, $3Mg(NO_3)_2+24H_2O$.

Slightly deliquescent. Easily sol. in H_2O or alcohol, and easily forms supersaturated solutions. (Holzmann, J. pr. **75.** 330.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Ceric magnesium nitrate, $CeMg(NO_3)_6$. $+8H_2O$.

Decomp. by H_2O; sol. in HNO_3+Aq without decomp. (Meyer, Z. anorg. 1901, **27.** 373.)

Cerous manganous nitrate, $2Ce(NO_3)_3$, $3Mn(NO_3)_2+24H_2O$.

Sol. in H_2O. (Lange, J. pr. **82.** 129.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)

Ceric manganous nitrate, $CeMn(NO_3)_6+8H_2O$.

Decomp. by H_2O and dil. HNO_3; sol. in conc. HNO_3 without decomp. (Meyer, Z. anorg. 1901, **27.** 377.)

Cerous nickel nitrate, $2Ce(NO_3)_3$, $3Ni(NO_3)_2$ $+24H_2O$.

Easily sol. in H_2O. (Holzmann, J. pr. **75.** 321.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch.)

Ceric nickel nitrate, $CeNi(NO_3)_6+8H_2O$.

Decomp. by H_2O when heated; sol. in H_2O in the cold; sl. sol. in HNO_3. (Meyer, Z. anorg. 1901, **27.** 375.)

Cerous potassium nitrate, $Ce(NO_3)_3$, $2KNO_3$ $+2H_2O$.

Sol. in H_2O. (Lange, J. pr. **82.** 136.)

Ceric potassium nitrate, $CeK_2(NO_3)_6$.

Sol. in H_2O with decomp. (Meyer, Z. anorg. 1901, **27.** 370.)

$+1\frac{1}{2}H_2O$. Efflorescent. (Holzmann, J. pr. **75.** 324.)

Ceric rubidium nitrate, $CeRu_2(NO_3)_6$.

Very sol. in H_2O; sl. sol. in HNO_3. (Meyer.)

Ceric sodium nitrate.

Deliquescent. Decomp. by recrystallization. (Holzmann.)

Cerous thallous nitrate, $[Ce(NO_3)_5]Tl_2+4H_2O$.

Very hydroscopic. Decomp. by H_2O. (Jantsch, Z. anorg. 1911, **69.** 229.)

Cerous zinc nitrate, $2Ce(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

Sol. in H_2O. Easily forms supersat. solutions. (Lange, J. pr. **82.** 129.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 124.1 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Ceric zinc nitrate, $ZnCe(NO_3)_6+8H_2O$.

Decomp. by H_2O; sol. in HNO_3+Aq. (Meyer, Z. anorg. 1901, **27.** 374.)

Ceroceric zinc nitrate (?), Ce_3O_4, $2ZnO$, $6N_2O_5+18H_2O$ (?).

Easily sol. in H_2O. (Holzmann, J. pr. **75.** 321.)

Chromic nitrate, basic, $Cr_2O(NO_3)_4$.

Sol. in H_2O. (Löwel.)

$+12H_2O$. Sol. in H_2O. (Ordway.)

Chromic nitrate, $Cr(NO_3)_3+9H_2O$.

Very sol. in H_2O and alcohol. (Löwel.)

Melts in its crystal H_2O at 36.5°. Sat. $Cr(NO_3)_3$+Aq boils at 125.6°. (Ordway.)

Sp. gr. of $Cr(NO_3)_3$+Aq.

M = concentration of solution in gram. mols.

W = wt. of 25 cc. of solution.

M	0.0934	0.1868	0.3736	0.5604	0.9340
W	25.4300	25.8828	26.7302	27.5524	29.3072

M	1.1208	1.3076	1.4944	1.8680
W	30.0668	30.8464	31.6327	33.3379

(Jones and Getman, Z. phys. Ch. 1904, **49.** 426.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)

Chromic nitrate chloride, $CrCl_2(NO_3)$.

Sol. in H_2O and alcohol. (Schiff, A. **124.** 177.)

$Cr(NO_3)_2Cl$. (Schiff.)

Chromic nitrate sulphate, $Cr_2(SO_4)(NO_3)_4$.

Hygroscopic. Completely sol. in H_2O.

$Cr_2(SO_4)_2(NO_3)_2$. Sol. in H_2O. (Schiff, A. **124.** 174.)

Cobaltous nitrate, basic, $6CoO$, $N_2O_5+5H_2O$.

Ppt. Gradually sol. in H_2O with deposition of CoO. (Winkelblech, A. **13.** 155.)

Sol. in cold HCl, and HNO_3+Aq. Decomp. by hot KOH+Aq.

$4CoO$, $N_2O_5+6H_2O$. Ppt. (Habermann, M. **5.** 432.)

Cobaltous nitrate, $Co(NO_3)_2$.

Deliquescent in moist air. Very sol. in H_2O.

See +3, 6, and $9H_2O$.

Sp. gr. of aqueous solution at 17.5° containing:

5	10	15	20% $Co(NO_3)_2$,
1.0462	1.0906	1.1378	1.1936

25	30	35	40% $Co(NO_3)_2$.
1.2538	1.3190	1.3896	1.4662

Sp. gr. of sat. solution = 1.5382.

(Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $Co(NO_3)_2$+Aq at room temp. containing:

8.28	15.96	24.528% $Co(NO_3)_2$.
1.0732	1.1436	1.2288

(Wagner, W. Ann. 1883, **18.** 268.)

Sp. gr. of $Co(NO_3)_2$+Aq at 25°.

Concentration of $Co(NO_3)_2$+Aq.	Sp. gr.
1–normal	1.0728
1/2– "	1.0369
1/4– "	1.0184
1/8– "	1.0094

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

Sp. gr. at 20° of $Co(NO_3)_2$+Aq containing M g. mols. $Co(NO_3)_2$ per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001496	1.003863	1.007579	1.011289
M	0.10	0.25	0.5	0.75
Sp. gr.	1.015084	1.03737	1.07415	1.11204
M	1.0	1.5	2.0	
Sp. gr.	1.14612	1.21720	1.28576	

(Jones and Pearce, Am. Ch. J. 1907, **38.** 715.)

Sol. in liquid NH_3. (Guntz, Bull. Soc. 1909 (4) **5.** 1009.)

100 g. sat. solution in glycol contains 80 g. $Co(NO_3)_2$. (de Coninck, C. C. **1905,** II. 883.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

$+3H_2O$. Solubility in H_2O.

Sat. solution contains at:

55°	62°	70°	84°	91° mpt.
61.74	62.88	64.89	68.84	77.21% $Co(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 408.)

$+6H_2O$. Melts in its crystal H_2O at 56° (Ordway); 38° (Tilden).

Solubility in H_2O.

Sat. solution contains at:

–21°	–10°	–4°	0°
41.55	43.69	44.85	45.66% $Co(NO_3)_2$,

+18°	41°	56° mpt.
49.73	55.96	62.88% $Co(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 408.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Easily sol. in alcohol. Sol. in 1 pt. strong alcohol at 12.5°. (Wenzel.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+9H_2O$. Solubility in H_2O.

Sat. solution contains at:

–26°	–23.5°	–20.5°
39.45	40.40	42.77% $Co(NO_3)_2$.

Cryohydrate is formed at –29°. (Funk, Z. anorg. 1899, **20.** 409.)

Cobaltous didymium nitrate, $3Co(NO_3)_2$, $2Di(NO_3)_3+48H_2O$.

Very deliquescent. (Frerichs and Smith, A. **191.** 331.)

Cobaltous gadolinium nitrate, $3Co(NO_3)_2$, $2Gd(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3 (sp. gr. 1.325) contains 451.4 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Cobaltous lanthanum nitrate, $3Co(NO_3)_2$, $2La(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 109.2 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Cobaltous neodymium nitrate, $3Co(NO_3)_2$, $2Nd(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 151.6 hydrous salt at 16°. (Jantsch.)

Cobaltous praseodymium nitrate, $3Co(NO_3)_2$, $2Pr(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 12.99 g. hydrous salt at 16°. (Jantsch.)

Cobaltous samarium nitrate, $3Co(NO_3)_2$, $2Sm(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 34.27 g. hydrous salt at 16°. (Jantsch.)

Cobaltous thorium nitrate, $CoTh(NO_3)_6+8H_2O$.

Hydroscopic; sol. in HNO_3+Aq. (Meyer, Z. anorg. 1901, **27.** 387.)

Cobaltous nitrate ammonia, $Co(NO_3)_2$, $6NH_3+2H_2O$.

Decomp. by H_2O with separation of basic nitrate. (Fremy.)

Sol. in NH_4OH+Aq. (Hess.)

Cobaltous nitrate cupric oxide, $Co(NO_3)_2$, $3CuO+3H_2O$.

Ppt. (Mailhe, C. R. 1902, **134.** 234.)

Cobaltous nitrate hydrazine, $Co(NO_3)_2$, $3N_2H_4$.

Decomp. by hot H_2O. (Franzen, Z. anorg. 1908, **60.** 274.)

Cupric nitrate, basic, $2CuO$, N_2O_5.

(Ditte, A. ch. 1879, (5) **18.** 339.)

$4CuO$, $N_2O_5+3H_2O$. Insol. in H_2O. Easily sol. in acids. (Graham, A. **29.** 13.)

Insol. in H_2O; easily sol. in acids. (Athanasesco, Bull. Soc. 1895, (3) **11.** 1113.)

$+3\frac{1}{2}H_2O$. Insol. in H_2O, and decomp. by heat. (Casselman, Z. anal. **4.** 24.)

Cupric nitrate, $Cu(NO_3)_2$.

Deliquescent. Very easily sol. in H_2O or alcohol; also in moderately conc. HNO_3+Aq, but is precipitated from conc. aqueous solution by HNO_3+Aq of 1.522 sp. gr. (Mitscherlich, Pogg. **18.** 159.)

Sat. $Cu(NO_3)_2$+Aq contains at:

−10°	−3°	+3°	
38.8	41.6	44.5%	$Cu(NO_3)_2$,
8°	20°	32°	
48.5	54.1	61.2%	$Cu(NO_3)_2$.

(Étard, A. ch. 1894, (7) **2.** 528.)

See +3, 6, and $9H_2O$.

Sp. gr. of $Cu(NO_3)_2$+Aq at 17.5° containing:

5	10	15%	anhydrous salt,
1.0452	1.0942	1.1442	
20	25	30%	anhydrous salt,
1.2036	1.2644	1.3298	
35	40	45%	anhydrous salt.
1.3974	1.4724	1.5576	

(B. Franz, J. pr. (2) **5.** 274.)

Sp. gr. of $Cu(NO_3)_2$+Aq at 15°.

% $Cu(NO_3)_2$	Sp. gr.
5.22	1.046
10.44	1.094
15.67	1.146
20.85	1.202
26.12	1.262
35.00	1.377

(Long, W. Ann. 1880, **11.** 39.)

Sp. gr. of $Cu(NO_3)_2$+Aq at room temp. containing:

18.99	26.68	46.71%	$Cu(NO_3)_2$.
1.1774	1.2637	1.5363	

(Wagner, W. Ann. 1883, **18.** 272.)

Sp. gr. of $Cu(NO_3)_2$+Aq at 25°.

Concentration of $Cu(NO_3)_2$+Aq	Sp. gr.
1-normal	1.0755
1/2- "	1.0372
1/4- "	1.0185
1/8- "	1.0092

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Sp. gr. of $Cu(NO_3)_2$+Aq at 12.5°.

% $Cu(NO_3)_2$	1	5	10	14
Sp. gr.	1.0059	1.0320	1.0655	1.0916
% $Cu(NO_3)_2$	20	24	30	34
Sp. gr.	1.1350	1.1716	1.2320	1.2712
% $Cu(NO_3)_2$	40	44	50	56
Sp. gr.	1.3320	1.3749	1.4440	1.5205

(Hassenfratz, Muspratt, 1893, **4.** 2243.)

Sp. gr. at 20° of $Cu(NO_3)_2$+Aq containing M g. mols. salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001504	1.004076	1.007859	1.011715
M	0.25	0.50	0.75	0.935
Sp. gr.	1.040290	1.07723	1.11469	1.14262
Sp. gr.	1.5	2.0		
M	1.22618	1.29262		

(Jones and Pearce, Am. Ch. J. 1917, **38.** 719.)

Sat. $Cu(NO_3)_2$+Aq boils at about 173°. (Griffiths.)
Insol. in fuming HNO_3. (Ditte, A. ch. 1879 (5) **18.** 339.)

Solubility of $Cu(NO_3)_2+Pb(NO_3)_2$ in H_2O at 20°.

Sp. gr.	In 1 l. of solution				Solid phase
	$Cu(NO_3)_2$		$Pb(NO_3)_2$		
	g.	g. mol.	g.	g. mol	
1.354	70.5	0.375	359.5	1.086	$Pb(NO_3)_2$
1.322	139.2	0.742	257.2	0.777	"
1.321	226.5	1.207	175.1	0.529	"
1.343	301.8	1.608	133.4	0.403	"
1.360	341.8	1.821	117.8	0.356	"
1.451	519.4	2.767	70.5	0.213	"
1.546	681.7	3.632	44.0	0.133	"
1.622	798.1	4.252	28.1	0.085	"
1.700	943.2	5.028	17.2	0.052	$Pb(NO_3)_2$+ $Cu(NO_3)_2.6H_2O$

(Fedotieff, Z. anorg. 1911, **73.** 178.)

Very sol. in liquid NH_3 (Guntz, Bull. Soc. 1909, (4) **5.** 1007.)
Easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Insol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
$+3H_2O$. Melts in crystal H_2O at 114.5°. (Ordway; Tilden, Chem. Soc. **45.** 409.)
Solubility in H_2O.
Sat. solution contains at:

25°	30°	40°	50°
60.01	60.44	61.51	62.62% $Cu(NO_3)_2$,
60°	70°	80°	114.5° Mpt.
64.17	65.79	67.51	77.59% $Cu(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 413.)

100 pts. HNO_3 dissolve 2 pts. at 13°, considerably more on heating. (Ditte, A. ch. 1879, (5) **18.** 339.)
Sol. in 1 pt. strong alcohol at 12.5°. (Wenzel.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
$+6H_2O$. Efflorescent. Melts in crystal H_2O at 38°. (Ordway.)
Solubility in H_2O.
Sat. solution contains at:

—21°	—10°	0°	+10°
39.52	42.0[illegible]	45.00	48.79% $Cu(NO_3)_2$,
18°	20°	26.4° mpt.	
53.86	55.58	63.39% $Cu(NO_3)_2$.	

(Funk, Z. anorg. 1899, **20.** 413.)

Sat. solution of $Cu(NO_3)_2+6H_2O$ in H_2O at 20° contains 5.04 g. mol. per l. Sp. gr. of sat. solution = 1.688. (Fedotieff, Z. anorg. 1911, **73.** 78.)
Sat. solution of $Cu(NO_3)_2+6H_2O$ in H_2O contains 45.0 g. $Cu(NO_3)_2$ in 100 g. solution at 0°; 53.9 g. at 18°. (Mylius, Z. anorg. 1912, **74.** 411.)
$+9H_2O$.
Solubility in H_2O.
Sat. solution contains at:

—23°	—21°	—20°
36.08	37.38	40.92% $Cu(NO_3)_2$.

Cryohydrate is formed at —24°. (Funk, Z. anorg. 1899, **20.** 414.

Cupric nitrate ammonia (**Cuprammonium nitrate**), $Cu(NO_3)_2, 4NH_3$.
Easily sol. in H_2O, from which it can be recrystallized. Sol. in alcohol. (Berzelius.)
Sol. in 1 pt. liquid NH_3. (Horn, Am. Ch. J. 1908, **39.** 216.)
$Cu(NO_3)_2, 5NH_3$. (Horn, Am. Ch. J. 1907, **37.** 620.)
$4Cu(NO_3)_2, 23NH_3$. (Horn.)

Cupric nitrate hydrazine, $Cu(NO_3)_2, N_2H_4$.
Decomp. by H_2O. (Hofmann and Marburg, A. 1899, **305.** 221.)

Cupric nitrate mercuric oxide, $Cu(NO_3)_2, HgO+3H_2O$.
Sol. in HCl, HNO_3 and H_2SO_4. (Finzi, Gazz. ch. it. 1913, **43.** (2) 709.)

Didymium nitrate, basic, $4Di_2O_3, 3N_2O_5+15H_2O$.
Insol. in H_2O. (Marignac.)
$2Di_2O_3, 3N_2O_5$. (Becquerel, A. ch. (6) **14.** 257.)

Didymium nitrate, $Di(NO_3)_3$.
Anhydrous. Very sol. in H_2O. As sol. in 96% alcohol as in H_2O, and the solution is not precipitated by much ether. Insol. in pure ether. (Marignac, A. ch. (3) **36.** 161.)
Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)
$+6H_2O$. Very deliquescent. (Cleve, Bull. Soc. (2) **43.** 361.)

Didymium nickel nitrate, $2Di(NO_3)_3$, $3Ni(NO_3)_2+36H_2O$.

Very deliquescent. (Frerichs and Smith, A. **191.** 355.)

See **Neodymium** and **praseodymium.**

Didymium zinc nitrate, $2Di(NO_3)_3$, $3Zn(NO_3)_2+69H_2O$.

Very deliquescent. (F. and S.)

See **Neodymium** and **praseodymium.**

Dysprosium nitrate, $Dy(NO_3)+5H_2O$.

Very sol. in H_2O; less sol. in H_2O+HNO_3. Sol. in alcohol. (Urbain, C. R. 1908, **146.** 129.)

Erbium nitrate, basic, $2Er_2O_3$, $3N_2O_5+9H_2O$.

Decomp. by H_2O. Sl. sol. in HNO_3. (Bahr and Bunsen.)

$3Er_2O_3$, $4N_2O_5+20H_2O$. (Cleve, Bull. Soc. (2) **21.** 344.)

Erbium nitrate, $Er(NO_3)_3+6H_2O$.

Easily sol. in H_2O, alcohol, and ether. (Höglund.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Gadolinium nitrate, $Gd(NO_3)_3+6\frac{1}{2}H_2O$.

Sol. in H_2O. (Benedicks, Z. anorg. 1900, **22.** 406.)

$+5H_2O$. Sol. in HNO_3. (B.)

Gadolinium magnesium nitrate, $2Gd(NO_3)_3$, $3Mg(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 352.3 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Gadolinium nickel nitrate, $2Gd(NO_3)_3$, $3Ni(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 400.8 g. hydrous salt at 16°. (Jantsch.)

Gadolinium zinc nitrate, $2Gd(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 472.7 g. hydrous salt at 16°. (Jantsch.)

Gallium nitrate, $Ga(NO_3)_3$.

Very deliquescent, and sol. in H_2O. (Dupré.)

Glucinum nitrate, basic, $2GlO$, $N_2O_5+3H_2O$ (?).

Sol. in H_2O.

$3GlO$, N_2O_5. Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 205.)

Compounds more basic than this are insol. in H_2O. (Ordway.)

Glucinum nitrate, $Gl(NO_3)_2+3H_2O$.

Very deliquescent. (Joy, Sill. Am. J. (2) **36.** 90.)

Easily sol. in H_2O and alcohol. (Vauquelin.)

Melts in its crystal H_2O at 29.4°. (Ordway.)

Sat. $Gl(NO_3)_2$+Aq boils at 140.5°. (Ordway.)

Gold (auric) nitrate, basic, Au_2O_3, $N_2O_5+\frac{2}{5}H_2O$, or **Auryl nitrate,** $(AuO)NO_3+\frac{1}{5}H_2O$.

(Schottländer, A. **217.** 364.)

$2Au_2O_3$, $N_2O_5+2H_2O=Au_4O_5(NO_3)_2+2H_2O$. Slowly sol. in HNO_3+Aq at 100°. (Schottländer, A. **217.** 356.)

Gold (auric) nitrate, $Au(NO_3)_3+xH_2O$.

Decomp. by H_2O. Sol. in acetone. (Hanriot and Raoult, C. R. 1912, **155.** 1086.)

Gold (auric) hydrogen nitrate, $Au(NO_3)_3$, HNO_3+3H_2O.

Decomp. by H_2O. Sol. in HNO_3+Aq. (Schottländer, A. **217.** 356.)

Gold (auric) potassium nitrate, $KAu(NO_3)_4$.

Easily sol. in H_2O.

$HK_2Au(NO_3)_6$. Decomp. immediately by H_2O.

$2KAu(NO_3)_4$, $K_2HAu(NO_3)_6$. (Schottländer, J. B. **1884.** 453.)

Gold (auric) rubidium nitrate, $RbAu(NO_3)_4$.

Easily sol. in H_2O.

$HRb_2Au(NO_3)_6$. As above. (Schottländer.)

Gold (auric) thallium nitrate, $TlAu(NO_3)_4$.

Easily sol. in H_2O.

$6Au_2O_3$, $2Tl_2O_3$, $3N_2O_5+15H_2O$. Ppt. (Schottländer.)

Indium nitrate, $In(NO_3)_3+4\frac{1}{2}H_2O$.

Very deliquescent. Easily sol. in H_2O and absolute alcohol. (Winkler.)

$+1\frac{1}{2}H_2O$.

Iron (ferrous) nitrate, $Fe(NO_3)_2+6H_2O$.

100 pts. of crystals dissolve in 50 pts. H_2O at 0°, sp. gr. of solution = 1.44; 40.8 pts. H_2O at 15°, sp. gr. of solution = 1.48; 33.3 pts. H_2O at 25°, sp. gr. of solution = 1.50. (Ordway, Sill. Am. J. (2) **40.** 325.)

Sat. solution contains at:

−9°	0°	+18°	24°	60.5° Mpt.	
39.68	41.53	45.14	46.51	62.50%	$Fe(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 406.)

Sat. solution of $Fe(NO_3)_2+6H_2O$ in H_2O contains 41.5% $Fe(NO_3)_2$ at 0°; 45.1% at 18°. (Mylius, Z. anorg. 1912, **74.** 411.)

$+9H_2O$. Solubility in H_2O.

Sat. solution contains at:

—27°	—21.5°	—19°	—15.5°	
35.66	36.10	36.56	37.17%	$Fe(NO_3)_2$.

Cryohydrate is formed at —28°. (Funk, Z. anorg. 1899, **20.** 407.)

$Fe(NO_3)_2$+Aq decomposes on heating; less rapidly when dil., more readily in presence of excess of acid. (Ordway.)

Iron (ferric) nitrate, basic, $36Fe_2O_3$, N_2O_5+ $48H_2O$ (?).

Easily sol. in H_2O. Sl. sol. in dil. HNO_3+Aq; very sl. sol. in alcohol. (Hausmann, A. **89.** 111.)

$8Fe_2O_3$, $N_2O_5+12H_2O$. Sl. sol. in H_2O; very sl. sol. in cold or warm dil. HNO_3+Aq; more easily sol. in hot HCl+Aq. (Hausmann.)

$+xH_2O$. Sol. in H_2O; completely pptd. from aqueous solution by NaCl, NH_4Cl, KI, $KClO_3$, Na_2SO_4, $CaSO_4$, $ZnSO_4$, $CuSO_4$, KNO_3 $NaNO_3$, $Ba(C_2H_3O_2)_2$, or $Zn(C_2H_3O_2)_2$+Aq. More slowly pptd. by NH_4NO_3, $Mg(NO_3)_2$, $Ba(NO_3)_2$, or $Pb(NO_3)_2$+Aq. Not pptd. by alcohol, $Pb(C_2H_3O_2)_2$, $Cu(C_2H_3O_2)_2$, $Hg(CN)_2$, $AgNO_3$, or As_2O_3+Aq. (Ordway, Sill. Am. J. (2) **9.** 30.)

$4Fe_2O_3$, $N_2O_5+1\frac{1}{2}H_2O$. Easily sol. in H_2O; sl. sol. in dil. HNO_3+Aq, and in alcohol. (Hausmann.)

$+3H_2O$. Insol. in H_2O or HNO_3+Aq; sol. in HCl+Aq. (Scheurer-Kestner, C. R. **87.** 927.)

$+9H_2O$. Not deliquescent; easily sol. in H_2O. (Ordway.)

$3Fe_2O_3$, $N_2O_5+2H_2O$. Insol. in H_2O. (Scheurer-Kestner.)

$2Fe_2O_3$, $N_2O_5+H_2O$. Decomp. by H_2O. (Scheurer-Kestner.)

$+8H_2O$. (S.-K.)

Fe_2O_3, N_2O_5. Decomp. by H_2O. (S.-K.)

Fe_2O_3, $2N_2O_5$. Sol. in H_2O or alcohol in all proportions. Insol. in HNO_3+Aq.

N_2O_5 with 1, 2, 3, 4, 5, 6, and $8Fe_2O_3$ forms compounds, sol. in H_2O. (Ordway.)

Solubility determinations show that there are no definite basic nitrates of iron formed from solutions at 25°, and that the solid phase under these conditions is a solid solution of Fe_2O_3, HNO_3 and H_2O. The normal salt, Fe_2O_3, $3N_2O_5$, $18H_2O$ is stable in solutions containing about 30–45% N_2O_5. In higher concentrations of nitric acid it appears to be metastable and a new salt, Fe_2O_3, $4N_2O_5$, 18(?)H_2O is the stable form. (Cameron, J. phys. Chem. 1909, **13.** 252.)

Iron (ferric) nitrate, $Fe(NO_3)_3$.

$+H_2O$. (Scheurer-Kestner, A. ch. (3) **65.** 113.)

$+6H_2O$. Deliquescent, and sol. in any amount of H_2O. (Schönbein, Pogg. **39.** 141.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+9H_2O$. Deliquescent. Sol. in H_2O and alcohol. Sl. sol. in HNO_3+Aq. 2 pts. salt with 1 pt. H_2O lower the temperature 18.5°. (Scheurer-Kestner.)

Sp. gr. of solution at 17.5° containing:

5	10	15	20	25%	$Fe(NO_3)_3$,
1.0398	1.0770	1.1182	1.1612	1.2110	
30	35	40	45	50%	$Fe(NO_3)_3$,
1.2622	1.3164	1.3746	1.4338	1.4972	
55	60	65%	$Fe(NO_3)_3$.		
1.5722	1.6572	1.7532			

(Franz, J. pr. (2) **5.** 274.)

Nearly insol. in conc. HNO_3+Aq at temp. below 15.5°.

Easily sol. in alcohol.

Melts in crystal H_2O at 47.2°. (Ordway.)

Sat. $Fe(NO_3)_3$+Aq boils at 125°. (Ordway.)

Lanthanum nitrate, $La(NO_3)_3+6H_2O$.

Very deliquescent; easily sol. in H_2O and alcohol. (Mosander.) Melts in its crystal H_2O at 40°; boils at 124.5°. (Ordway.)

$La(NO_3)_3$+Aq sat. at 25% contains 60.17% $La(NO_3)_3$, or 100 g. H_2O dissolve 151.1 g. $La(NO_3)_3$ at 25°. (James and Whittemore, J. Am. Chem. Soc. 1912, **34.** 1169.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328; Eidmann, C. C. **1899,** II. 1014.)

Lanthanum magnesium nitrate, $2La(NO_3)_3$, $3Mg(NO_3)_2+24H_2O$.

Deliquescent in moist air. (Holzmann, J. pr. **75.** 350.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Lanthanum manganous nitrate, $2La(NO_3)_3$, $3Mn(NO_3)_2+24H_2O$.

Sol. in H_2O. (Damour and Deville.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)

Lanthanum nickel nitrate, $2La(NO_3)_3$, $3Ni(NO_3)_2+36H_2O$.

Very sol. in H_2O. (Frerichs and Smith, A. **191.** 355.)

$+24H_2O$. 1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch.)

Lanthanum rubidium hydrogen nitrate, $[La(NO_3)_4]Rb$, HNO_3+6H_2O.

Sol. in H_2O and HNO_3. (Jantsch, Z. anorg. 1911, **69.** 225.)

Lanthanum thallous nitrate, $[La(NO_3)_5]Tl_2$+ $4H_2O$.

Hydroscopic. (Jantsch, Z. anorg. 1911, **69.** 228.)

Lanthanum zinc nitrate, $2La(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

Very sol. in H_2O. (Damour and Deville, J. B. **1858.** 135.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 124.1 g. hydrous salt at 16° (Jantsch, Z. anorg. 1912, **76.** 321.)

$+69H_2O$. (Frerichs and Smith, A. **191.** 355.)

Lead nitrate, basic, $2PbO$, $N_2O_5+H_2O=Pb(OH)NO_3$.

Sol. in 5.15 pts. H_2O at 19.2°. (Pohl, W. A. B. **6.** 597.) Very sl. sol. in cold, much more in hot H_2O. (Berzelius.) Sol. in $Pb(C_2H_3O_2)_2$+Aq. (Guignet, C. R. **56.** 358.)

Insol. in H_2O; sol. in acids. (Athanesco, Bull. Soc. 1895, (3) **13.** 178.)

$+2H_2O$. (André, C. R. **100.** 639.)

$3PbO, N_2O_5+1\frac{1}{2}H_2O$. Sl. sol. in pure H_2O. Insol. in H_2O containing HCl. (Berzelius.)

$+3H_2O$. Sol. in 119.2 pts. cold, and 10.5 pts. boiling H_2O. Sol. in $Pb(C_2H_3O_2)_2$+Aq, but sl. sol. in KNO_3+Aq. (Vogel, jr. A. **94.** 97.)

$=10PbO, 3N_2O_5+5H_2O$. (Wakemann and Wells, Am. Ch. J. **9.** 299.)

$+4H_2O$. (André, C. R. **100.** 639.)

$6PbO, N_2O_5+H_2O$. Nearly insol. in H_2O. (Löwe, J. pr. **98.** 385.)

$10PbO, 3N_2O_5+4H_2O$. Less sol. in H_2O than $Pb(NO_3)OH$, and not decomp. by boiling H_2O. (Wakemann and Wells, Am. Ch. J. **9.** 299.)

Lead nitrate, $Pb(NO_3)_2$.

Sol. in H_2O with absorption of much heat. (Rose.)

1 pt. $Pb(NO_3)_2$ dissolves in 7½ pts. cold H_2O. (Mitscherlich.)

1 pt. $Pb(NO_3)_2$ dissolves in 1.989 pts. H_2O at 17.5° and forms a liquid of 1.3978 sp. gr. (Karsten.)

1 pt. $Pb(NO_3)_2$ dissolves in 1.707 pts. H_2O at 22.3°; in 1.585 pts. H_2O at 24.7°. (Kopp.)

Sol. in 1.87 pts. H_2O at 17.5°. (Schiff, A. **109.** 326.)

100 pts. $Pb(NO_3)_2$+Aq sat. at 102.2° contain 52.5 pts. $Pb(NO_3)_2$, or 100 pt. H_2O dissolve 110.526 pts. $Pb(NO_3)_2$ at 102.2°. (Griffiths.)

Sol. in 7.5 pts. cold H_2O and much less hot H_2O. (Wittstein.)

100 pts. boiling H_2O dissolve 13 pts. $Pb(NO_3)_2$. (Ure's Dict.)

100 pts. $Pb(NO_3)_2$+Aq sat. at 19–20° contain 35.80 pts. salt. (v. Hauer, W. A. B. **53, 2.** 221.)

1 pt. dissolves:

at	0°	10°	25°	45°	65°	85°	100°	
in	2.58	2.07	1.65	1.25	0.99	0.83	0.72	pts. H_2O.

(Kremers, Pogg. **92.** 497.)

1 l. $Pb(NO_3)_2$+Aq sat. at 15° contains 461.49 g. $Pb(NO_3)_2$ and 928.58 g. H_2O, and has sp. gr. 1.39. (Michel and Krafft, A. ch. (3) **41.** 471.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Pb(NO_3)_2$	t°	Pts. $Pb(NO_3)_2$	t°	Pts. $Pb(NO_3)_2$
0	36.5	36	65.9	72	99.7
1	37.4	37	66.7	73	100.7
2	38.3	38	67.6	74	101.7
3	39.[illegible]	39	68.5	75	102.6
4	39.8	40	69.4	76	103.6
5	40.5	41	70.3	77	104.6
6	41.2	42	71.2	78	105.6
7	42.0	43	72.1	79	106.6
8	42.8	44	73.0	80	107.6
9	43.6	45	74.0	81	108.6
10	44.4	46	74.9	82	109.6
11	45.2	47	75.9	83	110.6
12	46.0	48	76.8	84	111.5
13	46.8	49	77.7	85	112.5
14	47.5	50	78.7	86	113.5
15	48.3	51	79.6	87	114.5
16	49.1	52	80.5	88	115.4
17	49.9	53	81.5	89	116.4
18	50.7	54	82.4	90	117.4
19	51.5	55	83.3	91	118.4
20	52.3	56	84.3	92	119.4
21	53.1	57	85.2	93	120.3
22	53.9	58	86.1	94	121.3
23	54.7	59	87.1	95	122.3
24	55.6	60	88.0	96	123.2
25	56.4	61	89.0	97	124.2
26	57.3	62	90.0	98	125.2
27	58.1	63	90.9	99	126.1
28	59.0	64	91.9	100	127.0
29	59.8	65	92.8	101	128.0
30	60.7	66	93.8	102	128.9
31	61.6	67	94.8	103	129.9
32	62.4	68	95.7	104	130.9
33	63.3	69	96.7	104.7	131.5
34	64.1	70	97.7	...	...
35	65.0	71	98.7	...	...

(Mulder, Scheik. Verhandel. **1864.** 66.).

100 g. H_2O dissolve 52.76 g. $Pb(NO_3)_2$ at 17°. (Euler, Z. phys. Ch. 1904, **49.** 315.)

Solubility of $Pb(NO_3)_2$ in H_2O at 20° = 1.52 g. mol. per l. Sp. gr. of sat. solution = 1.419. (Fedotieff, Z. anorg. 1911, **73.** 178.)

Sat. $Pb(NO_3)_2$+Aq at 0° contains 26.7% $Pb(NO_3)_2$; at 18°, 29.1% $Pb(NO_3)_2$. (Mylius, Z. anorg. 1912, **74.** 411.)

Sp. gr. of $Pb(NO_3)_2$+Aq at 19.5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
5	1.045	25	1.266
10	1.093	30	1.334
15	1.144	35	1.414
20	1.203	..	...

(Kremers, calculated by Gerlach, Z. anal. **8** 286.)

Sp. gr. of $Pb(NO_3)_2$+Aq at 17.5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
5	1.044	25	1.263
10	1.092	30	1.333
15	1.144	35	1.409
20	1.200	sat. sol.	1.433

(Gerlach, Z. anal. **27.** 283.)

Sp. gr. of $Pb(NO_3)_2$+Aq sat. at 8° = 1.372. (Anthon.)

Sp. gr. of $Pb(NO_3)_2$+Aq at 17.5°.

% $Pb(NO_3)_2$	Sp. gr.	% $Pb(NO_3)_2$	Sp. gr.
1	1.0080	20	1.1902
2	1.0163	21	1.2016
3	1.0247	22	1.2132
4	1.0331	23	1.2251
5	1.0416	24	1.2372
6	1.0502	25	1.2495
7	1.0591	26	1.2620
8	1.0682	27	1.2747
9	1.0775	28	1.2876
10	1.0869	29	1.3907
11	1.0963	30	1.3140
12	1.1059	31	1.3276
13	1.1157	32	1.3416
14	1.1257	33	1.3558
15	1.1359	34	1.3702
16	1.1463	35	1.3848
17	1.1569	36	1.3996
18	1.1677	37	1.4146
19	1.1788	..	...

(Schiff, calculated by Gerlach, Z. anal. **8.** 286.)

Sp. gr. of $Pb(NO_3)_2$+Aq at t°.

t°	% $Pb(NO_3)_2$	Sp. gr.
14	5	1.0451
14	10	1.0939
14.5	15	1.1468
14.3	20	1.2045
15	25	1.2678
15	32.28	1.3716

(Long, W. Ann. 1880, **11.** 40.)

Sp. gr. of $Pb(NO_3)_2$+Aq at room temp. containing:

17.93   32.22% $Pb(NO_3)_2$.
1.1786   1.3619

(Wagner, W. Ann. 1883, **18.** 267.)

Sp. gr. of $Pb(NO_3)_2$+Aq at 25°.

Concentration of $Pb(NO_3)_2$+Aq	Sp. gr.
1-normal	1.1380
1/2- "	1.0699
1/4- "	1.0351
1/8- "	1.0175

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

$Pb(NO_3)_2$+Aq containing 15.93% $Pb(NO_3)_2$ has sp. gr. 20/°20° = 1.1558.
$Pb(NO_3)_2$+Aq containing 30.57% $Pb(NO_3)_2$ has sp. gr. 20°/20° = 1.3436.
$Pb(NO_3)_2$+Aq containing 30.69% $Pb(NO_3)_2$ has sp. gr. 20°/20° = 1.3465.
(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sat. $Pb(NO_3)_2$+Aq boils at 103.5°. (Kremers.)

Sat. $Pb(NO_3)_2$+Aq boils at 102.2°, and contains 140 pts. $Pb(NO_3)_2$ to 100 pts. H_2O. (Griffiths.)

Sat. $Pb(NO_3)_2$+Aq boils at 103.5°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $Pb(NO_3)_2$+Aq containing pts. $Pb(NO_3)_2$ to 100 pts. H_2O, according to Gerlach (Z. anal. **26.** 449).

B.-pt.	Pts. $Pb(NO_3)_2$	B.-pt.	Pts. $Pb(NO_3)_2$
100.5°	11	102.5°	87
101	26	103	111
101.5	44	103.5	137
102	65	...	...

Insol. in conc. HNO_3+Aq.

Solubility of $Pb(NO_3)_2$+$Ba(NO_3)_2$. *See under* $Ba(NO_3)_2$.

Solubility of $Pb(NO_3)_2$+$Cu(NO_3)_2$. *See under* $Cu(NO_3)_2$.

Sol. in sat. KNO_3+Aq without pptn., 100 pts. H_2O at 18.75° dissolving 114 pts. mixed salt, viz. 84.1 pts. $Pb(NO_3)_2$ and 29.9 pts. KNO_3. (Karsten.)

100 pts. H_2O dissolve 119.6 pts. $Pb(NO_3)_2$ and 67.1 pts. KNO_3 at 21.2°. (Rüdorff, B. **6.** 484.)

100 g. H_2O dissolve 95.39 g. $Pb(NO_3)_2$ and 61.05 g. KNO_3 at 20°. (Le Blanc and Noyes. Z. phys. Ch. 1890, **6.** 386.)

Sol. in sat. $NaNO_3$+Aq without pptn., 100 pts. H_2O at 18.75° dissolving 121.9 pts. mixed salt, viz. 87.8 pts. $Pb(NO_3)_2$ and 34.1 pts. $NaNO_3$. (Karsten.)

Solubility of $Pb(NO_3)_2$+$NaNO_3$.

Solid phase = $Pb(NO_3)_2$.

t° of saturation	% $NaNO_3$	% $Pb(NO_3)_2$
32	34.42	19.69
35.5	34.15	20.33
39.5	33.71	21.35
44.	33.35	22.19
49.1	32.94	23.15
55	32.60	23.93
58	32.47	24.24
62	32.33	24.57
65	32.14	24.89

Solubility of $Pb(NO_3)_2+NaNO_3$—*Continued.*

Solid phase = $NaNO_3$		
t° of saturation	% $NaNO_3$	% $Pb(NO_3)_2$
21	40.97	13.62
26.5	42.04	13.38
31	43.18	12.88
38.8	44.63	12.78
41	45.11	12.94
44.25	46.03	12.45
51	47.28	12.50
58	49.03	11.76
64	49.92	11.56

(Isaac, Chem. Soc. 1908, **93.** 398.)

Also sol. in KNO_3+NaNO_3+Aq

100 pts. sat. $Pb(NO_3)_2+Sr(NO_3)_2+Aq$ contain 45.98 pts. of the two salts at 19.20°. (v. Hauer, J. pr. **98.** 137.)

Solubility of $Pb(NO_3)_2+Sr(NO_3)_2$ at 25°.

G. per 100 cc.		Mol per cent in solid phase	
$Pb(NO_3)_2$	$Sr(NO_3)_2$	$Pb(NO_3)_2$	$Sr(NO_3)_2$
46.31	0	100.	0
50.47	4.56	99.05	0.95
53.92	8.14	98.11	1.89
45.34	17.81	97.02	2.98
44.48	18.74	96.06	3.94
25.23	35.03	83.84	16.16
19.13	37.54	32.88	67.12
0	71.04	0	100.

(Fock, Z. Kryst. Min. 1897, **28.** 365.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

100 pts. alcohol of 0.9282 sp. gr. dissolve:

at 4°	8°	22°	40°	50°	
4.96	5.82	8.77	12.8	14.9	pts. $Pb(NO_3)_2$.

(Gerardin, A. ch. (4), **5.** 129.)

100 pts. absolute methyl alcohol dissolve 1.37 pts. at 20.5°.

100 pts. absolute ethyl alcohol dissolve 0.04 pt. at 20.5°. (de Bruyn. Z. phys. Ch. **10.** 783.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in cold, sl. sol. in hot CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 21.)

Solubility of $Pb(NO_3)_2$ in pyridine at t°.

t°	G $Pb(NO_3)_2$ per 100 g. C_5H_5N	Solid phase
−19.4	2.93	$Pb(NO_3)_2, 4C_5H_5N$
−14.5	2.14	"
−10	1.90	"
0	3.54	"
5.4	3.93	"
8.7	5.39	"
14.72	6.13	"
19.97	6.78	"
24.75	8.56	"
30.03	10.98	"
34.9	13.20	"
40.03	16.94	"
45.	22.03	"
49.97	29.37	"
51 tr. pt.	....	" $+Pb(NO_3)_2, 3C_5H_5N$
59.52	36.70	$Pb(NO_3)_2, 3C_5H_5N$
70	47.29	"
80	61.60	"
89.93	90.21	"
94.94	128.06	"
96 tr. pt.	....	" $+Pb(NO_3)_2, 2C_5H_5N$
99.89	143.36	$Pb(NO_3)_2, 2C_5H_5N$
104.90	152	"
109.90	163.80	"

(Walton and Judd, J. Am. Chem. Soc. 1911, **33.** 1036.)

Lead mercurous nitrate, $2PbO, 2Hg_2O, 3N_2O_5$.

Decomp. by H_2O. Sol. in warm dil. HNO_3, or $Hg_2(NO_3)_2+Aq$ without decomp. (Städeler, A. **87.** 129.)

Lead silver nitrate, $Pb(NO_3)_2, 2AgNO_3$.

Sol. in H_2O. (Stürenberg, Pogg. **74.** 115.)

Lead silver nitrate iodide, $Pb(NO_3)_2, 8AgNO_3, 4AgI$.

Decomp. by H_2O. (Stürenberg.)

$Pb(NO_3)_2, 2AgNO_3, 2AgI$. Decomp. by H_2O. (Stürenberg.)

Lead nitrate nitrite, basic, $4PbO, N_2O_5, N_2O_3 +2H_2O = Pb(OH)NO_3, Pb(OH)NO_2$.

Sl. sol. in cold, easily in hot H_2O. Sol. in 80 pts. H_2O at 23° (Chevreuil); 85 pts. at ord. temp. (Bromeis, A. **72.** 38); 10.6 pts. at 100° (Chevreuil).

$+2H_2O$.

Solubility in acetic acid.

Normality of acid	g. PbO per 100 cc. sat. solution	Normality of acid	g. PbO per 100 cc. sat. solution
0	0.601	0.25	5.450
0.05	1.323	0.50	9.690
0.10	2.185	0.75	15.874

(Chilesotti, Att. Acad. Linc. 1908, (5) **17, II.** 475.)

Formula is $3Pb(OH)NO_3$, $5Pb(OH)NO_2+H_2O$. (v. Lorenz, W. A. B. **84, 2.** 1133.)

$+3H_2O$. (v. Lorenz.)

$4PbO$, N_2O_5, $3N_2O_3+4H_2O$. Sol. in H_2O. (Bromeis.)

$6PbO$, N_2O_5, $2N_2O_3+3^2/_3H_2O=Pb(OH)NO_3$, $2Pb(OH)NO_2+^2/_3H_2O$. (v. Lorenz.)

$6PbO$, $2N_2O_5$, $N_2O_3+3^2/_3H_2O=2Pb(OH)NO_3$, $Pb(OH)NO_2+^1/_3H_2O$. (v. Lorenz.)

$7PbO$, N_2O_3, $N_2O_5+3H_2O$. Less sol. in H_2O than $4PbO$, N_2O_5, $N_2O_3+2H_2O$; sol. in cold conc. HNO_3+Aq. (Peligot, A. **39.** 338.)

$8PbO$, N_2O_5, $3N_2O_3+4^2/_3H_2O=Pb(OH)NO_3$, $3Pb(OH)NO_2+^1/_3H_2O$. (v. Lorenz.)

$10PbO$, N_2O_5, $4N_2O_3+5H_2O=Pb(OH)NO_3$, $4Pb(OH)NO_2$. (v. Lorenz.)

$12PbO$, N_2O_5, $5N_2O_3+6H_2O=Pb(OH)NO_3$, $5Pb(OH)NO_2$. (v. Lorenz.)

$10PbO$, N_2O_5, $2N_2O_3+4H_2O=Pb(OH)NO_3$, $2Pb(OH)NO_2$, $2PbO+\frac{1}{2}H_2O$. (v. Lorenz.)

$14PbO$, N_2O_5, $3N_2O_3+6H_2O=Pb(OH)NO_3$, $3Pb(OH)NO_2$, $3PbO+H_2O$. (Bromeis.)

$14PbO$, $3N_2O_5$, $N_2O_3+6H_2O=3Pb(OH)NO_3$, $Pb(OH)NO_2$, $3PbO+H_2O$. (Bromeis.)

$16PbO$, $2N_2O_5$, $3N_2O_3+6H_2O=4Pb(OH)NO_3$, $6Pb(OH)NO_2$, $5PbO$, $Pb(OH)_2$ (v. Lorenz.)

$16PbO$, $3N_2O_5$, $5N_2O_3+10H_2O=3Pb(OH)NO_3$, $5Pb(OH)NO_2+H_2O$. (v. Lorenz.)

$26PbO$, $6N_2O_5$, $7N_2O_3+21H_2O=6Pb(OH)NO_3$, $7Pb(OH)NO_2+4H_2O$. (v. Lorenz.)

Lead nitrate phosphate, $Pb(NO_3)_2$, $Pb_3(PO_4)_2+2H_2O$.

Completely insol. in cold H_2O. Decomp. by boiling H_2O into its constituents. Sol. in a little conc. HNO_3+Aq without decomp. (Gerhardt, A. **72.** 83.)

Lead nitrate phosphite, $Pb(NO_3)_2$, $PbHPO_3$.

Decomp. by H_2O. Sol. in $Pb(NO_3)_2$+Aq. $Pb(NO_3)_2$+Aq (33.3 g. per litre) dissolves 1 g. salt at 15°. If less than 31 g. per litre of $Pb(NO_3)_2$ are present the salt is decomp. (Amat, A. ch. (6) **24.** 317.)

Lead nitrate potassium nitrite, $Pb(NO_3)_2$, $2KNO_2+H_2O$.

Difficultly sol. in H_2O. (Lang, J. B. **1862.** 102.)

$3PbO$, $3K_2O$, $4N_2O_3$, $2N_2O_5+3H_2O$. Sol. in H_2O. (Hayes, Sill. Am. J. (2) **31.** 226.)

Lithium nitrate, $LiNO_3$.

Very deliquescent, and sol. in H_2O.

100 pts. H_2O dissolve:

at 0°	20°	40°	70°	100°	110°	
48.3	75.7	169.4	196.1	227.3	256.4	pts. $LiNO_3$.

(Kremers, Pogg. **99.** 47.)

Forms supersaturated solutions with ease, which crystallize when temp. is lowered to +1°. (Kremers, Pogg. **92.** 520.)

Sat. solution boils at over 200°. (Kremers, Pogg. **99.** 43.)

1 pt. $LiNO_3$ dissolves in 200 pts. HNO_3. (Schultz, Zeit. Ch. (2) **5.** 531.)

100 pts. of the sat. solution contain at:

64.2°	70.9°	
64.9	66.1	pts. anhydrous salt.

(Donnan and Burt, Chem. Soc. 1903, **83.** 339.)

See $+\frac{1}{2}H_2O$, and $3H_2O$.

Sp. gr. of $LiNO_3$+Aq at 19.5° containing pts. $LiNO_3$ in 100 pts. H_2O:

12.7	14.2	26.4	41.8 pts. $LiNO_3$,
1.069	1.077	1.134	1.197
54.8	57.5	77.4	79.4 pts. $LiNO_3$.
1.245	1.255	1.315	1.319

(Kremers, Pogg. **114.** 45.)

Sp. gr. of $LiNO_3$+Aq.

g. $LiNO_3$ in 1000 g. of solution	Sp. gr. 16/16°
0	1.000000
4.8526	1.002469
10.9128	1.0055495
17.9016	1.009113

(Dijken, Z. phys. Ch. 1897, **24.** 109.)

Sp. gr. 20°/4° of a normal solution of $LiNO_3$ =1.03803; of a 0.5-normal solution =1.01830. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Sol. in strong alcohol.

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Solubility in acetone=0.343 g. mol. per l. at 18°. (Roshdestwensky and McBride, Chem. Soc. 1911, **99.** 2140.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+\frac{1}{2}H_2O$. Solubility in H_2O.

100 pts. of the sat. solution contain at:

43.6°	50.5°	55.0°	60.0°	
60.8	61.3	63.0	63.6	pts. anhydrous salt.

61.1° is the temp. at which $LiNO_3+\frac{1}{2}H_2O$ goes over into $LiNO_3$. (Donnan and Burt, Chem. Soc. 1903, **83.** 339.)

$+3H_2O$.

Solubility in H_2O.

100 pts. of the sat. solution contain pts. anhydrous salt at t°.

t°	Pts. anhydrous salt
0.10	34.8
10.50	37.9
12.10	38.2
13.75	39.3
19.05	40.4
22.10	42.9
27.55	47.3
29.47	53.67
29.78.	55.09
29.87	56.42
29.86	56.68
29.64	57.48
29.55	58.03

Mpt. of $LiNO_3+3H_2O$ is 29.88°.

(Donnan and Burt, Chem. Soc. 1903, **83**. 337.)

Magnesium nitrate, basic, $Mg_3N_2O_8$.

Insol. in H_2O and alcohol. Sol. in acids. (Chodnew, A. **71**. 241.)

$+5H_2O$. Decomp. by H_2O. (Didier, C. R. 1896, **122**. 936.)

Magnesium nitrate, $Mg(NO_3)_2$.

Anhydrous. Deliquescent.

Sol in 1 pt. H_2O at 15.6°. Sol. in 4 pts. abs. alcohol at 15.6°, and 2 pts. at boiling temp. More sol. in alcohol of 0.817 sp. gr than in that of 0.900. (Kirwan.)
Sol. in 0.3458 pt. strong alcohol at 82.5°. (Wenzel.)
Sol. in 10 pts. strong alcohol at 15°. (Bergmann.)
Sol. in 9 pts. strong alcohol on heating. (Bergmann.)

Solubility in H_2O in presence of the anhydrous salt.

Sat. solution contains at:

89°	77.5°	67°
63.14	65.67	67.55% $Mg(NO_3)_2$.

(Funk, Z. anorg. 1899, **20**. 396.)

See +6, and $9H_2O$.

Sp. gr. of $Mg(NO_3)_2$+Aq at 14°.

% $Mg(NO_3)_2$, $6H_2O$	Sp. gr.	% $Mg(NO_3)_2$, $6H_2O$	Sp. gr.
1	1.0034	30	1.1347
5	1.0202	35	1.1649
10	1.0418	40	1.1909
15	1.0639	45	1.2176
20	1.0869	49	1.2397
25	1.1103	..	...

(Oudemans, Z. anal. **7**. 419.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 21°.

% $Mg(NO_3)_2$ $+6H_2O$	Sp. gr.	% $Mg(NO_3)_2$ $+6H_2O$	Sp. gr.
2	1.0078	28	1.1216
4	1.0158	30	1.1312
6	1.0239	32	1.1410
8	1.0321	34	1.1508
10	1.0405	36	1.1608
12	1.0490	38	1.1709
14	1.0577	40	1.1811
16	1.0663	42	1.1914
18	1.0752	44	1.2019
20	1.0843	46	1.2124
22	1.0934	48	1.2231
24	1.1026	50	1.2340
26	1.1120	..	...

(Schiff, calculated by Gerlach, Z. anal. **8**. 286.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 18°.

% $Mg(NO_3)_2$	Sp. gr.	% $Mg(NO_3)_2$	Sp. gr.
5	1 0378	15	1.1181
10	1.0763	17	1.1372

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of $Mg(NO_3)_2$+Aq at room temp. containing:

18.62	34.19	39.77% $Mg(NO_3)_2$.
1.1025	1.2000	1.4298

(Wagner, W. Ann. 1883, **18**. 273.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 25°.

Concentration of $Mg(NO_3)_2$+Aq	Sp. gr.
1–normal	1.0512
1/2– "	1.0259
1/4– "	1.0130
1/8– "	1.0066

(Wagner, Z. phys. Ch. 1890, **5**. 38.)

Sp. gr. of solution sat. at 18° = 1.384, containing 43.1% $Mg(NO_3)_2$. (Mylius, B. 1897, **30**. 1718.)

Sp. gr. of $Mg(NO_3)_2$+Aq.

½ $Mg(NO_3)_2$ g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.8099	1.000660
1.5621	1.001253
3.3398	1.002539
7.4410	1.005523
15.161	1.011151
29.356	1.021580
58.353	1.043329
81.025	1.060773

(Dijken, Z. phys. Ch. 1897, **24**. 107.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 20.1°.

p = per cent strength of solution; d = observed density; w = volume concentration in grams per cc. $\left(\frac{pd}{100} = w.\right)$

p	d	w
35.02	1.3110	0.46695
31.15	1.2655	0.39420
25.03	1.2057	0.30172
19.55	1.1551	0.22585
13.43	1.1028	0.14815
10.09	1.0753	0.10850
6.650	1.0480	0.06968
4.672	1.0330	0.04826
4.001	1.0276	0.04112
1.372	1.0085	0.01383

(Barnes, J. phys. Chem. 1898, **2.** 545.)

Sp. gr. of $Mg(NO_3)_2$+Aq at 20° containing M g. mols. of salt per liter.

M	0.02	0.05	0.10	0.15
Sp. gr.	1.00224	1.005626	1.011118	1.016557

M	0.20	0.50	1.00	1.274
Sp. gr.	1.022026	1.054804	1.107865	1.136615

(Jones and Pearce, Am. Ch. J. 1907, **38.** 707.)

Less sol. in $Ca(NO_3)_2$+Aq than in H_2O. (Dijonval.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

+$2H_2O$. Mpt. 127°. (Wasiljew, C. C. **1909,** II. 1966.)

+$4H_2O$. Mpt. 45.5°. (W.)

+$6H_2O$. Deliquescent. Sol. in H_2O and alcohol. Sol. in 0.5 pt. cold H_2O, and 9 pts. cold alcohol of 0.84 sp. gr.; very sl. sol. in abs. alcohol. (Graham.)

Melts in its crystal H_2O at 90°, and the resulting liquid boils at 143.4°. (Ordway, Sill. Am. J. (2) **27.** 14.)

Solubility in H_2O.

Sat. solution contains at:

—18°	—4.5°	0°	18°
38.03	39.50	39.96	42.33% $Mg(NO_3)_2$,

40°	80°	90° (mpt.).
45.87	53.69	57.81% $Mg(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 395.)

+$9H_2O$. Solubility in H_2O.

Sat. solution contains at:

—23°	—20.5°	—18°
35.44	36.19	38.03% $Mg(NO_3)_2$.

Cryohydrate is formed at —29°. (Funk, Z. anorg. 1899, **20.** 398.)

Magnesium neodymium nitrate, $3Mg(NO_3)_2$, $2Nd(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 97.7 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Magnesium praseodymium nitrate, $3Mg(NO_3)_2$, $2Pr(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 7.70 g. hydrous salt at 16°. (Jantsch.)

Magnesium samarium nitrate, $3Mg(NO_3)_2$. $Sm(NO_3)_3+24H_2O$.

(Demarçay, C. R. 1900, **130.** 1187.)

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 24.55 g. hydrous salt at 16°. (Jantsch.)

Magnesium thorium nitrate, $MgTh(NO_3)_6+H_2O$.

Hydroscopic; sol. in HNO_3. (Meyer, Z. anorg. 1901, **27.** 385.)

Magnesium nitrate ammonia, $Mg(NO_3)_2$, $6NH_3$.

Sl. sol. in liquid NH_3. (Franklin, J. Am. Chem. Soc. 1913, **35.** 1459.)

Manganous nitrate, basic, $2MnO$, $N_2O_5+3H_2O$.

Sol. in H_2O. (Gorgeu.)

Manganous nitrate, $Mn(NO_3)_2$.

Deliquescent. Easily sol. in H_2O and alcohol.

See +3, and $6H_2O$.

Sp. gr. of $Mn(NO_3)_2$+Aq at 8°.

% $Mn(NO_3)_2$ +$6H_2O$	Sp. gr.	% $Mn(NO_3)_2$ +$6H_2O$	Sp. gr.
5	1.0253	45	1.2705
10	1.0517	50	1.3074
15	1.0792	55	1.3459
20	1.1078	60	1.3861
25	1.1137	65	1.4281
30	1.1688	70	1.4721
35	1.2012	71	1.4811
40	1.2352	..	...

(Oudemans, Z. anal. **7.** 421.)

Sp. gr. of aqueous solutions containing:

10	20	30 % $Mn(NO_3)_2+6H_2O$,
6.237	12.474	18.711% $Mn(NO_3)_2$,
1.052	1.107	1.165

40	50	60 % $Mn(NO_3)_2+6H_2O$,
24.948	31.185	37.422% $Mn(NO_3)_2$,
1.230	1.302	1.381

70	80 % $Mn(NO_3)_2+6H_2O$.
43.659	49.896% $Mn(NO_3)_2$.
1.466	1.558

(Gerlach, Z. anal. **28.** 477.)

Sp. gr. of $Mn(NO_3)_2$+Aq at room temp. containing:

18.309	29.602	49.309% $Mn(NO_3)_2$.
1.1482	1.3227	1.5056

(Wagner, W. Ann. 1883, **18.** 271.)

Sp. gr. of $Mn(NO_3)_2$+Aq at 25°.

Concentration of $Mn(NO_3)_2$+Aq	Sp. gr.
1–normal	1.0690
1/2– "	1.0349
1/4– "	1.0174
1/8– "	1.0093

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

Sol. in liquid NH_3. (Guntz, Bull. Soc. 1909, (4) **5.** 1006.)
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)
$+H_2O$. Deliquescent. (Guntz, Bull. Soc. 1909 (4) **5.** 1005.)
$+3H_2O$. From solution in HNO_3. (Schultz-Sellack, Zeit. Ch. **1870.** 646.)
Solubility in H_2O.
Sat. solution contains at:

27°	29°	30°	34°	35.5° mpt.
65.66	66.99	67.38	71.31	76.82% $Mn(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 403.)

$+6H_2O$. Melts in its crystal H_2O at 25.8° and boils at 129.4°. (Ordway.)
Solubility in H_2O.
Sat. solution contains at:

—29°	—26°	—21°	—16°	—5°
42.29	43.15	44.30	45.52	48.88% $Mn(NO_3)_2$,

0°	+11°	18°	25.8° mpt.
50.49	54.50	57.33	62.37% $Mn(NO_3)_2$.

Cryohydrate is formed at —36°. (Funk, Z. anorg. 1899, **20.** 403.)

Manganous neodymium nitrate, $3Mn(NO_3)_2$, $2Nd(NO_3)_3+24H_2O$.
1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 296 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Manganous praseodymium nitrate, $3Mn(NO_3)_2$, $2Pr(NO_3)_3+24H_2O$.
1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 23.4 g. hydrous salt at 16°. (Jantsch.)

Manganous samarium nitrate, $3Mn(NO_3)_2$, $2Sm(NO_3)_3+24H_2O$.
1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 50.04 g. hydrous salt at 16°. (Jantsch.)

Manganous thorium nitrate, $MnTh(NO_3)_6+8H_2O$.
Ppt. (Meyer, Z. anorg. 1901, **27.** 388.)

Manganous nitrate cupric oxide, $Mn(NO_3)_2$, $3CuO+3H_2O$.
Ppt. (Mailhe, C. R. 1902, **134.** 234.)

Manganous nitrate hydrazine, $Mn(NO_3)_2$, $2N_2H_4$.
Not decomp. by H_2O. (Franzen, Z. anorg. 1908, **60.** 286.)

Mercurous nitrate, basic, $2Hg_2O$, $N_2O_5+H_2O$.
Ppt. Decomp. by boiling with H_2O. (Marignac, A. ch. (3) **27.** 332.)
Slowly sol. in cold, rapidly in hot HCl+Aq; insol. in NH_4Cl, and NH_4NO_3+Aq.
$+10H_2O$ Slowly sol. in normal HNO_3. (Reuss, Dissert. **1886**.)
$4Hg_2O$, $3N_2O_5+H_2O$. Sol. in a small quantity of H_2O; decomp. by a large amt. of H_2O or by warm H_2O. (Rose, Pogg. **83.** 154.)
Is $3HgO$, $2N_2O_5+H_2O$ according to Gerhardt.
$+5H_2O$. (Reuss, Dissert. **1886.**)
$5Hg_2O$, $3N_2O_5+2H_2O$. (Marignac.) Is $2Hg_2O$, $N_2O_5+H_2O$. (Lefort, A. **56.** 247.) Sol. in boiling, less sol. in cold H_2O. (Marignac, *l. c.*)
$+4H_2O$, and $+6H_2O$. (Reuss, Dissert. **1886.**)
$8Hg_2O$, $5N_2O_5+5H_2O$, and $+11H_2O$. (Reuss.)
$11Hg_2O$, $6N_2O_5+25H_2O$. (Reuss.)
$16Hg_2O$, $9N_2O_5+19H_2O$, $+23H_2O$, and $+31H_2O$. (Reuss.)
$3Hg_2O$,$N_2O_5+2H_2O$. (Cox, Z. anorg. 1904, **40.** 177.)

Mercurous nitrate, $HgNO_3$.
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
Fairly sol. in boiling CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)
Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in methylamine. (Franklin, J. Am. Chem. Soc. 1906, **28.** 1419.)
$+H_2O$. Completely sol. in a little warm H_2O, but decomp. by more H_2O. Completely sol. as acid salt in H_2O containing HNO_3. (Marignac, A. ch. (3) **27.** 332.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
$+1^1/_4H_2O$, $+1^1/_3H_2O$, $+1^1/_2H_2O$, etc. (Reuss, Dissert. **1896.**)

Mercuric nitrate, basic, $6HgO$, N_2O_5 (?).
Insol. in hot H_2O. (Kane.)
$3HgO$, $N_2O_5+H_2O$. Decomp. to oxide by washing with cold H_2O. Sol. in dil. HNO_3+Aq. (Millon, A. ch. (3) **18.** 361.)
$2HgO$, $N_2O_5+H_2O$. Sl. deliquescent. Decomp. by H_2O; sol. in dil. HNO_3+Aq. (Millon.)
$+2H_2O$. Decomp. by cold H_2O. Deliquescent. Sol. in H_2O containing HNO_3. (Marignac.)
$+3H_2O$. (Ditte, J. B. **1854.** 366.)

Mercuric nitrate, $Hg(NO_3)_2$.
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Neither dissolved nor attacked by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sol. in methylal. (Eidmann, C. C. **1899.** II, 1014.)

$+\frac{1}{2}H_2O$. Deliquescent. Very sol. in a little H_2O. H_2O precipitates basic salt from conc. $Hg(NO_3)_2$+Aq. Insol. in alcohol. Decomp. by ether. (Millon.)

$+H_2O$. Extraordinarily sol. in H_2O. (Cox, Z. anorg. 1904, **40.** 159.)

$+8H_2O$. Melts at 6° in crystal H_2O. (Ditte.)

Mercuromercuric nitrate, Hg_2O, $2HgO$, N_2O_5.

Boiling H_2O gradually dissolves out $Hg_2(NO_3)_2$, and leaves residue of HgO and Hg. (Brooks, Pogg. **66.** 63.)

$2Hg_2O$, HgO, $N_2O_5+H_2O$. (Rây, Chem. Soc. 1905, **87.** 175.)

Hg_2O, $2HgO$, $N_2O_5+H_2O$. (Rây.)

Mercurous hydrogen nitrate, $4HgNO_3$, HNO_3 $+8H_2O$.

(Reuss, Dissert. **1886.**)

$5HgNO_3$, $3HNO_3+26H_2O$. (Reuss.)

Mercuric silver nitrate, $Hg(NO_3)_2$, $2AgNO_3$.

Easily sol. in H_2O without decomp. (Berzelius.)

Mercurous strontium nitrate, $2SrO$, $2Hg_2O$, $3N_2O_5$.

Decomp. by H_2O. Much more sol. in H_2O than the corresponding Ba compound.

Readily sol. in warm dil. HNO_3+Aq or $Hg_2(NO_3)_2$+Aq without decomposition. (Städeler, A. **87.** 131.)

Mercurous thallous nitrate, $HgNO_3$, $TlNO_3$.

Miscible with H_2O. (Retgers, N. Jahrb. Miner, **1896.** II, 183.)

Mercuric nitrate bromide, $Hg(NO_3)_2$, $HgBr_2$.

(Morse, Z. phys. Ch. 1902, **41.** 733.)

Mercuric nitrate cadmium oxide, $Hg(NO_3)_2$, $CdO+2H_2O$.

Ppt. (Mailhe, Bull. Soc. 1901, (3) **25.** 788.)

$+3H_2O$. Decomp. by H_2O. (Mailhe.)

Mercuric nitrate cobaltous oxide, $Hg(NO_3)_2$, $CoO+3H_2O$.

Ppt. (Mailhe, C. R. 1901, **132.** 1275.)

$+4H_2O$. Decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 369.)

Mercuric nitrate cupric oxide, $Hg(NO_3)_2$, $CuO+2H_2O$, and $+4H_2O$.

(Mailhe, Bull. Soc. 1901, (3) **25.** 791.)

$+5H_2O$. Decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 365.)

Mercuric nitrate cyanide, $Hg(NO_3)_2$, $Hg(CN)_2$.

Very sol. in H_2O. Very sol. in methyl alcohol and solution is not decomp. at bpt. Ethyl alcohol apparently decomp. it. (Prussia, Gazz. ch. it. 1898, **28.** (2) 115.)

Mercurous nitrate hydrazine, $2HgNO_3$, N_2H_4.

Decomp. by H_2O. Stable in dil. HNO_3+Aq solution. (Hofmann and Marburg, A. 1899, **305.** 215.)

Ppt.; very unstable. (Hofmann, B. 1897, **30.** 2021.)

$Hg(NO_3)_2$, N_2H_4. Sol. in dil. HCl and HNO_3. (Hofmann and Marburg, A. 1899, **305.** 215.)

Ppt.; sol. in acids; decomp. by alkali. (Hofmann, B. 1897, **30.** 2021.)

Mercuric nitrate iodide, $Hg(NO_3)_2$, $2HgI_2$.

Decomp. by long boiling with H_2O. (Riegel, Jahrb. Pharm. **11.** 396.)

$2Hg(NO_3)_2$, $3HgI_2$. Easily decomp. by H_2O; less easily by alcohol or ether. (Riegel.)

$Hg(NO_3)_2$, HgI_2. Decomp. very quickly by HNO_3+Aq or alcohol of 0.814 sp. gr. (Souville, J. Pharm. **26.** 474.)

Mercuric nitrate manganous oxide, $Hg(NO_3)_2$, $MnO+2H_2O$.

Decomp. by H_2O. (Mailhe, Bull. Soc. 1901, (3) **25.** 790.)

$+3H_2O$. (Mailhe.)

$+4H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 370.)

Mercuric nitrate nickel oxide, $Hg(NO_3)_2$, NiO $+2H_2O$.

(Mailhe, Bull. Soc. 1901, (3) **25.** 788.)

$+4H_2O$. Decomp. by H_2O. (Mailhe, A. ch. 1902, (7) **27.** 369.)

Mercurous nitrate phosphate, $HgNO_3$, $Hg_3PO_4+H_2O$.

Insol. in H_2O, but decomp. by boiling therewith. Insol. in H_3PO_4+Aq or alcohol. Completely sol. in hot NH_4Cl+Aq. Decomp. by cold KOH+Aq, and warm K_2CO_3+Aq. (Wittstein.)

$2HgNO_3$, Hg_2O, $5Hg_3PO_4+H_2O$. (Haack, A. **262.** 192.)

Mercuric nitrate silver bromide, $Hg(NO_3)_2$, $AgBr$.

(Morse, Z. phys. Ch. 1902, **41.** 733.)

Mercuric nitrate silver cyanide, basic, $Hg(OH)NO_3$, $AgCN+2H_2O$.

(Schmidt, Z. anorg. 1895, **9.** 431.)

$Hg(OH)NO_3$, $5Ag_2O$, $20AgCN+7H_2O$. (Schmidt.)

Mercuric nitrate silver iodide, $Hg(NO_3)_2$, $2AgI+\frac{1}{2}H_2O$.

Decomp. by H_2O. (Preuss, A. **29.** 328.)

Mercuric nitrate sulphide, $Hg(NO_3)_2$, $2HgS$.

Very sl. sol. in hot H_2O. Insol. in HNO_3+Aq. Decomp. by hot H_2SO_4 or aqua regia, also by hot HCl+Aq. (Barfoed, J. pr. **93.** 230.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) **17.** 355.)

$2Hg(NO_3)_2$, HgO, $6HgS+12H_2O$. Insol. in H_2O, and HNO_3+Aq of 1.2 sp. gr (Gramp, J. pr. (2) **14.** 299.)

Mercuric nitrate zinc oxide, $Hg(NO_3)_2$, $ZnO+H_2O$.

Ppt. Decomp. by H_2O. (Maille, C. R. 1901, **132.** 1274.)

Molybdenum nitrate, Mo_2O_3, N_2O_5 (?).

Sol. in dil. HNO_3+Aq. (Berzelius.)

MoO_2, $2N_2O_5$ (?). Sol. in dil. HNO_3+Aq. (Berzelius.)

Neodymium nickel nitrate, $2Nd(NO_3)_3$, $3Ni(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 116.6 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Neodymium rubidium nitrate, $[Nd(NO_3)_5]Rb_2+4H_2O$.

Hydroscopic. (Jantsch, Z. anorg. 1911, **69.** 230.)

Neodymium zinc nitrate, $2Nd(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 177 g. hydrous salt at 16°. (Jantsch.)

Nickel nitrate, basic.

Insol. in H_2O. (Proust.)

$8NiO$, $2N_2O_5+5H_2O$. Insol. in cold or hot H_2O. (Habermann, M. **5.** 432.)

$5NiO$, $N_2O_5+4H_2O$. Not decomp. by boiling H_2O. (Rousseau and Tite, C. R. **114.** 1184.)

Nickel nitrate, $Ni(NO_3)_2$.

Solubility in H_2O. *See* +3, 6, and $9H_2O$.

Sp. gr. of aqueous solution at 17.5° containing:

5	10	15	20	% $Ni(NO_3)_2$,
1.0463	1.0903	1.1375	1.1935	
25	30	35	40	% $Ni(NO_3)_2$.
1.2534	1.3193	1.3896	1.4667	

(Franz, J. pr. (2) **5.** 295.)

Sp. gr. of $Ni(NO_3)_2$+Aq containing g. $Ni(NO_3)_2$ (anhydrous) in 1000 g. H_2O at 24.4°:

91.5 g. (=½ mol.)	183	274.5	369	460.5	549
1.073	1.141	1.205	1.266	1.324	1.378

(Gerlach, Z. anal. **28.** 468.)

Sp. gr. of $Ni(NO_3)_2$+Aq at room temp. containing:

16.493	30.006	40.953	% $Ni(NO_3)_2$.
1.1363	1.2776	1.3879	

(Wagner, W. Ann. 1883, **18.** 269.)

Sp. gr. of $Ni(NO_3)_2$+Aq at 25°.

Concentration of $Ni(NO_3)_2$+Aq	Sp. gr.
1–normal	1.0755
1/2– "	1.0381
1/4– "	1.0192
1/8– "	1.0096

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

Sp. gr. at 20° of $Ni(NO_3)_2$+Aq containing M g. mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001521	1.003882	1.007792	1.011541
M	0.1	0.25	0.5	0.75
Sp. gr.	1.015307	1.03837	1.07611	1.11310
M	1.0	1.5	2.0	
Sp. gr.	1.14562	1.22134	1.29459	

(Jones and Pearce, Am. Ch. J. 1907, **38.** 720.)

Sol. in liquid NH_3. (Gunts, Bull. Soc. 1909, (4) **5.** 1008.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Solubility in glycol = 7.5%. (de Coninck, C. C. **1905**, II. 1234.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

$+3H_2O$. Solubility in H_2O.

Sat. solution contains at:

58°	60°	64°	70°	
61.61	61.99	62.76	63.95	% $Ni(NO_3)_2$,
90°	95° mpt.			
70.16	77.12	% $Ni(NO_3)_2$.		

(Funk, Z. anorg. 1899, **20.** 411.)

$+6H_2O$. Not deliquescent in dry air. Sol. in 2 pts. cold H_2O and in alcohol. (Tupputi.)

Mpt. of $Ni(NO_3)_2+6H_2O$ = 56.7°. (Ordway; Tilden, Chem. Soc. **45.** 409.)

Sat. solution boils at 136.7°. (Ordway.)

Solubility in H_2O.

Sat. solution contains at:

−21°	−12.5°	−10°	−6°	
39.94	41.59	42.11	43.00	% $Ni(NO_3)_2$,
0°	+20°	41°	56.7° mpt.	
44.32	49.06	55.22	62.76	% $Ni(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 410.)

Sat. solution of $Ni(NO_3)_2+6H_2O$ contains 44.3% $Ni(NO_3)_2$ at 0°, and 48.7% $Ni(NO_3)_2$ at 18°. (Mylius, Z. anorg. 1912, **74.** 411.)

Sp. gr. of $Ni(NO_3)_2$+Aq containing in 1000 g. H_2O at 24.4°, g. $Ni(NO_3)_2+6H_2O$.

145.5 g. (=½ mol.)	291	436.5	582
1.069	1.128	1.179	1.224
727.5	873	1018.5	1164
1.264	1.299	1.329	1.357

(Gerlach, Z. anal. **28.** 468.)

Sol. in NH_4OH+Aq.
Insol. in absolute alcohol.
Sl. sol. in acetone. (Krug and M'Elroy.)
Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)
$+9H_2O$. Solubility in H_2O.
Sat. solution contains at:

—23°	—21°	—10.5°
39.02	39.48	44.13% $Ni(NO_3)_2$.

Cryohydrate is formed at —27°. (Funk, Z. anorg. 1899, **20.** 411.)

Nickel praseodymium nitrate, $3Ni(NO_3)_2$, $2Pr(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 9.28 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 303.)

Nickel samarium nitrate, $3Ni(NO_3)_2$, $2Sm(NO_3)_3+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 29.11 g. hydrous salt at 16°. (Jantsch.)

Nickel thorium nitrate, $NiTh(NO_3)_6+8H_2O$.

Sol. in HNO_3+Aq. (Meyer, Z. anorg. 1901, **27.** 387.)

Nickel uranyl nitrate, $10Ni(NO_3)_2$, $3(UO_2)(NO_3)_2$.

Sol. in H_2O and acids; insol. in aq. alkali. (Lancien, C. C. **1912,** I. 208.)

Nickel nitrate ammonia, $Ni(NO_3)_2$, $4NH_3+2H_2O$.

Efflorescent. Easily sol. in cold H_2O; decomp. by boiling. Insol. in alcohol. (Erdmann, J. pr. **97.** 395; Ephraim, B. 1913, **46.** 3106.)

$+1\frac{1}{2}H_2O$. (André, C. R. **106.** 936.)

Nickel nitrate chloride ammonia, $6Ni(NO_3)_2$, $NiCl_2$, $30NH_3+16H_2O$.

Sol. in H_2O with decomp. (Schwarz, W. A. B. **1850.** 272.)

Nickel nitrate cupric oxide, $Ni(NO_3)_2$, $3CuO+3H_2O$.

Ppt. (Maihle, C. R. 1902, **134.** 234.)

Nickel nitrate hydrazine, $Ni(NO_3)_2$, $3N_2H_4$.

Insol. in H_2O. Decomp. by hot H_2O. Easily sol. in dil. acids. (Franzen, Z. anorg. 1908, **60.** 267.)

Palladium nitrate, basic, $Pd(NO_3)_2$, $3PdO+4H_2O$.

Ppt. Insol. in H_2O. (Kane.)

Palladium nitrate, $Pd(NO_3)_2+xH_2O$.

Very deliquescent, and sol. in H_2O. Decomp. by much H_2O or alcohol. (Kane.)

Decomp. by cold or hot H_2O. (Rose, A. **83.** 143.)

Platinic nitrate, $Pt(NO_3)_4$ (?).

Known only in solution, which is decomp. on evaporating. (Berzelius.)

$Pt(NO_3)_2$, $3PtO_2+5H_2O$. Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Platinum nitrate sulphocarbamide, $Pt(NO_3)_2$, $4CS(NH_2)_2$.

Very sol. in H_2O. Unstable. (Kurnokow, J. pr. 1894, (2) **50.** 490.)

Potassium nitrate, KNO_3.

Not deliquescent, but, according to Mulder, 100 pts. KNO_3 under a bell jar with H_2O take up 339 pts. H_2O in 22 days, and small amounts finally deliquesce completely.

Sol. in H_2O with absorption of heat.

16 pts. KNO_3+100 pts. H_2O at 13.2° lower the temperature 10.2°. If the initial temp. is 23° it falls to 12.8°, if 0° it does not fall below —2.7°, which is the freezing-point of the mixture. (Rüdorff, Pogg. **136.** 276.)

KNO_3+Aq sat. at 18.1° has 1.1601 sp. gr. and contains 22.72% KNO_3, or 100 pts. H_2O at 18.1° dissolve 29.45 pts. KNO_3. (Karsten, 1840.)

Sol. in 3.745 pts. H_2O at 15°. (Gerlach.)

Sol. in 3 pts. H_2O at 21° (Schiff, A. **109.** 326), and solution has 1.1683 sp. gr.

Sol. in 3 pts. cold, and 0.5 pt. boiling H_2O. (Fourcroy.)

KNO_3+Aq sat. at 18° has sp. gr. 1.151, and contains 21.63% KNO_3, or 100 pts. H_2O dissolve 27.60 pts. KNO_3 at 18°. (Longchamp.)

Sol. in 4 pts. H_2O at 16°, and 0.25 pt. at b.-pt. (Riffault.)

100 pts. H_2O at 114.5° dissolve 284.61 pts. (Griffiths.)

Sol. in 7 pts. cold, and 1 pt. boiling H_2O. (Bergmann.)

Sol. in 6.15 pts. cold H_2O at 18.75°. (Abl.)

100 pts. H_2O at 15.5° dissolve 26.6 pts.; at 100°, 100 pts. (Ure's Dictionary.)

KNO_3+Aq sat. at 10° contains 33.3%. (Eller.)

KNO_3+Aq sat. in the cold contains 25%. (Fourcroy.)

KNO_3+Aq sat. at 12.5° contains 24.8%. (Hassenfratz.)

Solubility of KNO_3 in 100 pts. H_2O at t°.

t°	Pts. KNO_3	t°	Pts. KNO_3
0	13.2	45.10	74.7
5	16.7	54.72	97.1
11.67	22.2	65.45	125.5
17.91	29.3	79.72	169.2
24.94	38.4	97.66	236.4

(Gay-Lussac, A. ch. **11.** 314.)

Solubility of KNO_3 in 100 pts. H_2O at t°.

t°	Pts. KNO_3
16.0	26.7
29	43.5
44.2	71.4

(Nordenskjöld, Pogg. **136.** 312.)

100 pts. H_2O dissolve at:

10°	18°	27°	41°	53°
21.2	27.9	40.1	66.3	93.3 pts. KNO_3.

(Gerardin, A. ch. (4) **5.** 150.)

100 pts. KNO_3+Aq sat. at 14° contain 16.34 pts. KNO_3; at 15°, 18.81 pts. KNO_3. (v. Hauer, J. pr. **98.** 177.)

100 pts. H_2O dissolve at:

4°	16.3°	68.3°
16	27.2	132.1 pts KNO_3.

(Andreae, J. pr. (2) **29.** 456.)

Solubility in 100 pts. H_2O at t°.

t°	Pts KNO_3	t°	Pts. KNO_3	t°	Pts. KNO_3
0	13.3	39	62	78	165
1	13.8	40	64	79	168
2	14.6	41	66	80	172
3	15.5	42	68	81	175
4	16.4	43	70	82	179
5	17.1	44	72	83	182
6	17.8	45	74	84	185
7	18.5	46	76	85	189
8	19.3	47	78	86	192
9	20.2	48	81	87	196
10	21.1	49	83	88	199
11	22.0	50	86	89	203
12	23.0	51	88	90	206
13	24.0	52	91	91	210
14	25.0	53	93	92	214
15	26.0	54	96	93	218
16	27.0	55	98	94	222
17	28.1	56	101	95	226
18	29.1	57	103	96	230
19	30.2	58	106	97	234
20	31.2	59	108	98	238
21	32.3	60	111	99	243
22	33.5	61	113	100	247
23	34.7	62	116	101	252
24	36.0	63	119	102	256
25	37.3	64	121	103	261
26	38.6	65	124	104	266
27	40.0	66	127	105	272
28	41.4	67	130	106	278
29	42.9	68	133	107	284
30	44.5	69	136	108	289
31	46.0	70	139	109	295
32	48	71	142	110	301
33	50	72	146	111	307
34	52	73	149	112	313
35	54	74	152	113	319
36	56	75	155	114	326
37	58	76	159	114.1	327.4
38	60	77	162	...	...

(Mulder, Scheik. Verhandel. **1864.** 89.)

100 pts. H_2O dissolve 493 pts. KNO_3 at 125°. (Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Rhombohedral KNO_3 is more easily soluble than the prismatic, and easily forms supersaturated solutions. (Frankenheim.)

Sat. KNO_3 + Aq contains at:

139°	158°	160°	175°	180°
79.8	83.7	83.9	84.0	84.2% KNO_3.
190°	215°	225°	253°	283°
86.0	89.0	90.4	91.6	96.5% KNO_3

(Étard, A. ch. 1894, (7) **2.** 526.)

Solubility in 100 pts. H_2O at t°.

t°	G. KNO_3	Sp. gr. t°/4°
0.40	13.43	1.0817
14.90	25.78	1.1389
30.80	47.52	1.2218
44.75	74.50	1.3043
60.05	111.18	1.3903
76	156.61	1.4700
91.65	210.20	1.5394
114*	311.64	1.6269

* B.-pt. of sat. solution.

(Berkeley, Phil. Trans. 1904, **203,** A. 189.)

100 g. H_2O dissolve 37.79 g. KNO_3 at 25°.

100 g. H_2O dissolve 3.08 g. equiv. KNO_3 at 20°; 3.27 at 21.5°. (Euler, Z. phys. Ch. 1904, **49.** 312.)

1 l. H_2O dissolves 384.48 g. KNO_3 at 25°. (Armstrong and Eyre, Proc. Roy. Soc. 1910, A, **84.** 123.)

1 l. sat. KNO_3+Aq contains 2.8 g. mols. KNO_3. (Rosenheim and Weinheber, Z. anorg. 1911, **69.** 263.)

100 g. H_2O dissolve 38.485 g. KNO_3 at 25°. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1148.)

Sat. KNO_3+Aq contains at:

50°	58°	62°	68°
46.39	51.55	53.64	57.04% KNO_3.

(Tschugaeff, Z. anorg. 1914, **86.** 160.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

9.1°	21.1°	35°
16.76	24.77	35.01 g. KNO_3.

(Findlay, Chem. Soc. 1914, **105.** 780.)

Sp. gr. of solution sat. at 15° = 1.134. (Michel and Krafft.)

Sp. gr. of solution sat. at 16° = 1.138. (Stolba, J. pr. **97.** 503.)

Sp. gr. of solution sat. at 18° = 1.1601, and contains 29.45% KNO_3. (Karsten.)

Sp. gr. of KNO_3+Aq at 19.5°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
4.871	1.0307	17.965	1.1198
9.618	1.0618	21.488	1.1457
14.044	1.0920	...	...

(Kremers, Pogg. **95.** 120.)

Sp. gr. of KNO_3+Aq at 21°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1.0058	13	1.0819
2	1.0118	14	1.0887
3	1.0178	15	1.0956
4	1.0239	16	1.1026
5	1.0300	17	1.1097
6	1.0363	18	1.1169
7	1.0425	19	1.1242
8	1.0490	20	1.1316
9	1.0555	21	1.1390
10	1.0621	22	1.1464
11	1.0686	23	1.1538
12	1.0752	24	1.1613

(Schiff, A. **110.** 75.)

Sp. gr. of KNO_3+Aq at 15°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1.00641	12	1.07905
2	1.01283	13	1.08596
3	1.01924	14	1.09286
4	1.02566	15	1.09977
5	1.03207	16	1.10701
6	1.03870	17	1.11426
7	1.04534	18	1.12150
8	1.05197	19	1.12875
9	1.05861	20	1.13599
10	1.06524	21	1.14361
11	1.07215	..	...

(Gerlach, Z. anal. **8.** 286.)

Sp. gr. of KNO_3+Aq at 17.5°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
1	1.006	8	1.051	15	1.099
2	1.012	9	1.058	16	1.106
3	1.019	10	1.065	17	1.113
4	1.025	11	1.072	18	1.120
5	1.032	12	1.078	19	1.127
6	1.038	13	1.085	20	1.134
7	1.045	14	1.092	..	...

(Hager, Comm. 1883.)

Sp. gr. of KNO_3+Aq at 18°.

% KNO_3	Sp. gr.	% KNO_3	Sp. gr.
5	1.0305	20	1.133
10	1.0632	22	1.148
15	1.097	..	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of KNO_3+Aq at 20°, containing mols. KNO_3 in 100 mols. H_2O.

Mols. KNO_3	Sp. gr.	Mols. KNO_3	Sp. gr.
0.5	1.01730	4	1.12264
1	1.03373	5	1.14888
2	1.06524	.	...

(Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of KNO_3+Aq at 25°.

Concentration of KNO_3+Aq.	Sp. gr.
1-normal	1.0605
1/2- "	1.0305
1/4- "	1.0161
1/8- "	1.0075

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

Sp. gr. of KNO_3+Aq at 20.1°.

p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w.\right)$

p	d	w
25.54	1.1783	0.30095
21.95	1.1510	0.25270
17.88	1.1200	0.20033
13.93	1.0913	0.15203
8.706	1.0553	0.09186
5.393	1.0331	0.05571
4.389	1.0264	0.04506
2.848	1.0165	0.02895
2.030	1.0113	0.02053
0.741	1.0030	0.00743

(Barnes, J. Phys. Chem. 1898, **2.** 544.)

Sp. gr. 20°/4° of a normal solution of KNO_3 = 1.05954; of a 0.5 normal solution = 1.029325. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of sat. KNO_3+Aq at t°.

t°	G. KNO_3 sol. in 100 g. H_2O	Sp. gr.
0	13.27	1.084
10	20.89	1.120
20	31.59	1.161
30	45.85	1.212
40	63.90	1.282
50	85.51	1.339
60	109.00	1.403
70	138.00	1.446

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, **44.** 1565.)

The saturated solution boils at 114.1° (Mulder); 114.5° (Griffiths); 115.9° (Legrand, Gerardin); 117° (Magnus); 118° (Kremers); 126° (Le Page).

The saturated solution forms a crust at 111°, and boils at 115°; highest temp. observed, 115.3°. (Gerlach, Z. anal. **26.** 426.)

B.-pt of KNO+Aq containing pts. KNO_3 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 444); L = according to Legrand (A. ch. (2) **52.** 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	7.5	...	107°	120.5	119.0
101	15.2	12.2	108	141.5	140.6
101.5	23	...	109	164	163.0
102	31	26.4	110	188.5	185.9
102.5	39	...	111	215	209.2
103	47.5	42.2	112	243	233.0
103.5	56	...	113	274	257 6
104	64.5	59.6	114	306	283.3
104.5	73	...	115	338.5	310.2
105	82	78.3	115.9	...	335.1
106	101	98.2	...	...	...

1 pt. KNO_3 dissolves in 1.4 pts. HNO_3; at 20° in 3.8 pts., and at 123° in 1 pt. HNO_3+Aq of 1.423 sp. gr. (Composition $2HNO_3$, $3H_2O$.) (Schultz, Zeit. Ch. (2) **5.** 531.)

Solubility of KNO_3 in HNO_3 at 0°.

G. per 100 cc. solution		Sp. gr.
KNO_3	HNO_3	
12.65	0.00	1.079
10.02	3.71	...
8.38	8.38	1.093
7.49	13.58	1.117
7.49	19.47	1.144
7.68	30.04	1.202
10.42	42.86	1.289
28.64	75.95	1.498

(Engel, C. R., 1887, **104.** 913.)

Solubility in HNO_3+Aq.

Solution temp.	% by wt. KNO_3	Solid phase
—6°	24.4	KNO_3, $2HNO_3$(solution in HNO_3) (stable)
+14.0	32.6	"
17.0	34.8	"
19.5	37.2	"
22.0	44.5	(mpt.)
21.5	47.8	(Solution in KNO_3) (labile)
21.5	48.6	"
20.0	50.9	"
— 4.0	37.2	KNO_3, HNO_3 (labile)
+16.5	44.5	"
22.5	47.2	(stable)
23.5	47.8	"
25.5	48.6	"
27.0	49.4	"
29.0	50.1	(labile)
30.5	50.9	"
21.0	49.4	KNO_3(labile)
39.0	50.9	(stable)
50.0	51.7	"

(Groschuff, Z. anorg. 1904, **40.** 10.)

Sol. in sat. NH_4Cl+Aq. Solution thus obtained contains 43.07 pts. mixed salts, or 100 pts. H_2O dissolve 75.66 pts. mixed salts, viz. 38.62 pts. KNO_3 and 39.84 pts. NH_4Cl. (Karsten.) See also under NH_4Cl.

Solubility of KNO_3+K_2CO_3 and $KHCO_3$ in H_2O, see under K_2CO_3 and $KHCO_3$.

Sol. in sat. $BaCl_2$+Aq with pptn. of $Ba(NO_3)_2$.

Sol. in sat. NH_4NO_3+Aq, at first without pptn., but afterwards NH_4NO_3 is pptd. (Karsten.)

Sol in NH_4NO_3+Aq with pptn. of NH_4NO_3. (Rüdorff, B. **6.** 485.)

See also under NH_4NO_3.

Sol in sat. $Ba(NO_3)_2$+Aq, but soon a double salt separates. (Karsten.)

See also under $Ba(NO_3)_2$.

Sol. in $Ca(NO_3)_2$+Aq (Longchamp.)

See also under $Ca(NO_3)_2$.

Sol. in sat. $Pb(NO_3)_2$+Aq without pptn.

100 pts. H_2O dissolve 119.6 pts. $Pb(NO_3)_2$ and 67.1 pts. KNO_3 at 21.2°. (Rüdorff, B. **6.** 484.) See also under $Pb(NO_3)_2$.

Solubility in $AgNO_3$+Aq at t°.

t°	Sat. solution contains		
	% KNO_3	% $AgNO_3$	% total salt
—7	10.5	39.4	49.9
—7.5	10.5	40.5	51.0
—4	11.3	42.5	53.8
+20	23.6	46.4	70.0
33	26.3	50.9	77.2
34	27.3	51.1	78.4
36	29.4	52.0	81.4
38	...	...	81.7
46	...	...	82.3
54	33.1	55.0	88.1
54	...	55.8	...
61	...	...	89.5
68	34.3	54.6	88.9
96	37.8	55.4	93.2
105	38.5	55.6	94.1
142	41.5	55.8	97.3

(Étard, A. ch. 1894, (7) **3.** 286.)

Solubility of mixed crystals of KNO_3 and $AgNO_3$ in H_2O at 25°.

G. per l.		Mg. mols. per l.		Mol. % $AgNO_3$ in solution	Mol. % $AgNO_3$ in solid phase
$AgNO_3$	KNO_3	$AgNO_3$	KNO_3		
45.9	321.8	270	3180	7.83	0.2896
110.7	322.6	6513	3184	16.96	0.6006
176.8	333.7	1040	3298	23.97	0.9040
259.6	364.0	1258	3597	29.81	1.054
365.6	456.4	2151	4511	32.28	1.604
507.9	387.2	2988	3816	43.85	2.439
745.9	398.6	4388	3960	57.70	8.294

(Herz, Z. Kryst. Min. 1897, **28.** 405.)

Solubility of KNO_3+$AgNO_3$ at 30°.

Composition of the solution		Solid phase
% KNO_3	% $AgNO_3$	
0	73.0	$AgNO_3$
5.53	71.65	"
11.22	69.01	$AgNO_3$+$AgNO_3$, KNO_3
13.44	65.08	$AgNO_3$, KNO_3
17.38	57.85	"
25.05	46.32	KNO_3+$AgNO_3$, KNO_3
25.00	46.45	"
26.58	39.09	KNO_3
29.22	23.59	"
30.45	11.51	"
31.30	0	"

(Schreinemakers, Z. phys. Ch. 1909, **65.** 576.)

KNO_3+$NaNO_3$.

100 pts. H_2O dissolve 34.53 pts. KNO_3 and 91.16 pts. $NaNO_3$ at 15.6°, and solution has sp. gr. = 1.478. (Page and Keightley.)

100 pts. KNO_3+$NaNO_3$+Aq sat. at 14° contain 52.17 pts. of the two salts; sat. at 13° contain 53.15 pts. of the two salts. (v. Hauer.)

100 pts. H_2O dissolve at 18.75° 29.45 pts. KNO_3 and 89.53 pts. $NaNO_3$, if sat. KNO_3+Aq is treated with $NaNO_3$, and 35.79 pts. KNO_3 and 88.00 pts. $NaNO_3$ by the opposite process. 134.38 pts. of the two salts are dissolved if a mixture of the salts is treated with H_2O at 18.75°. (Karsten.)

100 pts. H_2O dissolve 39.34 pts. KNO_3 and 94.60 pts. $NaNO_3$, or 133.94 pts. of the two salts at 20°. (Nicol, Phil. Mag. (5) **13.** 385.)

Solubility of mixtures of KNO_3 and $NaNO_3$.

% $NaNO_3$ in mixture before solution	Total amt. mixed salts dissolved in 100 pts. H_2O at 20	Pts. $NaNO_3$ dissolved	Pts. KNO_3 dissolved	% $NaNO_3$ in mixture after solution and evap. to dryness
100	86.8	86.8	0	100
90	109.6	96.4	13.2	88
80	136.5	98.0	38.5	71.8
70	136.3	...	...	...
60	137.6	90.0	47.6	65.4
50	106.1	66.0	40.1	62.2
45.7*	88.0	53.3	34.7	60.6
40	81.1	45.6	35.6	56.2
30	73.5	...	...	...
20	54.1	20.8	33.3	38.5
10	40.9	9.4	31.5	22.9
0	33.6	0	33.6	0

* $NaNO_3$+KNO_3.

(Carnelley and Thomson, Chem. Soc. **53.** 782.)

Solubility of KNO_3+$NaNO_3$ in H_2O at 10°.

In 1000 ccm. H_2O		Solid phase
$NaNO_3$	KNO_3	
805.0	...	$NaNO_3$
848.3	301.9	$NaNO_3$, KNO_3
...	208.9	KNO_3

(Kremann and Zitek, M. 1909, **30.** 325.)

Solubility of KNO_3+$NaNO_3$ in H_2O at 24.2°.

In 1000 ccm. H_2O		Solid phase
$NaNO_3$	KNO_3	
913.58	...	$NaNO_3$
910.60	123.60	"
1019.65	435.85	$NaNO_3$, KNO_3
1018.40	437.70	"
931.30	422.00	KNO_3
346.70	390.00	"
...	377.35	"

(Kremann and Zitek.)

Solubility of KNO_3+$NaNO_3$ in H_2O at 25°.

% KNO_3	% $NaNO_3$	Solid phase
38.70	39.62	KNO_3
41.60	66.31	"
46.35	100.10	KNO_3+$NaNO_3$
39.08	98.99	$NaNO_3$
20.98	94.44	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, **2.** 245.)

Solubility in $NaNO_3$+Aq at 20°, 30°, 40° and 91°. Data, given in the original, show that each salt increases the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, **3.** 177; Chem. Soc. 1915, **108.** (2), 13.)

100 pts. H_2O dissolve 28.92 pts. KNO_3, 53.68 pts. $NaNO_3$, and 26.44 pts. NaCl at 15.6°, and solution has sp. gr. = 1.44. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

Solubility of KNO_3+$NaNO_3$+NaCl in H_2O at 25°.

% KNO_3	% $NaNO_3$	% NaCl	Solid phase
38.44	22.87	32.58	NaCl+KNO_3
38.57	44.40	27.67	"
42.55	63.26	23.59	$NaNO_3$, KNO_3+NaCl
17.77	61.12	23.94	"
28.08	62.92	23.70	"
44.72	82.82	9.56	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, **2.** 245.)

KNO_3+$Sr(NO_3)_2$.

1 l. H_2O sat. with both salts at 25° contains 552 g. KNO_3+1074 g. $Sr(NO_3)_2$. (Le Blanc and Noyes, Z. phys. Ch. 1890, **6.** 386.)

Solubility of $KNO_3+Sr(NO_3)_2$ at t°.

t°	% KNO_3	% $Sr(NO_3)_2$	Solid phase
20	22.90	5.49	KNO_3
	21.70	9.17	"
	21.01	17.10	"
	19.60	31.24	"
	19.49	34.91	"
	19.69	39.56	$KNO_3+Sr(NO_3)_2, 4H_2O$
	17.56	40.37	$Sr(NO_3)_2, 4H_2O$
	12.65	41.12	"
	10	40.70	"
40	30.26	23.70	KNO_3
	26.90	38.52	$KNO_3+Sr(NO_3)_2, 4H_2O$
	22.50	40.22	$Sr(NO_3)_2, 4H_2O$
	11.19	44.19	"
	0	47.7	"

(Findlay, Morgan and Morris, Chem. Soc. 1914, **105**. 779.)

KNO_3+TlNO_3.

100 g. H_2O dissolve 43.5 g. $TlNO_3$ +104.2 g. KNO_3 at 58°. (Rabe, Z. anorg. 1902, **31**. 156.)

Solubility of mixed crystals of KNO_3+TlNO_3 in H_2O at 25°.

G. per l.		Sp. gr.
$TlNO_3$	KNO_3	
0.00	351.0	1.2632
2.37	329.0	1.1903
6.15	332.4	1.1956
17.64	333.7	1.2050
49.74	333.3	1.2196
63.60	321.0	1.2436
86.18	330.5	1.2617
123.8	428.3	1.2950
101.3	245.1	1.2050
116.1	0.0	1.0964

(Herz, Z. Kryst. Min. 1897, **28**. 405.)

KNO_4+KBr.

Solubility in KBr+Aq.

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol. KBr	Mol. KNO_3	Mol. KBr	Mol. KNO_3
0.0	2.228	0.0	3.217
0.356	2.026	0.38	3.026
0.784	1.835	0.93	2.689
1.092	1.730	1.37	2.492
1.577	1.589	2.08	2.216
2.542	1.406	2.87	1.958
3.536	1.308	3.55	1.807

(Touren, C. R. 1900, **130**. 910.)

KNO_3+KCl.

100 pts. H_2O dissolve pts. of the two salts:

	At 12.9°	At 15.3°
KNO_3 . .	18.8	18.9
KCl . . .	28.5	29.8

(Kopp.)

100 pts. H_2O dissolve 315.2 pts. KCl and 19.1 pts. KNO_3 at 20.0°. (Rüdorff, B. **6**. **484**.)

100 pts. H_2O dissolve 18.95 pts. KNO_3+ 32.84 pts. KCl, or 51.79 pts. of the mixed salts at 20°. (Nicol, Phil. Mag. (5) **31**. 385.)

Solubility of KCl with addition of KNO_3 at 17.5°.

Sp. gr.	100 ccm. of solution contain g.		
	KCl	H_2O	KNO_3
1.1730	29.39	87.85	0
1.1980	27.50	85.68	6.58
1.2100	27.34	84.76	8.83
1.2250	26.53	83.58	12.48
1.2360	25.98	82.84	14.83
1.2390	25.96	82.65	15.22
1.2388	25.95	82.43	15.49
1.2410	26.24	82.63	15.33

KNO_3 separated out in last four solutions.

Solubility of KNO_3 with addition of KCl at 20.5°.

Sp. gr.	100 ccm. of solution contain g.		
	KNO_3	H_2O	KCl
1.1625	27.68	88.51	0
1.1700	24.39	87.89	4.72
1.1765	22.44	87.47	7.74
1.1895	20.23	86.48	12.23
1.1983	18.96	85.69	15.15
1.2150	17.67	84.23	19.61
1.2265	17.11	83.40	22.17
1.2400	16.79	82.24	24.96

(Bodländer, Z. phys. Ch. **7**. 359.)

Solubility in KCl+Aq at t°.

t°	Sat. solution contains % KNO_3	% KCl	% total salt
—11.4	4.0	18.4	22.4
—11	3.9	18.1	22.0
—10	3.8	18.6	22.5
—4	...	19.7	...
+2.5	6.3	19.9	26.2
4.5	7.3	20.7	28.0
4.5	7.8	19.8	27.6
8.5	7.9	20.9	28.8
10.5	8.4	21.0	29.4
13.5	8.9	21.8	30.7
14	10.2	21.3	31.5
17	9.7	22.6	32.3
23	12.5	21.8	34.3
27	14.9	21.3	36.2
29	16.1	21.0	37.1
34	18.9	21.2	39.3
36	18.9	21.6	40.5
37.5	19.2	21.6	40.8
39	21.0	21.0	42.0
42.5	21.8	20.9	42.7
48	25.3	20.3	45.6
50	28.3	20.8	49.1
52	...	20.2	...
53	...	...	48.7
56	29.5	19.5	49.0
61	34.5	18.3	52.8
62	35.4	...	...
71	40.5	17.3	57.8
81	47.1	15.4	62.5
85	48.2	15.3	63.5
90	52.8	13.3	66.1
96	54.1	12.6	68.7
97	56.6	12.4	69.0
104	59.9	10.8	70.7
105	...	10.9	...
120	69.6	7.7	77.3
120	69.1	7.6	76.7

(Étard, A. ch. 1894, (7) **3**. 285.)

Solubility in KCl+Aq.

1 litre of the solution contains at 14.5° Mol. KCl	Mol. KNO_3	at 25.2° Mol. KCl	Mol. KNO_3
0.0	2.228	0.0	3.217
0.182	2.172	0.26	3.086
0.424	2.057	0.66	2.853
0.880	1.830	1.35	2.510
1.778	1.576	2.08	2.218
2.204	1.515	2.78	2.015
2.635	1.423	3.04	1.946
3.172	1.355	...	...

(Touren, C. R. 1900, **130**. 909.)

Solubility of KCl in KNO_3+Aq.

t°	Concentration of KNO_3 % mol. per l.	G. salt dissolved in 1 l. H_2O	Molecular solubility
0°	0	283.55	3.81
"	¼	284.25	3.81
"	½	283.60	3.81
"	1	287.60	3.86
25°	0	364.15	4.89
"	¼	365.00	4.90
"	½	361.65	4.86
"	1	358.80	4.81
"	1½	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. (A) 1910, **84**. 127.)

Solubility in KCl+Aq at 20°, 30°, 40° and 91°. Data, given in the original, show that each salt diminishes the solubility in H_2O of the other. (Leather, Mem. Dept. Agric. India, 1914, **3**. 177; Chem. Soc. 1915, **108**. (2) 13.)

KNO_3+NaCl.

NaCl is sol. in sat. KNO_3+Aq, and the mixed solution is capable of dissolving more KNO_3. An amount of H_2O, which, when pure, could only dissolve 100 pts. KNO_3, can in this way be made to take up 152.64 pts. (Longchamp, A. ch. (2) **9**. 8.)

Sol. in sat. NaCl+Aq.

100 pts. H_2O dissolve:

	Longchamp 4° (1)	Rüdorff 14° (2)	Rüdorff 18° (3)	Page and Keightley 15.6° (4)
NaCl	35.96	38.5	38.9	39.57
KNO_3	26.01	28.7	36.1	32.32
	61.97	67.2	75.0	71.89

	Karsten 18.75° (5)	Karsten 18.75° (6)	Karsten 18.75° (7)	Mulder At b.-pt. (8)
NaCl	36.53	38.25	39.19	37.9
KNO_3	33.12	29.45	38.53	306.7
	69.65	67.70	77.72	344.6

1, 2, 3, 4, and 8. Both salts in excess.
5. Sat. NaCl+Aq treated with KNO_3.
6. Sat. KNO_3+Aq treated with NaCl.
7. The two salts simultaneously treated with H_2O.

100 pts. H_2O dissolve 31.44 pts. KNO_3, 139 pts. KCl, and 38.58 pts. NaCl at 15.6°, and solution has sp. gr. = 1.33. (Page and Keightley.)

Solubility in NaCl+Aq at t°.

t°	Sat. solution contains		
	% KNO_3	% NaCl	% total salt
—22	7.3	22.5	29.8
—19.5	7.9	22.6	30.5
—15.5	8.7	22.1	31.8
—7	10.1	22.5	32.6
—6	10.9	23.0	33.9
—1	12.7	23.3	36.0
+1	12.9	23.8	36.7
+11	16.6	22.8	39.4
17	19.0	22.8	41.8
18	19.8	22.0	41.8
18	18.9	22.5	41.5
20.5	20.4	22.3	42.7
22	...	21.2	...
22	21.8	20.7	42.5
26	20.7	22.3	43.0
27	...	..	45.0
30.5	24.7	20.7	45.4
32.5	25.0	20.2	45.2
32.5	25.9	20.2	46.1
33	26.7	20.7	47.4
35	27.9	20.2	48.1
39	29.8	19.5	49.3
42.2	31.1	20.0	51.1
50	38.5	16.5	55.0
54	39.4	17.1	56.5
58.5	40.9	15.3	56.2
70	49.7	14.0	63.7
76	53.9	13.6	67.5
79	54.8	12.9	67.7
84	57.4	12.6	70.0
90	61.4	10.4	71.8
96	64.7	9.5	74.2
105	70.0	9.0	79.0
106	69.9	9.3	79.2
107	71.3	8.4	79.7
115	72.2	9.0	81.2
122	73.8	8.0	81.8
127	73.6	7.9	81.5
127	72.9	8.8	81.7
127	73.0	7.6	80.6
128	74.2	7.9	82.1
132	75.7	7.6	83.3
145	77.7	7.6	85.3
170	80.7	5.8	86.5
171	79.1	5.9	85.0

(Étard, A. ch. 1894, (7) **3.** 283.)

100 g. H_2O dissolve 41.14 g. KNO_3 and 38.25 g. NaCl at 25°; 168.8 g. KNO_3 and 39.81 g. NaCl at 80°. (Soch, J. phys. Ch. 1898, **2.** 46.)

See also under NaCl.

Sol. in sat. $CuSO_4$+Aq, forming a double salt, which soon separates out.

Very slowly and slightly sol. in $MgSO_4$+Aq with pptn. of $MgSO_4$. (Karsten.)

$KNO_3+K_2SO_4$.

Sat. KNO_2+Aq dissolves some K_2SO_4, and sat. K_2SO_4+Aq slowly dissolves some KNO_3 without pptn., but K_2SO_4 is afterwards pptd. (Karsten.)

100 pts. H_2O dissolve:

	Mulder 18.75° (1)	Karsten 18.75° (2)	Kopp 20° (3)	Kopp 40° (4)	Mulder 18.75° (5)
KNO_3	29.90	29.42	26.9	59.35	...
K_2SO	...	4.0	6.6	5.75	10.8

2. H_2O sat. with KNO_3 and K_2SO_4 simultaneously, or to a sat. solution of one salt the other was added.

3 and 4. H_2O sat. with both salts simultaneously.

Mulder doubts the results of 3 and 4.

Solubility in K_2SO_4+Aq at t°.

t°	In 100 ccm. of the solution		Sp. gr. of solution
	G. KNO_3	G. K_2SO_4	
15	216.5	50.7	1.165
25	308.5	47.66	1.210

(Euler, Z. phys. Ch. 1914, **40.** 313.)

Slowly sol. in sat. Na_2SO_4 at first without pptn., but afterwards K_2SO_4 or $NaSO_4$ separates out.

Sol. in sat. $ZnSO_4$+Aq with pptn. of double salt. (Karsten.)

Sol. in sat. $KClO_3$+Aq, from which solution it is not pptd. by salts which would ppt. it from aqueous solution. (Karsten.)

Hydrazine dissolves 21.7 pts. KNO_3 at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)

Neither dissolved nor attacked by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in absolute alcohol; in dilute alcohol it dissolves proportional to the amount of H_2O present, but always less is dissolved than the H_2O would dissolve by itself. (Gerardin.)

100 pts. alcohol containing % by weight of alcohol dissolve pts. KNO_3 at 15°.

10	20	30	40	50	60	80%	alcohol
13.2	8.5	5.6	4.3	2.8	1.7	0.4	pts. KNO_3.

(Schiff, A. **118.** 365.)

Solubility in 100 pts. alcohol at t°. D = sp. gr. of alcohol; S = solubility.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
t°	S	t°	S	t°	S	t°	S
12	18.1	12	14.6	10	10.20	14	8.8
21	25.0	21	21.7	10	10.19	25	13.6
33	40.4	36	37.8	13	11.74	34	20.3
43	58.6	41	45.0	18	14.52	44	31.3
53	79.1	56	72.9	20	16.35	47	34.2
61	94.5	..	..	31	25.81	60	52.3
62	95.7	..	..	34	28.63	..	..
..	..	..	..	40	36.66	..	..
..	..	..	..	41	37.20	..	..
..	..	..	..	50	50.14	..	..
..	..	..	..	53	56.01	..	..
..	..	..	..	61	72.24	..	..
..	..	..	..	62	73.36	..	..

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8429	
t°	S	t°	S	t°	S	t°	S
14	5.4	16	4.13	12	1.61	15	0.29
25	9.0	24	6.00	33	3.62	22	0.39
33	13.2	40	10.94	47	5.77	40	0.62
44	19.1	51	16.51	57	6.97	54	0.78
57	29.1	60	21.54	..	..	60	1.10
65	36.2	64	24.22	..	..	..	..

(Gerardin, A. ch. (4) **5**. 151.)

Solubility of KNO_3 in alcohol at 18°.

Sp. gr.	100 ccm. contain g.		
	Alcohol	Water	KNO_3
1.1475	...	89.63	25.12
1.1085	3.30	87.44	20.11
1.1010	5.24	86.26	18.60
1.0805	8.69	83.18	16.18
1.0655	14.08	77.93	14.54
1.0490	16.27	76.36	12.27
1.0375	19.97	72.93	10.85
0.9935	28.11	64.74	6.50
0.9585	37.53	54.21	4.11
0.9456	42.98	48.15	3.37
0.9050	51.23	27.32	1.95
0.8722	61.65	24.74	0.83
0.8375	69.60	13.95	0.20

(Bodländer, Z. phys. Ch. **7**. 316.)

Solubility in alcohol.

Wt. % alcohol	G. KNO_3 per 100 g. alcohol	
	at 30°	at 40°
0	45.6	64.5
8.25	32.3	47.1
17.0	22.4	33.3
25.7	15.1	24.1
35.0	11.4 (34.5°)	16.7
44.9	7.0	11.6 (44°)
54.3	4.5	7.2 (55°)
65.0	2.7	4.4
75.6	1.3	2.0 (76.3°)
88.0	0.4	0.6 (88.5°)

(Bathrick, J. phys. Ch. 1896, **1**. 160.)

Solubility of KNO_3 in ethyl alcohol+Aq at 30°.

% by wt. H_2O	% by wt. alcohol	% by wt. KNO_3
68.7	0	31.3
69.2	10.1	20.7
67.3	17.0	15.7
64.1	23.8	12.1
58.8	32.2	9.0
50.8	43.1	6.1
39.8	56.9	3.3
33.9	63.8	2.3
22.3	76.8	0.88
7.5	92.3	0.15

(Schreinemakers, Z. phys. Ch. 1909, **65**. 556.)

Solubility in ethyl alcohol at 25°.

Concentration of alcohol in g. mol. per l. H_2O	Solubility in 1 l. H_2O	Mol. solubility
0	384.48	3.80
¼	368.30	3.64
½	354.40	3.50
1	327.00	3.22

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) **84**. 127.)

Solubility of KNO_3 in methyl alcohol+Aq at 30°.

% by wt. H_2O	% by wt. alcohol	% by wt. KNO_3
68.7	0	31.3
68.9	7.8	23.3
66.4	17.3	16.3
61.0	27.8	11.2
53.9	38.4	7.7
39.2	57.0	3.8
0.99	98.58	0.43

(Schreinemakers, Z. phys. Ch. 1909, **65**. 556.)

Solubility of KNO_3+AgNO_3 in 51.6% C_2H_5OH+Aq at 30°.

% KNO_3	% $AgNO_3$	Solid phase
4.8	0	KNO_3
4.55	5.15	"
4.11	16.47	"
4.26	21.28	KNO_3+AgNO_3, KNO_3
2.62	36.94	$AgNO_3$, KNO_3+AgNO_3
0	37	$AgNO_3$

(Schreinemakers, Z. phys. Ch. 1909, **65.** 556.)

100 g. 40% ethyl alcohol sat. with KNO_3+NaCl at 25° contain 13.74 g. KNO_3+15.78 g. NaCl. (Soch, J. phys. Ch. 1898, **2.** 43.)

Insol. in propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 277.)

Almost insol. in ether. (Braconnot.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014.)

Solubility in acetone+Aq at 40°.

Wt. % acetone	G. KNO_3 per 100 g. solvent
0	64.5
8.5	51.3
16.8	38.9
25.2	22.8
34.3	24.7
44.1	17.0
53.9	11.9
64.8	7.2
76.0	3.0
87.6	0.7

(Bathrick, J. phys. Ch. 1896, **1.** 160.)

100 pts. glycerine (sp. gr. 1.225) dissolve 10 pts. KNO_3. (Vogel, N. Rep. Ph. **16.** 557.)

100 g. trichlorethylene dissolve 0.01 g. KNO_3 at 15°. (Wester and Bruins, Pharm. Weekbl. 1914, **51.** 1443.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

100 g. H_2O sat. with sugar and KNO_3 dissolve 224.7 g. sugar + 41.9 g. KNO_3, or sat. solution contains 61.36 g. sugar + 11.45 g. KNO_3 at 31.25°. (Köhler, Z. Ver. Zuckerind. 1897, **47.** 447.)

Potassium hydrogen nitrate, KNO_3, HNO_3.

Very hygroscopic. Decomp. by H_2O. (Groschuff, B. 1904, **37.** 1489.)

Potassium *di*hydrogen nitrate, KNO_3, $2HNO_3$.

Decomp. by H_2O. (Ditte, A. ch. (5) **18.** 320.)

Solubility in H_2O.

Solution temp.	% by wt. KNO_3	% by wt. HNO_3	% by wt. H_2O
mpt. +22°	44.5	55.5	0
20.5	44.1	55.0	0.9
18.0	43.8	54.5	1.7
12.0	43.0	53.6	3.4
6.0	42.3	52.7	5.0
0	41.6	51.8	6.6

(Groschuff, Z. anorg. 1904, **40.** 11.)

Potassium silver nitrate, KNO_3, $AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26.** 357.)

$3KNO_3$, $AgNO_3$. Sol. in H_2O. (Rose, Pogg. **106.** 320.)

Potassium thallic nitrate, $2KNO_3$, $Tl(NO_3)_3+H_2O$.

Decomp. by H_2O. (Meyer, Z. anorg. 1900, **24.** 361.)

Potassium thorium nitrate, $4KNO_3$, $Th(NO_3)_4$.

Very sol. in H_2O and alcohol. (Berzelius.)

Hydroscopic, very unstable. (Meyer, Z. anorg. 1901, **27.** 379.)

Hydroscopic; sol. in dil. HNO_3+Aq. (Meyer, Z. anorg. 1901, **27.** 378.)

Potassium thorium hydrogen nitrate, $3KNO_3$, $Th(NO_3)_4$, $3HNO_3$.

Decomp. in the air. (Meyer, B. 1900, **33.** 2140.)

$+4H_2O$. Sol. in HNO_3 of 1.2 sp. gr. Effloresces in the air. (Meyer, Z. anorg. 1901, **27.** 380.)

Potassium uranyl nitrate, $K(UO_2)(NO_3)_3$.

Decomp. by H_2O. Sol. in conc. HNO_3. (Meyer, B. 1903, **36.** 4057.)

Solubility in H_2O at t°.

t°	In 100 pts. of the solution: Pts. by wt. UO_2	Pts. by wt. K	Pts. by wt. NO_3	Solid phase
0.5	31.98	1.72	...	Double salt + KNO_3
13.0	33.40	2.74	...	"
25.0 a)	37.08	4.05	23.49	"
b)	37.06	3.98	23.46	"
45.0	42.18	5.16	...	"
59.0	41.65	6.03	...	"
80.6 a)	43.72	6.42	...	Double salt
b)	43.70	6.34	...	"

Potassium uranyl nitrate is decomp. by H_2O at temp. below 60°; above 60° it is sol. in H_2O without decomp.

(Rimbach, B. 1904, **37.** 473.)

Potassium nitrate barium sulphate, KNO_3, $2BaSO_4$.

Easily decomp. Sol. in conc. H_2SO_4. (Silberberger, M. 1904, **25.** 251.)

Potassium nitrate phosphomolybdate.

See **Phosphomolybdate nitrate, potassium.**

Potassium nitrate sulphate, KNO_3, $KHSO_4$.

Decomp. by H_2O and alcohol. (Jacquelain.)

Potassium nitrate sulphotungstate, $2KNO_3$, K_2WS_4 (?).

Very sol. in hot or cold H_2O. Insol. in alcohol. (Berzelius.)

Potassium nitrate tungstate (?).

100 pts. boiling H_2O dissolve 5 pts. salt. (Storer's Dict., p. 393.)

Potassium nitrate zinc iodide.

Permanent. Easily sol. in H_2O. Insol. in alcohol. (Anthon.)

Praseodymium nitrate, $Pr(NO_3)_3+6H_2O$.

Sol. in H_2O. (von Schule, Z. anorg. 1898, **18.** 355.)

Praseodymium rubidium nitrate, $[Pr(NO_3)_5]Rb_2+4H_2O$.

Hydroscopic. (Jantsch, Z. anorg. 1911, **69.** 230.)

Praseodymium sodium nitrate, $Pr(NO_3)_3$, $2NaNO_3+H_2O$.

Sol. in H_2O. (von Schule, Z. anorg. 1898, **18.** 356.)

Praseodymium zinc nitrate, $2Pr(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 14.69 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Radium nitrate.

Has apparently the same solubility in H_2O as the corresponding Ba comp. (Curie, Dissert. **1903.**)

Rhodium nitrate, $Rh(NO_3)_3+2H_2O$ (?).

Deliquescent. Sol. in H_2O. Insol. in alcohol. (Claus.)

Rhodium uranyl nitrate, $2(UO_2)(NO_3)_2Rh_2(NO_3)_6+10H_2O$.

Sol. in H_2O and acids; insol. in aq. alkalies. (Lancien, C. C. **1912,** I. 208.)

Rubidium nitrate, $RbNO_3$.

100 pts. H_2O dissolve 20.1 pts. at 0°; 43.5 pts. at 10°. (Bunsen.)

Solubility in H_2O at t°.

t°	G. $RbNO_3$ per 100 g. H_2O	G. $RbNO_3$ per 100 g. Solution	t°	G. $RbNO_3$ per 100 g. H_2O	G. $RbNO_3$ per 100 g. Solution
0	19.5	16.3	60	200	66.7
10	33.0	24.8	70	251	71.5
20	53.3	34.6	80	309	75.6
30	81.3	44.8	90	375	78.9
40	116.7	53.9	100	452	81.9
50	155.6	60.9	118.3	617	86.1

(Berkeley, Trans. Roy. Soc. 1904, **203.** A. 207.)

100 g. H_2O dissolve 66.855 g. $RbNO_3$ at 25°. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1148.)

Sp. gr. 20°/4° of a normal solution of $RbNO_3$ = 1.100835; of a 0.5 normal solution = 1.04989. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of $RbNO_3$+Aq.

G.-equiv. $RbNO_3$ per l. at 18° =	0.5035	1.008
Sp. gr. at 6°/6°	1.05342	1.10566
Sp. gr. at 18°/18°	1.05226	1.10361
Sp. gr. at 30°/30°	1.05156	1.10222

G.-equiv. $RbNO_3$ per l. at 18° =	2.000	2.685
Sp. gr. at 6°/6°	1.20655	
Sp. gr. at 18°/18°	1.20302	1.27066
Sp. gr. at 30/30°	1.20036	1.26717

(Clausen, W. Ann. 1914, (4) **44.** 1069.)

Easily sol. in HNO_3. (Schultz, Zeit. Ch. (2) **5.** 531.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Rubidium hydrogen nitrate, $RbNO_3$, HNO_3.

Fairly stable in air. (Wells, Am. Ch. J. 1901, **26.** 273.)

Rubidium *di*hydrogen nitrate, $RbNO_3$, $2HNO_3$.

Decomp. rapidly in air. (Wells, Am. Ch. J. 1901, **26.** 273.)

$2RbNO_3$, $5HNO_3$. Decomp. by H_2O. Known only in solution in HNO_3+Aq. (Ditte, A. ch. (5) **18.** 320.)

Rubidium silver nitrate, $RbNO_3$, $AgNO_3$.

Sol. in H_2O. (Russell and Maskelyne, Roy. Soc. Proc. **26.** 357.)

Rubidium thorium nitrate, $Rb_2Th(NO_3)_6$.

Sl. sol. in HNO_3; decomp. by H_2O. (Meyer, Z. anorg. 1901, **27.** 384.)

Rubidium uranyl nitrate, $Rb(UO_2)(NO_3)_3$.

Decomp. by H_2O. Sol. in conc. HNO_3. (Meyer, B. 1903, **36.** 4057.)

Solubility of H_2O at t°.

t°	In 100 pts. of the solution				Solid phase
	Pts. by wt. UO_2	Pts. by wt. NO_3	Pts. by wt. Rb	Pts. by wt. total salt	
25	a) 35.42	19.72	4.63	59.57	Double salt + $RbNO_3$
"	b) 35.40	19.76	4.67	59.64	"
80	a) 34.64	..	11.01	69.46	Double salt
"	b) 34.68	...	11.01	69.52	"

Rubidium uranyl nitrate is decomp. by H_2O at low temp.; at 80° it is sol. in H_2O without decomp.

(Rimbach, B. 1904, **37.** 476.)

Samarium nitrate, $Sm(NO_3)_3+6H_2O$.

Easily sol. in H_2O. (Cleve, C. N. **48.** 74.)
Very hydroscopic. (Demarçay, C. R. 1900, **130.** 1187.)

Samarium zinc nitrate, $2Sm(NO_3)_3$, $3Zn(NO_3)_2+24H_2O$.

1 l. sat. solution in HNO_3+Aq (sp. gr. 1.325) contains 36.47 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, **76.** 321.)

Scandium nitrate, basic.

Sol. in H_2O. (Nilson, B. **13.** 1444.)
$ScOH(NO_3)_2+H_2O$. (Crookes, Roy. Soc. Proc. 1908, **80.** A. 518.)
$Sc_2O(NO_3)_4$. (Crookes.)

Scandium nitrate, $Sc(NO_3)_3$.

(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)
$+4H_2O$. Very sol. in H_2O. (Crookes.)

Silver nitrate, $AgNO_3$.

100 pts. H_2O at 11° dissolve 127.7 pts. (Schnauss, Arch. Pharm. (2) **82.** 260.)
100 pts. H_2O dissolve at:

0°	19.5°	54°	85°	110°	
121.9	227.3	500	714	1111	pts. $AgNO_3$.

(Kremers, Pogg. **92.** 497.)

100 pts. H_2O dissolve 1622.5 pts. at 125°, and 1941.4 pts. at 133°. (Tilden and Shenstone, Phil. Trans. **1884.** 23.)
Sat. solution boils at 125°. (Kremers.)

Solubility in H_2O at t°.
Sat. $AgNO_3$+Aq contains % $AgNO_3$ at t°.

t°	% $AgNO_3$	t°	% $AgNO_3$
—7	46.2	36.5	75.7
—7	46.0	40.5	76.8
—5	47.6	45	77.1
—1	52.4	48	78.5
—1	51.9	73	84.0
+5	56.3	122	88.7
10	61.2	134	92.1
15.5	66.1	135	92.8
20	67.8	135	92.7
26	71.1	148	93.3
29	73.0	160	95.2
31	73.8	182	96.9

(Étard, A. ch. 1894, (7) **2.** 526.)

100 g. sat. $AgNO_3$+Aq at 15.5° contain 65.5 g. $AgNO_3$. (Greenish and Smith, Pharm. Jour. 1903, **71.** 881.)
Solubility of $AgNO_3$ in H_2O at 30° = 10.31 mol.-litre. (Masson, Chem. Soc. 1911, **99.** 1136.)
100 g. $AgNO_3$+Aq sat. at 30° contain 73.0 g. $AgNO_3$. (Schreinemakers and de Baat, Arch. Néer. Sc. 1911, (2) **15.** 415.)
100 g. sat. $AgNO_3$+Aq contain 53.5 g. $AgNO_3$ at 0°; 66.7 g. at 18°. (Mylius, Z. anorg. 1912, **74.** 411.)
Sp. gr. of aqueous solution, according to C. K. = Chemiker Kalender; K. M. = Kohlrausch by Mendelejeff (Z. anal. **27.** 284); and K = Kohlrausch (W. Ann. **1879.** 1), containing:

	5	10	15	20% $AgNO_3$,
C. K.	1.041	1.080	1.125	1.160
K. M.	1.0440	1.0901	...	1.1969
K.	1.0422	1.0893	1.1404	1.1958

	25	30	35	40% $AgNO_3$,
C. K.	1.206	1.251	...	...
K. M.	...	...	...	1.4791
K.	1.2555	1.3213	1.3945	1.4773

	45	50% $AgNO_3$.
K.	1.5705	1.6745

Sp. gr. of $AgNO_3$+Aq at 25°.

Concentration of $AgNO_3$	Sp. gr.
1–normal	1.1386
1/2– "	1.0692
1/4– "	1.0348
1/8– "	1.0173

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

Sol. in 500 pts. HNO_3; 30 pts. $2HNO_3$, $3H_2O$ at 20°; and 6 pts. $2HNO_3$, $3H_2O$ at 100°. (Schultz, Zeit. Ch. **1869.** 531.)
Insol. in conc. HNO_3. (Warren, C. C. **1897.** I, 438.)

Solubility of $AgNO_3$ in HNO_3+Aq at 25°.

G. mol. per l.		G. $AgNO_3$ per l.	Sp. gr. 25°
HNO_3	$AgNO_3$		
0	10.31	1752	2.3921
0.404	9.36	1591	2.2754
0.962	8.08	1373	2.1243
1.698	6.54	1111	1.9402
2.834	4.526	769.1	1.7052
4.497	2.590	440.1	1.4980
5.992	1.698	288.6	1.4195
8.84	0.843	143.2	1.3818
12.53	0.347	58.90	1.3976

(Masson, Chem. Soc. 1911, **99.** 1132.)

$AgNO_3+NH_4NO_3$. Solubility of $AgNO_3$ in NH_4NO_3+Aq. *See under* NH_4NO_3.
$AgNO_3+KNO_3$. Solubility of $AgNO_3$ $+KNO_3$ in H_2O. *See under* KNO_3.

$AgNO_3+AgNO_2$.
Solubility of $AgNO_3+AgNO_2$ at 18°.

G. per l.		G. per l.	
$AgNO_3$	$AgNO_2$	$AgNO_3$	$AgNO_2$
0.000	3.184	3.512	2.201
0.439	3.042	7.024	1.799
0.878	2.926	14.048	1.480
1.756	2.601		

(Naumann and Rucker, B. 1905, **38.** 2293.)
See also under $AgNO_2$.

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
Sol. in 4 pts. boiling alcohol.
Sol. in 10 pts. alcohol. (Dumas.)
Sol. in 11 pts. alcohol of 90%. (Hager.)

Solubility in 100 pts. alcohol of given vol. % at t°.

t°	95%	80%	70%	60%
15	3.8	10.3	22.1	30.5
50	7.3	...	...	58.1
75	18.3	42.0	...	89.0

t°	50%	40%	30%	20%	10%
15	35.8	56.4	73.7	107	158
50	....	98.3	....	214	...
75	....	160	....	340	...

(Eder, J. pr. (2) **17.** 44.)

100 pts. absolute methyl alcohol dissolve 3.72 pts. at 19°; 100 pts. absolute ethyl alcohol dissolve 3.1 pts. at 19°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Only traces are sol. in absolute alcohol or ether. 100 pts. of a mixture of 1 vol. alcohol (95 vol. %)+1 vol. pure ether dissolve 1.6 pts. $AgNO_3$ at 15°; 100 pts. of 2 vols. alcohol +1 vol. ether dissolve 2.3 pts. $AgNO_3$. (Eder, J. pr. 1878, (2) **17.** 45.)

Solubility of $AgNO_3$ in ethyl alcohol+Aq at 30°.

% by wt. H_2O	% by wt. alcohol	% by wt. $AgNO_3$
27.0	...	73.0
27.71	2.8	69.49
30.80	13.67	55.53
32.10	20.13	47.77
31.40	25.85	42.75
28.95	37.26	33.79
27.91	44.54	27.55
20.92	64.42	14.66
6.83	86.54	6.63

(Schreinemakers, Z. phys. Ch. 1909, **65.** 571.)

Solubility of $AgNO_3+KNO_3$ in alcohol. See under KNO_3.
Sol. in methyl, ethyl, and isobutyl alcohols, CCl_4, $CHCl_3$, acetone and pyridine. (Wilcox, J. phys. Chem. 1910, **14.** 587.)
100 pts. H_2O sat. with ether dissolve 88.4 pts. $AgNO_3$ at 15°. (Eder, *l. c.*)
Sol. in glycerine.
Sol. in benzonitrile. 100 g. benzonitrile dissolve about 105 g. $AgNO_3$ at 18°. (Naumann and Schier, B. 1914, **47.** 1369.)
1 pt. acetonitrile dissolves about 1.5 pts. $AgNO_3$. (Scholl and Steinkopf, B. 1906, **39.** 4398.)
Easily sol. in methyl, ethyl, and amyl amine. (Shinn, J. phys. Chem. 1907, **11.** 538.)
Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

0.35 pts. are sol. in 100 pts. acetone at 14°.
0.35 " " " " 100 " " " 59°.
(Laszyznski, B. 1894, **27.** 2287.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)
1 g. $AgNO_3$ is sol. in 227 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° =0.798. (Naumann, B. 1904, **37.** 4339.)
Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)
Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)
100 g. C_6H_6 dissolve 0.022 g. $AgNO_3$ at 35°; 0.044 g. at 40.5°. (Linebarger, Am. J. Sci. 1895, **49.** 48.)
Mol. weight determined in piperidine, pyridine and benzonitrile. (Werner, Z. anorg. 1897, **15.** pp. 17, 23 and 32.)

Solubility of $AgNO_3$ in pyridine at t°.

t°	G. $AgNO_3$ per 100 g. C_5H_5N	Solid phase
−48.5°*	0	C_5H_5N
−50.5	3	"
−53	6	"
−59	9	"
−65	...	$C_5H_5N+AgNO_3, 6C_5H_5N$
−51.25	11.1	$AgNO_3, 6C_5H_5N$
−44	11.7	"
−40	12.2	"
−35	12.6	"
−30	13.9	"
−25	17.6	"
−24	....	" $+AgNO_3, 3C_5H_5N$
−22	18.8	$AgNO_3, 3C_5H_5N$
−10	20.03	"
0	22.34	"
+10	27.21	"
20	33.64	"
30	40.86	"
40	53.52	"
45	62.26	"
46	63.06	"
47	66.35	"
48	70.85	"
48.5	....	" $+AgNO_3, 2C_5H_5N$
45	69.85	$AgNO_3, 2C_5H_5N$
50	72.25	"
60	.78.60	"
70	89.10	"
80	121.21	"
87	215.02	"
80	228.5	"
74	230.6	"
74	235.4	"
80	230.4	"
87	237.1	"
90	241.9	"
100	253.8	"
110	271.4	"

* M. pt.

(Kahlenberg and Brewer, J. phys. Ch. 1908, **12.** 283.)

Silver nitrate acetylide, $AgNO_3, AgHC_2$.

(Willgerodt, B. 1895, **28.** 2108.)

$AgNO_3, Ag_2C_2$. Ppt. (Chavastelon, C. R. 1897, **124.** 1365.)

$2AgNO_3, Ag_2C_2$. (Chavastelon.)

Silver nitrate ammonia, $AgNO_3, NH_3$.

Partly sol. in H_2O; rather sol. in alcohol. Sl. sol. in ether. (Reychler, B. **16.** 990.)

Very sol. in liquid ammonia below —10°. (Joannis, C. R. 1894, **118.** 1151.)

$AgNO_3, 2NH_3$. Easily sol. in H_2O. (Mitscherlich.)

1 l. alcohol dissolves 0.0383 g. mols. (Kurilow, C. C. **1903.** II, 97.)

$AgNO_3, 3NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20.** 153.)

Silver nitrate antimonide, $AgNO_3, Ag_3Sb$.

Decomp. at once by H_2O. (Poleck and Thümmel, B. **16.** 2435.)

Silver nitrate arsenide, $AgNO_3, Ag_3As$.

Decomp. at once by H_2O. (Poleck and Thümmel.)

Silver nitrate bromide, $AgNO_3, AgBr$.

Decomp. immediately by H_2O or alcohol, with separation of AgBr. (Risse, A. **111.** 39.)

Silver nitrate chloride, $AgNO_3, AgCl$.

Quickly decomp. with H_2O; more slowly with absolute alcohol; not decomp. by ether-alcohol. (Reichert, J. pr. **92.** 237.)

Silver nitrate cyanide, $2AgNO_3, AgCN$.

Decomp. by H_2O, not by alcohol. (Hellwig, Z. anorg. 1900, **25.** 177.)

Silver nitrate iodide, $AgNO_3, AgI$.

Cold H_2O separates AgI, which redissolves on heating. (Stürenberg, Arch. Pharm. (2) **143.** 12.) Sol. in little H_2O without decomp.; more H_2O separates AgI. (Kremers, J. pr. **71.** 54.) Insol. in absolute alcohol. Sol. in conc. $AgNO_3$+Aq.

$2AgNO_3, AgI$. Sol. in little but decomp. by more boiling H_2O. (Risse, A. **111.** 39.)

Silver nitrate mercuric oxide, $AgNO_3, 2HgO$.

Decomp. by H_2O. Sol. in HNO_3 and H_2SO_4. (Finci, Gazz. ch. it. 1910, **41.** (2) 548.)

Silver nitrate phosphide, $3AgNO_3, Ag_3P$.

(Warren, C. N. **56.** 113.)

Silver nitrate silicide, $4AgNO_3, AgSi$.

(Büchner, Ch. Ztg. **9.** 484.)

Silver nitrate silicate, $2AgNO_3, 3Ag_4SiO_4$.

Sol. in dil. HNO_3+Aq, but SiO_2 separates out after heating. (Rousseau and Tite, C. R. **114.** 294.)

Silver nitrate sulphide, $AgNO_3, Ag_2S$.

Decomp. by H_2O. (Poleck and Thümmel, B. **16.** 2435.)

Silver nitrate sulphocyanide, $2AgNO_3$, AgSCN.

Decomp. by H_2O, not by alcohol. (Hellwig, Z. anorg. 1900, **25.** 178.)

Sodium nitrate, $NaNO_3$.

Deliquescent in moist air. Sol. in H_2O with absorption of heat. 75 pts. $NaNO_3$ mixed with 100 pts. H_2O at 13.2° lower the temperature 18.5°. (Rüdorff, B. **2.** 68.)

Sol. in 1.58 pts. H_2O at	—6°.	(Marx.)
" 0.46 " "	+119°.	(Marx.)
" 2.89 " "	2°.	(Osann.)
" 1.12 " "	28°.	(Osann.)
" 0.79 " "	47°.	(Osann.)
" 1.14 " "	18.5°.	(Kopp.)
" 1.136 " "	18.75°.	(Karsten.)
" 1.16 " "	20°.	(Schiff, A. **109.** 326.)
" 2 " "	18.75°.	(Abl.)

100 pts. H_2O at t° dissolve pts. $NaNO_3$.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
—6	68.80	50	111.13
0	79.75	60	119.94
10	84.30	70	129.63
16	87.63	80	140.72
20	89.55	90	153.63
30	95.37	100	168.20
40	102.31	120	225.30

(Poggiale, A. ch. (3) **8.** 469.)

100 pts. H_2O at 119° dissolve 150 pts. $NaNO_3$. (Griffiths.)

$NaNO_3$+Aq sat. at 18.75° has 1.3769 sp. gr., and 100 pts. H_2O have dissolved 88.001 pts. $NaNO_3$. (Karsten.)

$NaNO_3$+Aq sat. in cold contains 33.3% $NaNO_3$. (Fourcroy.)

$NaNO_3$+Aq sat. at 12.5° contains 34% $NaNO_3$. (Hassenfratz.)

100 pts. H_2O at 15.5° dissolve 33 pts.; at 52°, 100 pts. $NaNO_3$. (Ure's Dict.)

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	73.0	60.65	125.5
13.9	81.6	99.9	173.6
44.65	110.5	119.7	211.4

(Nordenskjöld, Pogg. 136 312.)

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	70.94	70	142.31
10	78.57	80	153.72
20	87.97	90	165.55
30	98.26	100	178.18
40	109.01	110	194.26
50	120.00	119.4	213.43
60	131.11	...	...

(Maumené, C. R. 58. 81.)

100 pts. $NaNO_3$+Aq sat. at 14° contain 43.88 pts. $NaNO_3$; at 15°, 44.53 pts. $NaNO_3$. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O dissolve 84.21–84.69 pts. $NaNO_3$ at 15.6°, and sat. solution has sp. gr. 1.337–1.378. (Page and Keightley, Chem. Soc. (2) **10.** 556.)

100 pts. H_2O dissolve pts. $NaNO_3$ at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	66.69	18	83.62
2	70.97	21	85.73
4	71.04	26	90.33
8	75.65	29	92.93
10	76.31	36	99.39
13	79.00	51	113.63
15	80.60	68	125.07

Solubility is constant from 0° to —15.7°, when $NaNO_3+7H_2O$ separates out. (Ditte, C. R. **80.** 1164.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $NaNO_3$	t°	Pts. $NaNO_3$
0	72.9	60	122
1	74.7	61	124
2	75.4	62	125
3	76.0	63	126
4	76.7	64	127
5	77.4	65	128
6	78.1	66	130
7	78.7	67	131
8	79.4	68	132
9	80.1	69	133
10	80.8	70	134
11	81.4	71	136
12	82.0	72	137
13	82.7	73	138
14	83.4	74	139
15	84.0	75	140
16	84.7	76	142
17	85.4	77	143
18	86.1	78	145
19	86.8	79	146
20	87.5	80	148
21	88.3	81	149
22	89.0	82	151
23	89.7	83	152
24	90.3	84	153
25	91.0	85	155
26	91.8	86	156
27	92.5	87	158
28	93.2	88	159
29	94.0	89	161
30	94.9	90	162
31	96.0	91	164
32	96	92	166
33	97	93	168
34	98	94	169
35	99	95	171
36	100	96	173
37	100	97	175
38	101	98	177
39	102	99	178
40	102	100	180
41	103	101	182
42	104	102	184
43	105	103	186
44	106	104	188
45	107	105	190
46	108	106	192
47	109	107	194
48	110	108	196
49	111	109	198
50	112	110	200
51	113	111	202
52	114	112	204
53	115	113	207
54	116	114	209
55	117	115	211
56	118	116	213
57	119	117	215
58	120	117.5	216.4
59	211	...	...

(Mulder, Scheik. Verhandel. **1864.** 83.)

Sat. solution at b.-pt. contains 216.4 pts. $NaNO_3$ (Mulder); 218.5 pts. $NaNO_3$ (Marx); 213.4 pts. $NaNO_3$ (Maumené); 211.4 pts. $NaNO_3$ (Nordenskjöld); 224.8 pts. $NaNO_3$ (Legrand); 150 pts. $NaNO_3$ (Griffiths).

Sat. $NaNO_3$+Aq contains at:

120°	130°	172°	180°	199°	
66.8	67.5	77.1	78.1	82.0%	$NaNO_3$,
220°	250°	255°	290°	313° (mpt.).	
83.5	89.5	91.5	97.5	100%	$NaNO_3$.

(Étard, A. ch. 1894, (7) **2.** 527.)

100 g. sat. $NaNO_3$+Aq contain 42.47 g. $NaNO_3$ at 0°. (Coppadoro, Rass. Min. 1911, XVII, **35.** 123.)

100 g. sat. $NaNO_3$+Aq contain 49.16 g. $NaNO_3$ at 30°. (Coppadoro, Rass. Min. 1912, **37.** 7.)

100 g. H_2O dissolve 92.14 g. $NaNO_3$ at 25°. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1148.)

The solubility of crystals on different faces has been determined by Lebrun. (Belg. Acad. Bull. **1913.** 953.)

Sp. gr. of $NaNO_3$+Aq at 19.5°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
12.057	1.0844	39.860	1.3176
22.726	1.1667	46.251	1.3805
31.987	1.2450	...	...

(Kremers, Pogg. **95.** 120.)

Sp. gr. of $NaNO_3$+Aq at 20.2°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
1	1.0065	26	1.1904
2	1.0131	27	1.1987
3	1.0197	28	1.2070
4	1.0264	29	1.2154
5	1.0332	30	1.2239
6	1.0399	31	1.2325
7	1.0468	32	1.2412
8	1.0537	33	1.2500
9	1.0606	34	1.2589
10	1.0676	35	1.2679
11	1.0746	36	1.2770
12	1.0817	37	1.2863
13	1.0889	38	1.2958
14	1.0962	39	1.3055
15	1.1035	40	1.3155
16	1.1109	41	1.3225
17	1.1184	42	1.3355
18	1.1260	43	1.3456
19	1.1338	44	1.3557
20	1.1418	45	1.3659
21	1.1498	46	1.3761
22	1.1578	47	1.3864
23	1.1659	48	1.3968
24	1.1740	49	1.4074
25	1.1822	50	1.4180

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Sp. gr. of $NaNO_3$+Aq at 18°.

% $NaNO_3$	Sp. gr.	% $NaNO_3$	Sp. gr.
5	1.0327	20	1.1435
10	1.0681	30	1.2278

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $NaNO_3$+Aq at 20°, containing mols. $NaNO_3$ in 100 mols. H_2O.

Mols $NaNO_3$	Sp. gr.
2	1.05980
5	1.13813

(Nicol, Phil. Mag. (5) **16.** 122.)

The saturated solution boils at 117.5°. (Mulder.)
" " " 118.9°. (Griffiths.)
" " " 119°. (Marx.)
" " " 119.4°. (Maumené.)
" " " 119.7° (Nordenskjöld.)
" " " 121°. (Legrand.)
" " " 122–123°. (Kremers.)

$NaNO_3$+Aq forms a crust at 118°, and contains 194 pts. $NaNO_3$ to 100 pts. H_2O; highest temp. observed, 120.5°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of $NaNO_3$+Aq containing pts. $NaNO_3$ to 100 pts. H_2O. G=according to Gerlach (Z. anal. **26.** 433); L=according to Legrand (A. ch. (2) **59.** 431).

B.-pt.	G	L	B.-pt.	G	L
101°	9	9.3	112°	121.5	120.3
102	18.5	18.7	113	133	131.3
103	28	28.2	114	144.5	142.4
104	38	37.9	115	156	153.7
105	48	47.7	116	168.5	165.2
106	58	57.6	117	181	176.8
107	68	67.7	118	194	188.6
108	78.5	77.9	119	207.5	200.5
109	89	88.3	120	222	212.6
110	99.5	98.8	121	...	224.8
111	110.5	109.5	...	...	...

50 pts. $NaNO_3$ mixed with 100 pts. snow at —1° give a temp. of —17.5°. (Rüdorff, Pogg. **122.** 337.)

Sp. gr. of $NaNO_3$+Aq at t°.

G. $NaNO_3$ dissolved in 100 g. H_2O	G. $NaNO_3$ in 100 g. of the solution	t°	Sp. gr.
4.166	4	17.8°	1.0276
11.111	10	13.9°	1.0704
25.000	20	12°	1.1441

(de Lannoy, Z. phys. Ch. 1895, **18.** 465.)

Sp. gr. of $NaNO_3$+Aq at 20.1°, when p = per cent strength of sol.; d = observed density; w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w\right)$

p	d	w
42.05	1.3380	0.56267
35.65	1.2765	0.45510
31.72	1.2407	0.39365
23.24	1.1696	0.27180
17.370	1.1228	0.19505
11.915	1.0819	0.12888
9.665	1.0656	0.10300
7.039	1.0468	0.07369
4.241	1.0273	0.04357
1.589	1.0096	0.01604

(Barnes, J. phys. Chem. 1898, **2.** 545.)

Sp. gr. 20°/4° of a normal solution of $NaNO_3$ = 1.05386; of a 0.5 normal solution = 1.02646. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of sat. $NaNO_3$+Aq at t°.

t°	G. $NaNO_3$ sol. in 100 g. H_2O	Sp. gr.
—10	68.0	1.342
0	43.0	1.358
10	80.5	1.377
20	88.0	1.387
30	96.2	1.406
40	104.9	1.418
50	114.0	1.437
60	124.6	1.456
70	136.0	1.467

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, **44.** 1565.)

Sol. in 66 pts. HNO_3; in 32 pts. $2HNO_3$, $3H_2O$ at 32°; in 4 pts. $2HNO_3$, $3H_2O$ at 123°. (Schultz, Zeit. Ch. (2) **5.** 531.)

Solubility in HNO_3+Aq at 0°.

G. per 100 cc. of solution		Sp. gr.
$NaNO_3$	HNO_3	
56.5	0.00	1.341
54.2	1.67	1.338
51.48	3.59	1.331
48.42	5.55	1.324
44.88	7.92	1.312
41.44	10.65	1.308
33.61	17.02	1.291
29.86	20.33	1.285
26.46	23.48	1.282
20.00	30.26	1.276
15.32	36.09	1.276
10.97	44.76	1.291

(Engel, C. R. 1887, **104.** 911.)

Solubility of $NaNO_3$ in NH_4OH+Aq at 15°.

G. per 100 g. H_2O		Sp. gr.
NH_3	$NaNO_3$	
13.87	75.03	1.253
17.28	73.99	1.233
20.38	73.18	1.212

(Fedotieff and Koltunoff, Z. anorg. 1914, **85.** 251.)

$NaNO_3$+Na_2CO_3. (*See* Na_2CO_3.)

Sol. in sat. NH_4Cl+Aq.

Very rapidly sol. in sat. $BaCl_2$+Aq with pptn. of $Ba(NO_3)_2$.

Sol. in sat. KCl+Aq, with formation of KNO_3.

Sol. in sat. NH_4NO_3+Aq. (*See* NH_4NO_3.)

Sol. in sat. $Ba(NO_3)_2$+Aq, with partial pptn. of $Ba(NO_3)_2$. (See $Ba(NO_3)_2$.)

Sol. in sat. $Pb(NO_3)_2$+Aq, with subsequent pptn. of $Pb(NO_3)_2$. (See $Pb(NO_3)_2$.)

$NaNO_3$+KNO_3.

Sol. in sat KNO_3+Aq; solution thus made at 18° contains 54.33% mixed salt, or 100 pts. H_2O dissolve 118.98 pts. mixed salt, viz. 89.53 pts. $NaNO_3$ and 29.45 pts. KNO_3. (*See* KNO_3.)

$NaNO_3$+$Sr(NO_3)_2$.

If $Sr(NO_3)_2$+Aq sat. at 14.5° is sat. with $NaNO_3$, 100 pts. H_2O dissolve:

$NaNO_3$ . .	83.7	66.4	....
$Sr(NO_3)_2$ . .	....	51.0	62.0
		117.4	

(Mulder.)

$NaNO_3$+$NaNO_2$. *See* under $NaNO_2$.

$NaNO_3$+NaCl.

100 pts. H_2O dissolve 24.91 pts. NaCl+54.55 pts. $NaNO_3$ = 79.46 pts. of the two salts at 20°. (Nicol, Phil. Mag. (5) **31.** 386.)

100 pts. H_2O dissolve at 18.75°:

	1	2	3	4	5	6
NaCl .	36	25.22	24.96	24.98	....	24.6
$NaNO_3$	..	52.89	52.84	52.82	86.6	56.8

2. Sat. NaCl+Aq treated with $NaNO_3$.
3. Sat. $NaNO_3$+Aq treated with NaCl.
4. Simultaneous treatment of the two salts by H_2O. (Karsten.)
6. Excess of both salts+Aq warmed and cooled to 20°. (Rüdorff, B. **6.** 484.)

Solubility of NaCl with addition of $NaNO_3$ at 15.5°.

Sp. gr.	100 ccm. contain in g.		
	NaCl	H_2O	$NaNO_3$
1.2025	31.78	88.47	0.00
1.2305	27.89	87.63	7.53
1.2580	26.31	86.25	13.24
1.2810	23.98	82.66	21.58
1.3090	22.30	80.42	28.18
1.3345	20.40	79.25	33.80
1.3465	19.40	77.37	37.88
1.3465	19.67	77.34	37.64

$NaNO_3$ separated in last two solutions.

Solubility of $NaNO_3$ with addition of NaCl at 15°.

Sp. gr.	100 ccm. contain in g.		
	$NaNO_3$	H_2O	NaCl
1.3720	62.38	74.82	0
1.3645	56.56	75.69	4.00
1.3585	52.09	75.71	7.24
1.3530	47.08	76.86	11.36
1.3495	42.66	76.96	15.33
1.3485	39.90	77.14	17.81
1.3485	38.73	77.15	18.97
1.3485	38.02	77.49	19.34

NaCl separated in last two solutions.
(Bodländer, Z. phys. Ch. **7.** 360.)

Solubility of $NaNO_3$ in NaCl+Aq at 15°.

Sp. gr.	G. per 100 cc. sat. solution		
	NaCl	$NaNO_3$	H_2O
1.3720	0	62.38	74.82
1.3645	4.0	56.76	75.69
1.3585	7.24	52.09	75.71
1.3530	11.36	47.08	76.86
1.3495	15.33	42.66	76.96
1.3485	17.81	39.90	77.14
1.3485	18.97*	38.73*	77.15
1.3485	19.34*	38.02*	77.49

* Solutions sat. with both salts.
(Bodländer, Z. phys. Ch. 1891, **7.** 361.)

Solubility of $NaNO_3$+NaCl (g. in 100 g. H_2O) at 25°.

$NaNO_3$	NaCl	Solid phase
79.20	8.39	$NaNO_3$
68.38	16.32	"
56.56	23.74	$NaNO_3$+NaCl
39.20	27.56	NaCl
20.17	31.48	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, **2.** 245.)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91°. Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, **3.** 177; Chem. Soc. 1915, **108.** (2) 13.)
See also under NaCl.

$NaNO_3$+NaOH.

Solubility in NaOH+Aq at 0°. $NaNO_3$ = mols. $NaNO_3$ (in mg.) in 10 ccm. of solution; Na_2O = mols. Na_2O (in mg.) in 10 ccm. of solution.

$NaNO_3$	Na_2O	$NaNO_3$ +Na_2O	Sp. gr.
66.4	0	66.4	1.341
62.5	2.875	65.375	1.338
57.15	6.1	63.25	1.333
47.5	12.75	60.25	1.327
29.5	26	55.5	1.326
17.5	39	56.5	1.332
13.19	45.875	59.065	1.356
6.05	60.875	66.925	1.401

(Engel, Bull. Soc. (3) **6.** 16.)

Solubility in NaOH+Aq at 0°.

G. per 100 cc. solution		Sp. gr.
NaOH	$NaNO_3$	
0.0	56.50	1.341
2.30	53.19	1.338
4.89	48.63	1.333
10.21	40.42	1.327
20.83	25.10	1.326
31.25	14.89	1.332
36.76	11.22	1.356
48.75	5.15	1.401

(Engel, *l. c.*)

Easily sol. in K_2SO_4+Aq without pptn.
Easily sol. in Na_2SO_4+Aq without pptn.
Sol. in $MgSO_4$+Aq, at first to a clear solution, but afterwards $NaNO_3$ is pptd.
Very sol. in sat. $CuSO_4$+Aq, but double sulphate separates out.
Very sol. in $ZnSO_4$+Aq with pptn. of double sulphate. (Karsten.)

Solubility of $NaNO_3$ in $Na_2S_2O_3$+Aq at t°.

t°	% $NaNO_3$	% $Na_2S_2O_3$	Solid phase
9	33.31	12.26	$NaNO_3$
	22.57	23.41	" +$Na_2S_2O_3$, $5H_2O$
	4.22	34.77	$Na_2S_2O_3$, $5H_2O$
25	35.42	12.72	$NaNO_3$
	25.40	24.25	"
	19.90	31.81	" +$Na_2S_2O_3$, $5H_2O$
	18.02	32.83	$Na_2S_2O_3$, $5H_2O$
	4.33	40.50	"

(Kremann and Rothmund, Z. anorg. 1914, **86.** 373.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Hydrazine dissolves 26.6 pts. $NaNO_3$ at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)

100 pts. alcohol of 0.9 sp. gr. dissolve 10.5 pts. $NaNO_3$; 0.872 sp. gr., 6 pts.; 0.834 sp. gr., 0.38 pt.; insol. in alcohol of 0.817 sp. gr. (Kirwan.)

100 pts. alcohol of 61.4% by weight dissolve 21.2 pts. $NaNO_3$ at 26°. (Pohl. W. A. B. 6. 600.)

100 pts. alcohol of 62° Tr. dissolve 7.4 pts. $NaNO_3$ at 19.5°.

100 pts. alcohol of 93° Tr. dissolve 0.93 pt. $NaNO_3$ at 19.5°. (Wittstein.)

100 pts. alcohol containing % alcohol by weight dissolve pts. $NaNO_3$ at 15°, or 100 pts. solution contain % $NaNO_3$:

10	20	30	40	60	80% alcohol.
65.3	48.8	35.5	25.8	11.4	2.8 pts. $NaNO_3$.
39.5	32.8	26.2	20.5	10.2	2.7% $NaNO_3$.

(Schiff.)

100 pts. wood-spirit of 40% dissolve 32.3 pts. $NaNO_3$. (Schiff, A. **118.** 365.)

Solubility in alcohol at 16.5°.

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	$NaNO_3$
1.3745	0	75.25	62.20
1.3162	6.16	70.82	54.64
1.2576	11.60	68.10	46.06
1.2140	16.49	65.04	39.87
1.1615	22.17	61.67	32.31
1.0855	32.22	52.92	23.41
1.0558	37.23	48.50	19.85
1.0050	43.98	42.78	13.74
0.9420	52.60	32.13	9.47
0.9030	60.00	25.65	4.65
0.8610	63.16	21.31	1.63

(Bodländer, Z. phys. Ch. **7.** 317.)

100 pts. absolute methyl alcohol dissolve 0.41 pt. at 25°.

100 pts. absolute ethyl alcohol dissolve 0.036 pt. at 25°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility in alcohol at 40°.

Wt. % alcohol	G. $NaNO_3$ per 100 g. alcohol +Aq.
0	104.5
8.22	90.8
17.4	73.3
26.0	61.6
36.0	48.4
42.8	40.6
55.3	27.1
65.1	18.1
77.0	9.4
87.2	4.2

(Bathrick, J. phys. Ch. 1896, **1.** 162.)

Solubility in alcohol at 30°.

Wt. % alcohol in solvent	G. $NaNO_3$ per 100 g.	
	Solution	Water
0	49.10	96.45
5	46.41	91.15
10	43.50	85.55
20	37.42	74.75
30	31.31	65.10
40	25.14	55.95
50	18.94	46.75
60	12.97	37.25
70	7.81	28.25
90	1.21	12.25

(Taylor, J. phys. Ch. 1897, **1.** 723.)

Solubility in ethyl alcohol at 25°.

(Concentration of alcohol in g. mol. per 1000 g. H_2O.)

Normality	Solubility in 1000 g. H_2O	Mol. solubility
..	920.30	10.83
¼	908.80	10.70
½	896.60	10.54
1	870.95	10.24
2	825.35	9.70

(Armstrong and Eyre, Proc. R. Soc. 1910 (A), **84.** 127.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Solubility of $NaNO_3$ in acetone at 40°.

Wt. % acetone	G. $NaNO_3$ per 100 g. acetone +Aq
0.0	105
8.47	91.2
16.8	78.3
25.2	66.4
34.3	57.9
44.1	46.2
53.9	32.8
64.8	23.0
76.0	10.8
87.6	3.2

(Bathrick, J. phys. Ch. 1896, **1.** 162.)

Solubility of $NaNO_3$ in acetone at 30°.

Wt. % acetone in solvent	G. $NaNO_3$ per 100 g. Solution	G. $NaNO_3$ per 100 g. Water
0	49.10	96.45
5	46.96	93.20
9.09	45.11	90.40
20	40.10	83.70
30	35.08	77.20
40	29.80	70.75
50	24.34	64.40
60	18.55	59.95
70	13.15	50.50
80	7.10	38.20
90	1.98	20.20

(Taylor, Z. phys. Ch. 1897, **2.** 723.)

Sol. in glycerine.

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sodium thorium nitrate, $NaTh(NO_3)_5+9H_2O$.

Hydroscopic; sol. in dil. HNO_3 and Aq. (Meyer, Z. anorg. 1901, **27.** 381.)

Sodium nitrate sulphate, $NaNO_3$, $Na_2SO_4+{}^3/_2H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **12.** 44.)

$+H_2O$. Min. *Darapskite.*

Sodium nitrate tungstosilicate, $3Na_4W_{12}SiO_{40}.4NaNO_3+45H_2O$.

(Wyruboff, Chem. Soc. 1897, **72.** (2) 174.)

Strontium nitrate, $Sr(NO_3)_2$.

Sol. in 5 pts. cold, and 0.5 pt. boiling H_2O. (Dumas.)
" 2 " " 0.5 " " (Wittstein.)
" 2 " at 18.75°. (Abl.)

100 pts. sat. $Sr(NO_3)_2$+Aq at 19–20° contain 45.49 pts. $Sr(NO_3)_2$. (v. Hauer, J. pr. 98. 137.)

1 pt. $Sr(NO_3)_2$ dissolves in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
0	2.32	25	1.10	75	0.99
10	1.73	50	1.02	100	0.94

(Kremers, Pogg. **92.** 499.)

100 pts. H_2O dissolve at 0°, 39.5 pts. $Sr(NO_3)_2$ (Mulder); at 0°, 40.16 pts. $Sr(NO_3)_2$ (Poggiale); at 0°, 43.1 pts. $Sr(NO_3)_2$ (Kremers); at 100°, 101.1 pts. $Sr(NO_3)_2$ (Mulder); at 100°, 106.5 pts. $Sr(NO_3)_2$ (Kremers, Pogg. **92.** 499); at 100°, 119.25 pts. $Sr(NO_3)_2$ (Poggiale).

Solubility in 100 pts. H_2O at t°.

t°	Pts. $Sr(NO_3)_2$	t°	Pts. $Sr(NO_3)_2$	t°	Pts. $Sr(NO_3)_2$
0	39.5	36	90.7	73	96.0
1	41.2	37	90.8	74	96.2
2	42.8	38	91.0	75	96.4
3	44.3	39	91.1	76	96.5
4	45.8	40	91.3	77	96.7
5	47.3	41	91.4	78	96.8
6	48.8	42	91.5	79	97.0
7	50.3	43	91.6	80	97.2
8	51.8	44	91.8	81	97.4
9	53.4	45	91.9	82	97.5
10	54.9	46	92.1	83	97.7
11	56.5	47	92.2	84	97.9
12	58.0	48	92.3	85	98.0
13	59.6	49	92.5	86	98.2
14	61.2	50	92.6	87	98.4
15	62.8	51	92.8	88	98.6
16	64.4	52	92.9	89	98.8
17	66.0	53	93.1	90	99.0
18	67.6	54	93.2	91	99.2
19	69.2	55	93.4	92	99.4
20	70.8	56	93.5	93	99.6
21	72.5	57	93.6	94	99.8
22	74.1	58	93.8	95	100.0
23	75.8	59	93.9	96	100.2
24	77.4	60	94.0	97	100.4
25	79.0	61	94.2	98	100.6
26	80.7	62	94.3	99	100.9
27	82.4	63	94.5	100	101.1
28	84.1	64	94.6	101	101.3
29	85.8	65	94.8	102	101.6
30	87.6	66	94.9	103	101.8
31	89.5	67	95.1	104	102.0
31.3	90.0	68	95.2	105	102.3
32	90.2	69	95.4	106	102.5
33	90.3	70	95.6	107	102.7
34	90.5	71	95.7	107.9	102.9
35	90.6	72	95.9	...	...

(Mulder, Scheik. Verhandel. **1864.** 114.)

Sat. $Sr(NO_3)_2$+Aq contains at:

—6°	+14°	20°	32°	
24.5	35.9	39.8	46.9% $SrNO_3$,	
53°	56°	76°	94°	110°
47.2	47.8	49.1	50.4	50.2% $SrNO_3$.

(Étard, A. ch. 1894, (7) **2.** 528.)

79.27 g. anhydrous $Sr(NO_3)_2$ are sol. in 100 g. H_2O at 25°. (Parsons and Carson, J. Am. Chem. Soc. 1910, **32.** 1385.)

Solubility of $Sr(NO_3)_2$ in H_2O at t°.

t°	G. $Sr(NO_3)_2$ in 100 g. H_2O	Sp. gr.
0.58	40.124	1.2856
14.71	60.867	1.3938
26.40	82.052	1.4883
29.06	87.648	1.5110
30.28	88.577	1.5144
32.58	88.943	1.5141
39.74	90.086	1.5128
47.73	91.446	1.5115
61.34	93.856	1.5105
68.96	95.576	1.5106
78.98	97.865	1.5109
88.94	100.136	1.5117

(Berkeley and Appleby, Proc. R. Soc. 1911, (A) **85.** 503.)

100 g. of the sat. solution contain at 20°, 41.43 g. $Sr(NO_3)_2$. (Findlay, Chem. Soc. 1914, **105.** 782.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 19.5°.

% $Sr(NO_3)_2$	Sp. gr.	% $Sr(NO_3)_2$	Sp. gr.
1	1.009	21	1.192
2	1.017	22	1.202
3	1.025	23	1.213
4	1.034	24	1.223
5	1.041	25	1.233
6	1.049	26	1.246
7	1.059	27	1.257
8	1.068	28	1.268
9	1.076	29	1.280
10	1.085	30	1.292
11	1.095	31	1.304
12	1.103	32	1.316
13	1.113	33	1.330
14	1.122	34	1.340
15	1.131	35	1.354
16	1.140	36	1.367
17	1.150	37	1.381
18	1.160	38	1.395
19	1.170	39	1.410
20	1.181	40	1.422

(Kremers, calculated by Gerlach, Z. anal. **8.** 286.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 23.4°. a = no. of grms. × ½ mol. wt. dissolved in 1000 grms. H_2O; b = sp. gr. if a is $Sr(NO_3)_2$, $4H_2O$, ½ mol. wt. = 142; c = sp. gr. if a is $Sr(NO_3)_2$, ½ mol. wt. = 106.

a	b	c	a	b	c
1	1.078	1.081	5	1.303	1.350
2	1.146	1.155	6	1.345	1.407
3	1.205	1.224	7	1.383	...
4	1.257	1.284	...	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 17.5°.

% $Sr(NO_3)_2$	Sp. gr.	% $Sr(NO_3)_2$	Sp. gr.
10	1.083	40	1.422
20	1.180	Sat. sol.	1.52
30	1.294	....	....

(Gerlach, Z. anal. **27.** 283.)

Sp. gr. of $Sr(NO_3)_2$+Aq at t°.

t°	% $Sr(NO_3)_2$	Sp. gr.
14.0°	5	1.0420
14.3°	10	1.0859
14.5°	15	1.1319
14.5°	20	1.1816
14.5°	25	1.2364
14.4°	34.33	1.3470

(Long, W. Ann. 1880, **11.** 39.)

Sp. gr. of $Sr(NO_3)_2$+Aq at room temp. containing:

10.29	21.19	32.61% $Sr(NO_3)_2$.
1.0885	1.124	1.3067

(Wagner, W. Ann. 1883, **18.** 266.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 25°.

Concentration of $Sr(NO_3)_2$+Aq	Sp. gr.
1-normal	1.0822
½- "	1.0419
¼- "	1.0208
⅛- "	1.0104

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

$Sr(NO_3)_2$+Aq containing 10.50% $Sr(NO_3)_2$ has sp. gr 20°/20° = 1.0905.

$Sr(NO_3)_2$+Aq containing 25.51% $Sr(NO_3)_2$ has sp. gr. 20°/20° = 1.2440.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sp. gr. of $Sr(NO_3)_2$+Aq at 20° containing M g. mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001525	1.004207	1.008391	1.012646
M	0.10	0.25	0.50	0.75
Sp. gr.	1.016834	1.04201	1.08312	1.12386
M	1.00			
Sp. gr.	1.16354			

(Jones and Pearce, Am. Ch. J. 1907, **38.** 705.)

B.-pt. of $Sr(NO_3)_2$+Aq, containing pts. $Sr(NO_3)_2$ to 100 pts. H_2O.

B.-pt.	Pts. $Sr(NO_3)_2$	B.-pt.	Pts. $Sr(NO_3)_2$
100.5°	12	104°	81.4
101	24	104.5	89.6
101.5	34.8	105	97.6
102	45	105.5	105
102.5	54.4	106	112.2
103	63.6	106.3	116.5
103.5	72.6	...	...

(Gerlach, Z. anal. **26.** 418.)

Sat. $Sr(NO_3)_2$+Aq boils at 106.8°, and contains 112.9 pts. salt to 100 pts. H_2O. (Griffiths.)

Sat. $Sr(NO_3)_2$+Aq boils at 107.5–108° (Kremers); 107.9° (Mulder).

Sat. $Sr(NO_3)_2$+Aq forms a crust at 106.3°, and contains 116.5 pts. $Sr(NO_3)_2$ to 100 pts. H_2O; highest temp. observed was 107°. (Gerlach, Z. anal. **26.** 427.)

Very sl. sol. in conc. HNO_3 or HCl+Aq. (Wurtz.)

Insol. in HNO_3+Aq. (Schultz, Zeit. Ch. (2) **5.** 537.)

Solubility in $Sr(OH)_2$, $8H_2O$+Aq at 25°.

Sp. gr. 25°/25°	G. SrO as $Sr(OH)_2$ in 100 g. H_2O	G. $Sr(NO_3)_2$ in 100 g. H_2O
1.492	0.38	79.47
1.494	0.78	80.83

(Parsons, J. Am. Chem. Soc. 1910, **32.** 1388.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in 8500 pts. absolute alcohol. Sol. in 60,000 pts. of a mixture of 1 pt. ether and 1 pt. alcohol. (Rose, Pogg. **110.** 296.)

Sol. in 4189 pts. abs. alcohol and in 199.87 pts. ordinary rectified spirits. (Hill, Pharm. J. 1888 (3) **19.** 420.)

Solubility in ethyl alcohol+Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Sr(NO_3)_2$ in the solution
99.4	99.38	0.02
79.2	77.15	2.60
59.9	53.6	10.5
40.65	32.35	20.5
20.6	13.8	33.2
18.8	12.35	34.3
16.25	10.45	35.7
15.05	9.5	36.7
10.0	6.0	40.05
6.0	3.45	42.7
0	0	46.6

$Sr(NO_3)_2$ is the solid phase in the solutions which are rich in alcohol; $Sr(NO_3)_2+4H_2O$ in the solutions which contain small amounts of alcohol.

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** 39.)

Not completely insol. in boiling amyl alcohol, 30 ccm. dissolving about 1 mg. (Browning, Sill. Am. J. **143.** 52.)

Perfectly anhydrous $Sr(NO_3)_2$ is sol. in 83044 pts. absolute ether-alcohol (1 : 1). (Fresenius, Z. anal. **32.** 190.)

Solubility in organic solvents.

Solvent	% $Sr(NO_3)_2$ in the solution at 25°
Methyl alcohol	1.26
Ethyl alcohol	0.02
Propyl alcohol	0.02
Isobutyl alcohol	0.01
Amyl alcohol	0.003
Acetone	0.02

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** 44.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sol in acetone. (Eidmann, C. C. **1899.** II, 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

The composition of the hydrates formed by $Sr(NO_3)_2$ at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by $Sr(NO_3)_2$ and of the conductivity and sp. gr. of $Sr(NO_3)_2$+Aq. (Jones, Am. Ch. J. 1905, **34.** 305.)

$+4H_2O$. Efflorescent.

Solubility in ethyl alcohol+Aq at 25°.

% C_2H_5OH in the solvent	% C_2H_5OH in the solution	% $Sr(NO_3)_2$ in the solution
0	0	44.25
4	1.7	42.8
6	2.6	42.1
10.8	4.95	40.4
16.0	7.95	37.6
20	12.35	34.3

(D'Ans and Siegler, Z. phys. Ch. 1913, **82.** 39.)

Tellurium nitrate, basic, $4TeO_2$, N_2O_5+ $1\frac{1}{2}H_2O$.

Very hygroscopic. Easily decomp. by H_2O. Sol. in HNO_3+Aq, but more sol. when dil. than conc. (Klein and Morel, Bull. Soc. (2) **43.** 205.)

Tellurium nitrate, $TeNO_3$.

Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014.)

Terbium nitrate, $Tb(NO_3)_3+6H_2O$.

Sol. in H_2O. Sol. in alcohol. (Urbain, C. R. 1908, **146.** 128.)

Thallous nitrate, $TlNO_3$.

1 pt. $TlNO_3$ dissolves, according to C = Crookes; L = Lamy:

at	15°	18°	58°	107°
in	9.4	10.3	2.3	0.17 pts. H_2O.
	C	L	L	L

Sat. $TlNO_3$+Aq contains at:

3.5°	18°	32°	58°	95°
4.2	8.8	13.2	30.4	74.5% $TlNO_3$
107°	135°	145°	150°	155°
85]	95	95.2	96.5	97% $TlNO_3$.

(Étard, A. ch. 1894, (7) **2.** 527.)

Solubility in H_2O at t°.

t°	G. $TlNO_3$ in 100 g. H_2O	g. mol. $TlNO_3$ in 1 l.
0	3.91	0.149
10	6.22	0.230
20	9.55	0.357
25	....	0.433
30	14.3	0.522
40	20.9	0.755
50	30.4	1.07
60	46.2	1.58
70	69.5	2.29
80	111	3.40
90	200	5.32
100	414	8.29
105	594	10.25

(Berkeley, Trans. Roy. Soc. 1904, **203.** A, 211.)

Sp. gr. of $TlNO_3$+Aq at 25°.

Concentration of $TlNO_3$+Aq	Sp. gr.
1/4-normal	1.0562
1/8- "	1.0283

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

Solubility of $TlNO_3+KNO_3$. (*See* KNO_3.)
Insol. in alcohol. (Lamy.)
Sol. in acetone. (Eidmann, Dissert. **1899**; Naumann, B. 1904, **37.** 4328.)

Thallous hydrogen nitrate, $TlNO_3$, $2HNO_3$.

(Wells, Am. Ch. J. 1901, **26.** 273.)
$TlNO_3$, $3HNO_3$. (Ditte.)

Thallic nitrate, $Tl(NO_3)_3+3H_2O$.

Effloresces in the air. (Meyer, Z. anorg. 1900, **24.** 361.)
$+6H_2O$, or $8H_2O$. Deliquescent. Sol. in H_2O.

Thallous thallic nitrate, $2TlNO_3$, $Tl(NO_3)_3$.

Decomp. by H_2O. (Wells, Am. Ch. J. 1901, **26.** 278.)

Thallous uranyl nitrate, $Tl(UO_2)(NO_3)_3$.

Decomp. in moist air. Decomp. by H_2O. (Meyer, B. 1903, **36.** 4058.)

Thorium nitrate, ThO_2, $2N_2O_5+6H_2O$.

Crystallized. Sl. hydroscopic. (Fukse, Zeit. angew. Ch. 1897, **10.** 116.)
$+12H_2O$. Very deliquescent, and sol. in H_2O and alcohol.
Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Thorium zinc nitrate, $ZnTh(NO_3)_6+8H_2O$.

Sol. in HNO_3; very hydroscopic. (Meyer, Z. anorg. 1901, **27.** 386.)

Thulium nitrate, $Tm_2(NO_3)_6+8H_2O$.

Deliquescent. Can readily be cryst. from HNO_3. (James, J. Am. Chem. Soc. 1911, **33.** 1344.)

Tin (stannous) nitrate, basic, $2SnO$, N_2O_5.

Difficultly sol. with partial decomp. in H_2O. (Weber, J. pr. (2), **26.** 121.)

Tin (stannous) nitrate, $Sn(NO_3)_2+20H_2O$.

Deliquescent, and easily decomp. (Weber, J. pr. (2) **26.** 121.)

Tin (stannic) nitrate, basic, $4SnO_2$, $N_2O_5+4H_2O$.

(Thomas, Bull. Soc. 1896 (3) **15.** 312.)

Tin (stannic) nitrate, $Sn(NO_3)_4$.

Sol. in H_2O, but decomp. very soon on standing. Stable in presence of conc. HNO_3+Aq at 90°, but decomp. at 100°. (Montemartini, Gazz. ch. it. **22.** 384.)
Insol. in moderately conc. HNO_3; readily decomp. by H_2O. (Engel, C. R. 1897, **125.** 710.)

Titanium nitrate, $5TiO_2$, $N_2O_5+6H_2O$.

Sol. to a slight milkiness in cold H_2O. Decomp. on boiling. (Merz, J. pr. **99.** 157.)

Uranyl nitrate, basic.

Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 209.)

Uranyl nitrate, $UO_2(NO_3)_2$.

$+H_2O$. (de Forcrand, C. R. 1913, **156.** 1046.)
Sol. in fuming HNO_3 from which it can be cryst.
$+2H_2O$. 52.39% is sol. in dry ether at 7°.
54.25% " " " " " " 10°.

(Lebeau, Bull. Soc. 1911, (4) **9.** 300.)

$+2H_2O$. (Vasilieff, C. C. **1910**, II. 1527.)
$+3H_2O$. Mpt. 121.5°. (Vasilieff.)
Cryst. out of hot HNO_3+Aq. (Ditte.)
100 pts. HNO_3 dissolve 39 pts. at 14°. (Ditte, A. ch. 1879, (5) **18.** 337.)
$+4H_2O$. (de Coninck, C. C. **1901**, I. 1354.)
$+6H_2O$. Deliquescent in moist, and efflorescent in dry air. Sol. in 0.5 pt. cold H_2O, in 0.3 pt. absolute alcohol, and in 4.0 pts. ether. (Bucholz.)
Melts in crystal H_2O at 59.4°. (Ordway.)
1 pt. is sol. in 2 pts. H_2O at 12.9°–14.2°. (de Coninck, C. R. 1900, **131.** 1220.)

Solubility in H_2O at t°.

t°	% by wt. $UO_2(NO_3)_2$, $6H_2O$
—18.1	54.90
—12.1	58.00
— 2.2	62.13
0	63.01
+12.3	67.36
25.6	72.83
36.7	78.05
45.2	82.96
71.8	86.32

(Vasilieff, J. Russ. Phys. Chem. Soc. 1910, **42.** 570.)

Sp. gr. of $(UO_2)(NO_3)_2$+Aq at t°.

t°	% salt	Sp. gr.
11.5	1	1.0049
12.4	2	1.0096
15.1	3	1.01401
14.1	4	1.0187
16.7	5	1.0230
14.1	6	1.8281
15.7	7	1.0236
15.2	8	1.0378
16.5	9	1.0410
15.2	10	1.0462
13.7	11	1.0504
11.5	12	1.0550
14.5	13	1.0594
11.3	14	1.0643
12.5	15	1.0680
13.2	16	1.0718

(de Coninck, C. R. 1900, **131.** 1219.)

Sp. gr. of a sat. aq solution = 1.7536 at 17°, containing 54.77% $UO_2(NO_3)_2$.
Sp. gr. = 1.0257 when 2.80% $UO_2(NO_3)_2$ is present. (Vassiliev, C. C. **1912.** I, 1430.)

Sp. gr. of solution in HNO_3+Aq.

Pts. of salt in 100 pts. HNO_3 sp. gr. 1.153	1	2	3	4	5
Temp.	11.0°	11.8°	11.3°	12.0°	11.6°
Sp. gr. of the solution	1.1585	1.1614	1.1663	1.1698	1.1751

(de Coninck, C. R. 1901, **132.** 90.)

Sp. gr. of solution in H_2SO_4+Aq.

Pts. of salt in 100 pts. H_2SO_4 sp. gr. 1.138	1 pt.	2 pts.	3 pts.	4 pts.	5 pts.
Temp.	11.2°	11.8°	10.7°	12.0°	11.4°
Sp. gr. of solution	1.1427	1.1450	1.1511	1.1540	1.1576

(de Coninck.)

Very sol. in dil. HBr and selenic acid (d = 1.4). Sol. in conc. H_2SO_4, HNO_3, dil. HCl and less sol. in conc. HCl. (de Coninck, C. R. 1900, **131.** 1220.)

Sp. gr. of solution in HBr+Aq of sp. gr. 1.21.

Sp. gr.	% salt dissolved
1.2122	1
1.2168	2
1.2198	3
1.2250	4
1.2305	5

(de Coninck, Belg. Acad. Bull. **1901.** 222.)

Insol. in KOH+Aq, NaOH+Aq or NH_4OH+Aq. Sol. in lime water. (de Coninck, C. R. 1900, **131.** 1220.)
Sl. attacked by liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)
At 15°, uranyl nitrate is sol. in comm. methyl alcohol, dil. and conc. ethyl alcohol, propyl and isobutyl alcohol, comm. amyl alcohol, acetone, ether, ethyl acetate, dil. and conc. formic acid and dil. acetic acid; sl. sol. in comm. essence of terebenthine; insol. in benzene (cryst.), comm. toluene and xylene, ligroin, $CHCl_3$, glycerine and CS_2. (de Coninck, C. R. 1900, **131.** 1220.)
1 pt. is sol. in 55 pts. methyl alcohol at ca. 11.8°.
1 pt. is sol. in 30 pts. ethyl alcohol (85°) at ca. 12.9°.
1 pt. is sol. in 65 pts. acetone at ca. 12.0°.
1 pt. is sol. in 5.6 pts. acetic acid (d = 1.035) at ca. 14.25°.

(de Coninck, C. R. 1900, **131.** 1304.)

1 pt. sol. in 23.5 pts. methyl alcohol at 11.2°.
1 " " " 16.0 " ether " 11.9°.
1 " " " 18.4 " ethyl acetate " 10.3°.
1 " " " 5.3 " conc. formic acid at 15.1°.

(de Coninck, C. R. 1901, **132.** 91.)

Sp. gr. of solution in comm. methyl alcohol at t°.

t°	% salt	Sp. gr. referred to H_2O
11	1	0.8902
12.9	2	0.8938
12.2	3	0.9003
10.7	4	0.9068
12.8	5	0.9108

(de Coninck, C. R. 1900, **131.** 1304.)

Sp. gr. of solution in ethyl alcohol (85°) at t°.
d_2 = sp. gr. referred to alcohol.
d_1 = sp. gr. referred to H_2O.

t°	% salt	d_1	d_2
11.9	1	0.8918	1.0060
12.2	2	0.8979	1.0127
11.6	3	0.9023	1.0177
13.1	4	0.9056	1.0227
11.7	5	0.9131	1.0280

(de Coninck, C. R. 1900, **131.** 1219.)

Sp. gr. of solution in acetic acid (d=1.055) at t°.
d_1 = sp. gr. referred to H_2O.
d_2 = sp. gr. referred to acetic acid.

t°	% salt	d_1	d_2
14.0	1	1.0387	1.0034
13.8	2	1.0434	1.0080
14.8	3	1.0469	1.0100
16.9	4	1.0505	1.0148
14.6	5	1.0564	1.0205
10.4	6	1.0626	1.0265
11.7	7	1.0662	1.0300

(de Coninck, C. R. 1900, **131.** 1304.)

When excess of $UO_2(NO_3)_2$ is shaken with ether at 7°, two layers are formed, the ether layer containing 59 g. salt per 100 g. solution and the aqueous layer 62.5 g. salt per 100 g. solution. (Lebeau, C. R. 1911, **152.** 440.)

Sol. in nearly all proportions in glycerine. (Postans, Pharm. J. 1883, (3) **13.** 752.)

Sol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014; Naumann, B. 1904, **37.** 4328.)

$+18H_2O$. Sat. aq. solution has D17°/17° = 1.7536. (Vasilieff, J. Russ. phys. Chem. Soc. 1911, **43.** 1183.)

Uranyl nitrate ammonia, $(UO_2)(NO_3)_2$, $2NH_3$.

(v. Unruh, Dissert. **1909.**)
$(UO_2)(NO_3)_2$, $3NH_3$. (v. Unruh.)
$(UO_2)(NO_3)_2$, $4NH_3$. (v. Unruh.)

Uranyl nitrate phosphate, $UO_2H_4(PO_4)_2$, $UO_2(NO_3)_2+14H_2O$.

Easily sol. in warm H_2O, with gradual decomp. Easily sol. in HNO_3, HCl, or H_2SO_4+Aq. Sol. in acetic acid with decomp. (Heintz, A. **151.** 216.)

***Di*vanadyl nitrate** (?).

Known only in solution. Decomp. on evaporation.

Ytterbium nitrate, basic.

Easily sol. in H_2O.

Ytterbium nitrate.

Very sol. in H_2O.

$+3H_2O$. Ppt. (Cleve, Z. anorg. 1902, **32.** 140.)

$+4H_2O$. (Cleve.)

Yttrium nitrate, basic, $2Y_2O_3$, $3N_2O_5+9H_2O$.

Deliquescent in moist air. Decomp. by cold or boiling H_2O. Sol. in a solution of yttrium nitrate without decomp. (Bahr and Bunsen, A. **137.** 1.)

Yttrium nitrate, $Y(NO_3)_3+6H_2O$.

Easily sol. in H_2O, alcohol, or ether. (Cleve.)

141.6 grams are sol. in 100 grams H_2O at 25°. (James, J. Am. Chem. Soc. 1910, **32.** 876.)

Zinc nitrate, basic, $8ZnO$, $N_2O_5+2H_2O$.

Insol. in H_2O. (Grouvelle, A. ch. **19.** 137.)

$6ZnO$, $N_2O_5+8H_2O = Zn(NO_3)_2$, $5Zn(OH)_2 + 3H_2O$. (Bertels, J. B. **1784.** 274.)

$5ZnO$, $N_2O_5+5\frac{1}{2}H_2O$. Insol. in cold, somewhat sol. in hot H_2O. (Havermann.)

$+6H_2O$. Slowly decomp. by cold H_2O. (Rousseau and Tite.)

$9ZnO$, $2N_2O_5$. Decomp. by H_2O. (Vogel and Reischauer, N. Jahrb. Pharm. **11.** 137.)

$4ZnO$, $N_2O_5+2H_2O$. (Schindler.)

$+3H_2O$. (Ordway, Sill. Am. J. (2) **32.** 14; Gerhardt, J. Pharm. (3) **12.** 61.)

Insol. in H_2O; sol. in dil. acids. (Athanasesco, Bull. Soc. 1896, **15.** 1080.)

$2ZnO$, $N_2O_5+3H_2O$. Decomp. by H_2O, and slowly by alcohol. (Wells, Am. Ch. J. **9.** 304.)

$7ZnO$, $4N_2O_5+14H_2O = 4Zn(NO_3)_2$, $3Zn(OH)_2+11H_2O$. (Bertels.)

Zinc nitrate, $Zn(NO_3)_2$.

Very deliquescent. Easily sol. in H_2O or alcohol.

Sp. gr. of $Zn(NO_3)_2$+Aq. F. = according to Franz (J. pr. (2) **5.** 274) at 17.5°; O. = according to Oudemans (Z. anal. **7.** 410) at 14°:

	5	10	15% $Zn(NO_3)_2$,
F.	1.0496	1.0968	1.1476
O.	1.0425	1.087	1.1355

	20	25	30% $Zn(NO_3)_2$,
F.	1.2024	1.2640	1.3268
O.	1.1875	1.245	1.305

	35	40	45	50% $Zn(NO_3)_2$.
F.	1.906	1.4572	1.5258	1.5984
O.	...	...	...	...

Calculated for $Zn(NO_3)_2+6H_2O$:

10	20	30	40	50% salt.
1.05361	1.1131	1.1782	1.2496	1.3292

(Oudemans.)

$Zn(NO_3)_2$+Aq when heated soon decomposes, with formation of an insol. basic salt. (Ordway.)

Sp. gr. of $Zn(NO_3)_2+Aq$ at room temp. containing:

15.955	30.626	44.5% $Zn(NO_3)_2$.
1.1155	1.2291	1.4367

(Wagner, W. Ann. 1883, **18.** 270.)

Sp. gr. of $Zn(NO_3)_2+Aq$ at 25°.

Concentration of $Zn(NO_3)_2+Aq$	Sp. gr.
1–normal	1.0758
1/2– "	1.0404
1/4– "	1.0191
1/8– "	1.0096

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

Sp. gr. of $Zn(NO_3)_2+Aq$. at 16°.

½ $Zn(NO_3)_2$ g. per 1000 g. of solution	Sp. gr. 16°/16°
0.0000	1.000000
0.9950	1.000814
2.0061	1.001646
4.1535	1.003413
8.1824	1.006733
17.7760	1.014702
34.5920	1.028890
68.6780	1.058644

(Dijken, Z. phys. Ch. 1897, **24.** 108.)

Sp. gr. of $Zn(NO_3)_2+Aq$ at 17.3°, when p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc. $\left(\frac{pd}{100}=w.\right)$

p	d	w
47.28	1.5504	0.73310
41.32	1.4579	0.60240
30.86	1.3136	0.40535
29.21	1.2933	0.37780
19.65	1.1830	0.23246
14.39	1.1284	0.16232
11.36	1.0988	0.12478
7.091	1.0597	0.07515
5.923	1.0491	0.06213
1.574	1.0118	0.01593
1.210	1.0087	0.01221

(Barnes, J. Phys. Chem. 1898, **2.** 545.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

$+1\frac{1}{2}H_2O$. 100 pts. HNO_3 dissolve 28 pts. at 13°; 55 pts. at 55°. (Ditte, A. ch. 1879, (5) **18.** 335.)

$+2H_2O$. (Vasilieff, C. C. **1909,** II. 1966.)

$+3H_2O$.

Solubility in H_2O.

Sat. solution contains at:

37°	40°	41°	43°	45.5° mpt.
66.38	67.42	68.21	69.26	77.77% $Zn(NO_3)_2$.

(Funk, Z. anorg. 1899, **20.** 401.)

$+6H_2O$.

Solubility in H_2O.

Sat. solution contains at:

—18°	—15°	—13°	—12°
44.63	45.26	45.51	45.75% $Zn(NO_3)_2$,
0°	+12.5°	18°	25°
48.66	52.00	53.50	55.90% $Zn(NO_3)_2$,
36.4° (mpt.)	36°	33.5°	
63.63	64.73	65.83% $Zn(NO_3)_2$.	

(Funk, Z. anorg. 1899, **20** 400.)

100 g. $Zn(NO_3)_2+Aq$ sat. at 0° contain 48.7 g. $Zn(NO_3)_2$; at 18°, 53.5 g. $Zn(NO_3)_2$. (Mylius, Z. anorg. 1910, **74.** 411.)

Melts in its crystal H_2O at 36.4° (Ordway), 50° (Pierre); boils at 131° (Ordway).

Sp. gr. of solution sat. at 18° = 1.664, and contains 53.9% $Zn(NO_3)_2$. (Mylius, B. 1897, **30.** 1718.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+9H_2O$.

Solubility in H_2O.

Sat. solution contains at:

—25°	—22.5°	—20°	—18°
40.1?	40.75	42.03	43.59% $Zn(NO_3)_2$.

Cryohydrate is formed at —29°.

(Funk, Z. anorg. 1899, **20.** 401.)

Zinc nitrate ammonia, $Zn(NO_3)_2$, $4NH_3$.

Ppt. (Ephraim, B. 1915, **48.** 638.)

$+{}^2/_3H_2O$.

Deliquescent. Sol. in H_2O. (André, C. R. **100.** 639.)

$13ZnO$, $3N_2O_5$, $2NH_3+18H_2O$.

Insol. in cold, decomp. by warm H_2O. (André, C. R. 1885, **100.** 640.)

Zinc nitrate cupric oxide, $Zn(NO_3)_2$, $3CuO+3H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 169.)

Zinc nitrate hydrazine, $Zn(NO_3)_2$, $3N_2H_4$.

Decomp. by hot H_2O.

Sol. in NH_4OH. (Franzen, Z. anorg. 1908, **60.** 279.)

Zirconium nitrate, basic, $3ZrO_2$, $2N_2O_5$.

Insol. in H_2O.

ZrO_2, N_2O_5. Easily sol. in H_2O and alcohol.

$+H_2O$. As above.

Zirconium nitrate, $Zr(NO_3)_4+5H_2O$ (?).

Deliquescent, and sol. in H_2O.

Nitric oxide, NO.

See **Nitrogen *di*oxide.**

Nitrilobromosmic acid.

Ammonium nitrilo*penta*bromosmate, $[OsNBr_5](NH_4)_2+H_2O$.

Very sol. in H_2O. Decomp. in dil. aq. solution.
Stable in HBr+Aq.
Insol. in organic solvents. (Werner, B. 1906, **39.** 501.)

Cæsium hydrogen nitrilo*penta*bromosmate, $[OsNBr_5]_2Cs_3H$.

Sl. sol. in H_2O. (Werner.)

Potassium nitrilo*tetra*bromosmate, $[OsNBr_4]K_2+2H_2O$.

Very sol. in H_2O. Decomp. in aq. solution. Stable in HBr+Aq. Insol. in organic solvents. (Werner.)

Rubidium nitrilo*penta*bromosmate, $[OsNBr_5]Rb_2$.

Sol. in H_2O. Decomp. in dil. aq. solution after a short time. (Werner.)

Nitrilochlorosmic acid.

Ammonium nitrilo*penta*chlorosmate, $(OsNCl_5)(NH_4)_2$.

Sol. in H_2O; insol. in conc. HCl+Aq. (Werner, B. 1901, **34.** 2702.)

Cæsium nitrilo*penta*chlorosmate, $(OsNCl_5)Cs_2$.

Sol. in H_2O. (Werner.)

Potassium nitrilo*penta*chlorosmate, $(OsNCl_5)K_2$.

Sol. in H_2O; pptd. by HCl; insol. in organic solvents. (Werner.)

Rubidium nitrilo*penta*chlorosmate, $(OsNCl_5)Rb_2$.

Sol. in H_2O; decomp. in dil. neutral solution. (Werner.)

Nitrilo*trimeta*phosphoric acid, $H_2NP_3O_7=$

$$N\begin{cases} PO<OH \\ PO<{O \atop O} \\ PO<OH. \end{cases}$$

Known only in solution. (Mente, A. **248.** 260.)

Aluminum nitrilo*trimeta*phosphate.

Insol. in H_2O, conc. HCl, or HNO_3+Aq. Slowly sol. in boiling conc. H_2SO_4. Sol. in warm NaOH+Aq or Na_2CO_3+Aq without decomp. Insol. in NH_4OH+Aq. (Mente.)

Barium ——, $BaNP_3O_7$.

Insol. in dil. or conc. acids. Decomp. by boiling NaOH or Na_2CO_3+Aq. Insol. in NH_4OH+Aq. (Mente.)

Cadmium nitrilo*trimeta*phosphate.

Easily sol. in NH_4OH+Aq, or boiling $(NH_4)_2CO_3$, or NaOH+Aq. (Mente.)

Calcium ——, $CaNP_3O_7+H_2O$.

Sol. in conc. HCl+Aq by long boiling, and more easily in fuming HNO_3+Aq. Insol. in NH_4OH or NaOH+Aq. (Mente.)

Chromium ——.

Slowly sol. in dil. acids. Easily sol. in ammonia. Sol. in cold NaOH+Aq. (Mente.)

Cobalt ——, $CoNP_3O_7+H_2O$.

Insol. in H_2O. Sl. sol. in dil. acids. Easily sol. in NH_4OH+Aq. Decomp. by NaOH or Na_2CO_3+Aq. (Mente.)

Copper ——.

Sol. in NH_4OH+Aq. Decomp. by NaOH +Aq. (Mente.)

Ferric ——, $Fe_2(NP_3O_7)_3$.

Insol. in conc. acids. Easily sol. in NH_4OH +Aq or $(NH_4)_2CO_3$+Aq. Decomp. by NaOH or Na_2CO_3+Aq. (Mente.)

Lead ——.

Insol. in dil. acids. Sol. in fuming HNO_3. Insol. in NH_4OH+Aq. Sol. in NaOH+Aq. (Mente.)

Magnesium ——, $MgNP_3O_7+H_2O$.

Slowly sol. in HCl+Aq. Sol. in H_2SO_4 or fuming HNO_3 with addition of Br_2. Insol. in NH_4OH or $(NH_4)_2CO_3$+Aq. (Mente.)

Manganous ——, $MnNP_3O_7+H_2O$.

Insol. in dil. acids. Very sl. sol. in NaOH+Aq. Insol. in Na_2CO_3 or $(NH_4)_2CO_3$+Aq. Easily sol. in NH_4OH+Aq. (Mente.)

Mercurous ——, $Hg_2NP_3O_7$.

Insol. in dil. acids, NH_4OH, NaOH, or $(NH_4)_2CO_3$+Aq. Easily sol. in fuming HNO_3. (Mente.)

Nickel ——, $NiNP_3O_7+H_2O$.

Insol. in dil. acids, NH_4OH, or $(NH_4)_2CO_3$ +Aq. (Mente.)

Zinc ——, $ZnNP_3O_7+2H_2O$.

Easily sol. in NH_4OH, NaOH, or $(NH_4)_2CO_3$+Aq. (Mente.)

Nitrilosulphonic acid, $N(SO_3H)_3$.

Not known in free state. (Raschig, A. **241.** 161.)

Potassium nitrilosulphonate, $N(SO_3K)_3+2H_2O$.

Soluble in H_2O. (Raschig, A. **241.** 161.)
Is identical with "potassium ammon*tri*sulphonate" of Claus.

Insol. in cold H_2O (Claus); sol. in 50 pts. H_2O at 23° (Fremy); in H_2O at scarcely 40° without change. Decomp. by boiling. (Claus.)

Potassium sodium nitrilosulphonate, $N(SO_3K)_2(SO_3Na)$.

Nearly insol. in cold H_2O. (Raschig, A. **241.** 161.)

Sodium nitrilosulphonate, $N(SO_3Na)_3$.

Not isolated on account of its extreme solubility in H_2O. (Raschig, A. **241.** 161.)

Nitrilo*di*sulphophosphoric acid,
$NP(SH)_2$.

Decomp. by H_2O. (Stock, B. 1906, **39.** 2001.)

Ammonium nitrilo*di*sulphophosphate, $NP(SNH_4)_2$.

Easily sol. in H_2O. Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

Easily sol. in liquid NH_3. (Stock, B. 1903, **36.** 315.)

Ammonium hydrogen nitrilo*di*sulphophosphate, $SHP(SNH_4)N$.

Not decomp. by boiling with alkali. Decomp. by acids. (Stock, B. 1906, **39.** 1999.)

Barium nitrilo*di*sulphophosphate, $BaNPS_2+H_2O$.

Sol. in H_2O with decomp. Decomp. by hot H_2O. Not decomp. by warming with alkali. Decomp. by acid. (Stock.)

Lead nitrilo*di*sulphophosphate, NPS_2Pb.

Sol. in liquid NH_3. Solution decomp. rapidly with separation of PbS. (Stock.)

Sodium nitrilo*di*sulphophosphate, $NPSNa_2$.

Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

Nitrilosulphuric acid.

Ammonium nitrilosulphate, $N(SO_3NH_4)_3+2H_2O$.

Rather sl. sol. in H_2O, but much more sol. than K salt. (Divers and Haga, Chem. Soc. 1901, **79.** 1094.)

Sodium nitrilosulphate, $N(SO_3Na)_3+5H_2O$.

Very sol. in H_2O. (Divers and Haga, Chem. Soc. 1901, **79.** 1097.)

Nitrilosulphurous acid.

Ammonium nitrilosulphite, $NH(SO_2NH_4)_2$.

Somewhat deliquescent. Very sol. in H_2O. Slowly decomp. in solution. Decomp. by boiling with HCl. (Divers, Proc. Chem. Soc. 1901, **17.** 163.)

Nitritocobaltic chloride.

Sol. in 200 pts. cold H_2O. (Jörgensen, Z. anorg. **5.** 172.)

Nitritoplatin*di*amine nitrate,
$(NO_2)_2Pt(N_2H_6NO_3)_2$.

Sol. in cold H_2O with decomp.; violently decomp. on warming. (Hadow, Chem. Soc. (2) **4.** 345.)

Nitritopurpureocobaltic comps.

See **Xanthocobaltic comps.**

Nitritopurpureorhodium comps.

See **Xanthorhodium comps.**

Nitrocarbamic acid.

Potassium nitrocarbamate, $NO_2.NK.COOK$.

Decomp. by H_2O. (Thiele, B. 1894, **27.** 1909.)

Nitro cobalt, Co_2NO_2.

Decomp. by H_2O. (Sabatier and Senderens, C. R. **115.** 236.)

Nitro copper, $CuNO_2$.

Violently decomp. by H_2O. (Sabatier and Senderens, C. R. **116.** 756.)

Nitroferricyanhydric acid.

See **Nitroprussic acid.**

Nitrogen, N_2.

Nearly insol. in all known solvents.

1 vol. recently boiled H_2O absorbs 0.0147 vol. N at 15.5°. (Henry, **1803.**)

1 vol. recently boiled H_2O absorbs 0.025 vol. N. (Dalton.)

1 vol. recently boiled H_2O absorbs 0.0156 vol. N at ord. temp. (Dalton.)

1 vol. H_2O at t° and 760 mm. absorbs V vols. N gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0.02035	7	0.01713	14	0.01500
1	0.01981	8	0.01675	15	0.01478
2	0.01932	9	0.01640	16	0.01458
3	0.01884	10	0.01607	17	0.01441
4	0.01838	11	0.01577	18	0.01426
5	0.01794	12	0.01549	19	0.01413
6	0.01752	13	0.01523	20	0.01403

(Bunsen.)

Coefficient of absorption = $0.020346-0.00053887t+0.000011156t^2$. (Bunsen.)

1 l. H_2O absorbs ccm. N from atmospheric air at 760 mm. pressure and t°.

t°	ccm. N	t°	ccm. N
0	19.29	15	13.95
5	17.09	20	12.80
10	15.36	25	11.81

(Dittmar, Challenger Exped. Report, vol. i.)

t°	ccm. N	t°	ccm. N
0	19.14	15	13.73
5	16.93	20	12.63
10	15.14	25	11.80

(Hamberg, **1886.**)

Absorption of N by H_2O at t° and 760 mm. β = coefficient of absorption.

t°	β	t°	β	t°	β
0	0.02388	18	0.01696	36	0.01252
1	2337	19	1667	37	1233
2	2288	20	1639	38	1215
3	2241	21	1611	39	1198
4	2196	22	1584	40	1182
5	2153	23	1557	41	1166
6	2111	24	1530	42	1151
7	2070	25	1504	43	1137
8	2031	26	1478	44	1124
9	1993	27	1453	45	1111
10	1956	28	1428	46	1099
11	1920	29	1404	47	1088
12	1885	30	1380	48	1078
13	1851	31	1357	49	1069
14	1818	32	1334	50	1061
15	1786	33	1312	60	1000
16	1755	34	1291	100	1000
17	1725	35	1271	...	...

(Bohr and Bock, W. Ann. **44.** 318.)

Absorption of N by H_2O at t° and 760 mm. β = coefficient of absorption; β_1 = "Solubility" (see under Oxygen).

t°	β	β_1
0	0.02348	0.02334
1	2291	2276
2	2236	2220
3	2182	2166
4	2130	2113
5	2081	2063
6	2032	2013
7	1986	1966
8	1941	1920
9	1898	1877
10	1857	1834
11	1819	1795
12	1782	1758
13	1747	1722
14	1714	1687

Absorption of N by H_2O at t°.—*Continued.*

t°	β	β_1
15	0.1682	0.1654
16	1651	1622
17	1622	1591
18	1594	1562
19	1567	1534
20	1542	1507
21	1519	1482
22	1496	1457
23	1473	1433
24	1452	1410
25	1432	1387
26	1411	1365
27	1392	1344
28	1374	1323
29	1356	1303
30	1340	1284
31	1321	1263
32	1304	1243
33	1287	1224
34	1270	1204
35	1254	1185
36	1239	1167
37	1224	1149
38	1210	1131
39	1196	1114
40	1183	1097
41	1171	1082
42	1160	1067
43	1149	1052
44	1139	1037
45	1129	1023
46	1120	1009
47	1111	0995
48	1102	0982
49	1094	0968
50	1087	0955
52	1072	0929
54	1058	0902
56	1045	0876
58	1033	0849
60	1022	0822
62	1011	0794
64	1001	0765
66	0992	0736
68	0983	0707
70	0976	0676
72	0970	0645
74	0965	0614
76	0961	0581
78	0959	0546
80	0957	0510
82	0956	0472
84	0955	0432
86	0954	0388
88	0953	0343
90	0952	0294
92	0951	0242
94	0950	0187
96	0949	0128
98	0948	0066
100	0947	0000

(Winkler, B. **24.** 3606.)

Coefficient of absorption for H_2O = 0.01432 at 25°; 0.01621 at 20°; 0.01789 at 15°; 0.02003 at 10°; 0.02173 at 5°. (Braun, Z. phys. Ch. 1900, **33.** 730.)

Solubility in H_2O at various pressures.

V = volume of the absorbing liquid.
P = Hg-pressure in metres.
λ = coefficient of solubility.

V	t°	P	λ
33.134 ccm.	19.4	0.8910	0.01617
		1.0453	0.01616
		1.2488	0.01611
		1.4764	0.01608
		1.8111	0.01602
		2.3961	0.01597
		2.9074	0.01585
		3.3411	0.01579
		4.1382	0.01561
		4.5958	0.01554
		5.1103	0.01546
		5.8349	0.01528
		6.2767	0.01515
		7.1059	0.01499
		7.5815	0.01487
		8.1074	0.01473
32.152 ccm.	24.9	0.8977	0.01498
		1.0129	0.01493
		1.1887	0.01491
		1.5573	0.01487
		1.9846	0.01482
		2.5171	0.01478
		2.8781	0.01463
		3.2956	0.01455
		4.0947	0.01440
		4.5581	0.01434
		5.0529	0.01426
		5.5935	0.01413
		6.1956	0.01408
		7.0333	0.01382
		7.5596	0.01377
		?4.1846	0.01369

(Cassuto, Phys. Zeit. 1904, **5.** 236.)

Coefficient of absorption for H_2O = 0.01565 at 20.18°. (Hüfner, Z. phys. Ch. 1907, **57.** 615.)

Absorption of N_2 by distilled H_2O at t°.

a = ccm. of N_2 absorbed by 1 l. of H_2O at t° and 760 mm.

t°	*a*	t°	*a*	t°	*a*
0	23.00	17	16.29	34	12.93
1	22.50	18	16.03	35	12.79
2	22.02	19	15.78	36	12.65
3	21.55	20	15.54	37	12.52
4	21.09	21	15.29	38	12.39
5	20.64	22	15.06	39	12.27
6	20.20	23	14.84	40	12.15
7	19.77	24	14.63	41	12.04
8	19.35	25	14.43	42	11.92
9	18.94	26	14.23	43	11.80
10	18.54	27	14.04	44	11.68
11	18.16	28	13.87	45	11.57
12	17.80	29	13.71	46	11.46
13	17.46	30	13.55	47	11.35
14	17.14	31	13.39	48	11.24
15	16.84	32	13.23	49	11.13
16	16.56	33	13.08	50	11.02

(Fox, Trans. Faraday Soc. 1909, **5.** 73.)

Solubility in H_2O at 25° = 0.1561. (Drucker and Moles, Z. phys. Ch. 1910, **75.** 418.)

Solubility of N_2 in H_2O at 25° = 0.0231. (Calculated according to special formula, for which see original article.) (Findlay and Creighton, Chem. Soc. 1911, **99.** 1315.)

Coefficient of absorption for H_2O = 0.01689 at 15°; 0.01670 at 16.2°; 0.01622 at 17.2°. (Müller, Z. phys. Ch. 1912, **81.** 493.)

1 l. sea water (sp. gr. 1.027) absorbs ccm. N from atmosphere at t° and 760 mm. pressure—

t°	According to Tornoë	According to Dittmar	According to Hamberg
0	14.40	15.60	14.85
5	13.25	13.86	13.32
10	12.10	12.47	12.06
15	10.95	11.34	11.04
20	...	10.41	10.25
25	...	9.62	9.62

No. of ccm. of N_2 (containing 1.185% argon) absorbed by a l. of sea-water from a free dry atmosphere of 760 mm. pressure at given temperatures.

Cl per 1000	0°	4°	8°	12°	16°	20°	24°	28°
0	18.64	17.02	15.63	14.45	13.45	12.59	11.86	11.25
4	17.77	16.27	14.98	13.88	12.94	12.15	11.46	10.89
8	16.90	15.51	14.32	13.30	12.44	11.70	11.07	10.52
12	16.03	14.75	13.66	12.72	11.93	11.25	10.67	10.16
16	15.18	14.00	13.00	12.15	11.73	10.81	10.27	9.80
20	14.31	13.24	12.34	11.57	10.92	10.36	9.87	9.44

(Fox, Trans. Faraday Soc. 1909, **5.** 77.)

Absorption of N_2 by H_2SO_4+Aq at t°.

α = coefficient of absorption.

Normality of the acid	t°	α
0	20.9	0.0156
4.9	20.9	0.0091
8.9	20.9	0.0072
10.7	21.2	0.0066
20.3	21.1	0.0049
24.8	21.5	0.0048
29.6	20.8	0.0051
34.3	20.9	0.0100
35.8	21.1	0.0129

(Bohr, Z. phys. Ch. 1910, **71.** 49.)

Absorption of N_2 by $BaCl_2$+Aq.

$\alpha t°$ = coefficient of absorption at t°.

Per cent of $BaCl_2$ in the solution	α25°	α20°	α15°	α10°	α5°
13.830	0.00783	0.00923	0.01036	0.01166	0.01270
11.927	0.00855	0.00976	0.01139	0 01249	0.01368
6.903	0.01044	0.01184	0.01317	0.01474	0.01598
6.738	0.01036	0.01182	0.01340	0 01494	0 01628
3.870	0.01137	0.01323	0.01480	0.01660	0.01802
3.325	0.01190	0.01346	0.01502	0.01681	0.01826

(Braun, Z. phys. Ch. 1900, **33.** 733.)

Absorption of N_2 by NaCl+Aq.

$\alpha t°$ = coefficient of absorption at t°.

Per cent of NaCl in the solution	α25°	α20°	α15°	α10°	α5°
11.732	0.00470	0.00657	0.00810	0.00930	0 01016
10.945	0 00565	0 00703	0.00824	0.00912	0.01052
8.135	0 00749	0 00872	0.01014	0.01131	0.01266
8.033	0.00729	0.00871	0.00995	0.01121	0.01248
6.595	0 00802	0.00972	0.01120	0 01252	0.01380
6.400	0 00826	0.00975	0.01134	0.01259	0.01375
4.196	0.00990	0 01151	0 01294	0.01451	0.01579
3.880	0.01005	0.01168	0.01316	0.01475	0.01615
2 120	0.01131	0.01311	0.01469	0.01638	0.01795
2 100	0.01133	0.01314	0.01467	0.01656	0.01805
0.686	0.01295	0.01477	0.01640	0.01833	0.01994
0.671	0.01304	0.01484	0 01642	0.01845	0.02000

(Braun, *l. c.*)

At —191.5° liquid oxygen dissolves 458 times its vol. or 50.7 per cent of its weight of gaseous nitrogen. (Erdmann, B. 1904, **37.** 1191.)

At 18° and 760 mm. 100 vols. H_2O or alcohol of 0.84 sp. gr. absorb 4.2 vols. N gas. (de Saussure, **1814.**)

1 vol. alcohol at t° and 760 mm. dissolves V vols. N gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0.12634	13	0.12192
1	0.12593	14	0.12166
2	0.12553	15	0.12142
3	0.12514	16	0.12119
4	0.12476	17	0.12097
5	0.12440	18	0.12076
6	0.12405	19	0.12056
7	0.12371	20	0.12030
8	0.12338	21	0.12021
9	0.12306	22	0.12005
10	0.12276	23	0.11990
11	0.12247	24	0.11976
12	0.12219	..	...

(Bunsen's Gasometry.)

1 vol. alcohol absorbs $0.126338-0.000418t+0.0000060t^2$ vols. N gas. (Carius, A. **94.** 136.)

Solubility in alcohol at 25°.

Vol. H_2O	Vol. % alcohol	Solubility
100	0	0.01634
80	20	0.01536
67	33	0.01719
0	100	0.1432

(Just, Z. phys. Ch. 1901, **37.** 361.)

1 vol. ether absorbs 0.15 vol. N (Döbereiner); 1 vol. caoutchine absorbs 5 vols. N in 5 weeks (Himly).

Solubility of N_2 in ether = 0.2580 at 0°; 0.2561 at 10°. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Solubility in organic solvents

Solvent	Solubility at 25° C.	Solubility at 20° C.	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0.01634	0 01705	—0.000142
Aniline	0 03074	0 02992	+0.000164
Carbon bisulphide	0 05860	0 05290	+0.00114
Nitrobenzene	0.06255	0.06082	+0 000346
Benzene	0.1159	0 114	+0.0009
Glacial acetic acid	0 1190	0.1172	+0.00036
Xylene	0.1217	0 1185	+0.00062
Amyl alcohol	0.1225	0.1208	+0.00034
Toluene	0.1235	0.1186	+0.00098
Chloroform	0.1348	0 1282	+0.00132
Methyl alcohol	0.1415	0.1348	+0.00134
Ethyl alcohol (99.8%)	0.1432	0.1400	+0.00064
Acetone	0.1460	0 1383	+0.00154
Amyl acetate	0.1542	0 1512	+0.0006
Ethyl acetate	0.1727	0.1678	+0.00098
Isobutyl aceate	0.1734	0.1701	+0.00066

(Just, Z. phys. Ch. 1901, **37.** 361.)

Coefficient of absorption for petroleum = 0.117 at 20°; 0.135, at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

Absorption of N_2 by propionic acid+Aq.

$\alpha t°$ = coefficient of absorption at t°.

Per cent of propionic acid in the solution	$\alpha 25°$	$\alpha 20°$	$\alpha 15°$	$\alpha 10°$	$\alpha 5°$
11.220	0.01301	0.01463	0.01593	0.01779	0.01951
11.023	0.01295	0.01447	0.01585	0.01800	0.01977
9.537	0.01336	0.01471	0.01634	0.01823	0.02040
9.155	0.01329	0.01469	0.01630	0.01845	0.02026
6.066	0.01335	0.01476	0.01637	0.01855	0.02077
5.891	0.01338	0.01480	0.01648	0.01872	0.02089
4.081	0.01365	0.01541	0.01688	0.01919	0.02095
3.816	0.01371	0.01547	0.01674	0.01915	0.02087

(Braun, Z. phys. Ch. 1900, **33**. 732.)

Solubility of N_2 in isobutyric acid+Aq at t°.

P = Corrected pressure at end of experiment in mm. Hg at 0°.
S = Solubility of N_2.

Solvent	t°	P	S
Pure isobutyric acid	25.05	262.6	0.1609(?)
		388.3	0.1640
		566.1	0.1647
		662.4	0.1656
		783.5	0.1656
		832.2	0.1656
37.5% solution of isobutyric acid+Aq Vapor pressure = 21.6 mm.	23.02	246.2	0.0393
		492.2	0.0393
		563.6	0.0393
		836.3	0.0400
		867.3	0.0401
" Vapor pressure = 30.6 mm.	29.02	231	0.0373
		468.4	0.0384
		480.7	0.0383
		536	0.0385
		656	0.0384
		720	0.0386

(Drucker and Moles, Z. phys. Ch. 1910, **75**. 434.)

Absorption of N_2 by chloralhydrate+Aq.

t° = temp. of the solution.
P = % chloralhydrate in the solution.
$\beta t°$ = coefficient of absorption at t°.
$\beta 15°$ = coefficient of absorption at 15°.

t°	P	$\beta t°$	$\beta 15°$
15.6	15.8	0.01574	0.01580
15.4	28.2	0.01418	0.01422
16.4	37.25	0.01288	0.01300
16.9	47.0	0.01260	0.01275
17.0	56.52	0.01230	0.01245
15.3	71.5	0.01415	0.01420
14.8	78.8	0.01447	0.01495

(Müller, Z. phys. Ch. 1912, **81**. 499.)

Absorption of N_2 by organic substances+Aq at 15°.

P = % of the organic substance in the solvent.
$\beta 15°$ = coefficient of absorption at 15°.
S15° = Solubility at 15°.

Organic substance used	P	$\beta 15°$	S15°
Chloralhydrate	0	0.01725	...
	0	0.01675	0.01796
	0	0.01706	...
	6.9	0.0164	0.0173
	14.0	0.0154	0.0162
	15.0	0.0152	0.0160
	23.6	0.0134	0.0141
	26.1	0.0141	0.0149
	37.6	0.0123	0.0130
	48.9	0.0115	0.0121
	49.3	0.0118	0.0124
	61.3	0.0114	0.0120
	70.9	0.0131	0.0138
	71.2	0.0130	0.0137
	78.3	0.0152	0.0160
	79.1	0.0156	0.0165
Glycerine	0	0.01707	...
	0	0.01708	...
	15.7	0.01425	...
	15.7	0.01376	...
	29.9	0.01087	...
	46.6	0.00840	...
	57.6	0.00698	...
	67.1	0.00635	...
	72.8	0.00552	...
	74.7	0.00597	...
	77.0	0.00527	...
	85.1	0.00482	...
	87.3	0.00492	...
	88.5	0.00536	...
	99.25	0.00524	...

(Hammel, Z. phys. Ch. 1915, **90**. 121.)

Absorption of N_2 by glycerine+Aq.

t° = temp. of the solution.
P = % glycerine in the solution.
$\beta t°$ = coefficient of absorption at t°.
$\beta 15°$ = coefficient of absorption at 15°.

t°	P	$\beta t°$	$\beta 15°$
16.1	25.0	0.01240	0.01266
15.6	42.2	0.00966	0.00976
14.7	51.5	0.00759	0.00759
14.9	58.0	0.00703	0.00703
15.9	80.25	0.00520	0.00530
16.2	90.0	0.00570	0.00583
18.0	95.0	0.00578	0.00716

(Müller, Z. phys. Ch. 1912, **81**. 496.)

Solubility of N_2 in glycerine+Aq at 25°.

G = % by wt. of glycerine in the solvent.
S = solubility of N_2.
P = corrected pressure at end of experiment in mm. Hg at 0°.

G	P	S
16	598.4	0.0103
"	915.5	0.0103
29.7	556.5	0.0067
"	846.5	0.0068
48.9	617.7	0.0052
"	859.8	0.0051
74.5	588.5	0.0025
84.1	637.3	0.0024
"	757.0	0.0024

(Drucker and Moles, Z. phys. Ch. 1910, **75.** 418.)

Absorption of N_2 by sucrose+Aq.

t° = temp. of the solution.
P = % sucrose in the solution.
βt° = coefficient of absorption at t°.
β15° = coefficient of absorption at 15°.

t°	P	βt°	β15°
16.2		0.01670	0.01700
17.2		0.01622	0.01688
16.8	11.38	0.01432	0.01480
16.9	20.00	0.01233	0.01280
17	29.93	0.01025	0.01053
17.8	30.12	0.01033	0.01090
18	47.89	0.00742	0.00785
17.7	48.57	0.00658	0.00700

(Müller, Z. phys. Ch. 1912, **81.** 493.)

Absorption of N_2 by organic substances+Aq at t°.

V = absorbed volume reduced to 0° and 760 mm.
α = coefficient of absorption.

Solution	Vol. of solution ccm.	t°	V ccm.	α
N–dextrose	409.94	20.18	4.55	0.01215
½N–dextrose	409.94	20.21	5.14	0.01380
¼N–dextrose	409.94	20.2	5.51	0.01480
N–levulose	409.94	20.25	4.27	0.01221
N–arabinose	409.94	20.21	4.40	0.01203
N–erythritol	409.94	20.25	4.87	0.01321
N–alanine	409.94	20.19	4.445	0.01213
N–glycocoll	409.94	20.16	4.47	0.01212
N–urea	409.94	20.18	5.37	0.01477
N–acetamide	409.94	20.22	5.385	0.01475

(Hüfner, Z. phys. Ch. 1907, **57.** 618–621.)

Nitrogen bromide, NBr_3.

Decomp. under H_2O.

Nitrogen bromophosphide, PBr_2N.

Insol. in H_2O. Sol. in ether, less sol. in CS_2 or $CHCl_3$. (Besson, C. R. **114.** 1479.)

Nitrogen bromosulphide.

See **Nitrogen sulphobromide.**

Nitrogen chloride, NCl_3.

Very unstable. Explodes when heated to 93° or by contact with other substances. Insol. in H_2O, but is decomp. thereby (in 24 hours by cold H_2O). Sol. in CS_2, PCl_3, and S_2Cl_2. (H. Davy, Phil. Trans. **1813, 1.** 242.)

Sol. in C_6H_6, CS_2, $CHCl_6$, CCl_4. (Hentschel B. 1897, **30.** 1434.)

Nitrogen chlorophosphide, $N_3P_3Cl_6$.

Insol. in H_2O, but slowly decomp. thereby. Insol. in hot H_2SO_4, HCl, or HNO_3+Aq. Decomp. by hot fuming HNO_3. Sol. in alcohol; very sol. in ether, but these solutions gradually decompose. Sol. in CS_2, $CHCl_3$, C_6H_6, and oil of turpentine.

Sol. in $POCl_3$. (Gladstone, Chem. Soc. **3.** 138.)

Nitrogen chlorosulphide.

See **Nitrogen sulphochloride.**

Nitrogen fluoride.

Very explosive. (Warren, C. N. **55.** 289.)

Nitrogen *mono*iodamine, NH_2I.

Very rapidly decomp. by H_2O into $N_2H_3I_3$. (Raschig, A. **230.** 212.)

Nitrogen *di*iodamine, NHI_2.

Properties as *tri*iod*di*amine.

Nitrogen *tri*iod*di*amine, NH_3, NI_3.

Decomp. by H_2O. (Raschig, A. **230.** 212.)
Insol. in absolute alcohol. Sol. with decomp. in HCl+Aq. (Bunsen.)

Nitrogen iodide, N_3I.

See ***Tri*azoiodide.**

Nitrogen iodide, NI_3.

Insol. in H_2O, but slowly decomp. thereby. Sol. in HCl+Aq. Sol. in KCN+Aq. (Millon, J. pr. **17.** 1.)

Sol. in $Na_2S_2O_3$+Aq. (Guyard, C. R. **97.** 526.)

Sol. in KSCN+Aq. (Raschig, A. **230.** 212.)

Nitrogen iodide ammonia, NI_3, $3NH_3$; NI_3, $2NH_3$; and NI_3, NH_3.

(Hugot, C. R. 1900, **130.** 507.)

NI_3, $12NH_3$. Ppt.; insol. in ether. (Ruff, B. 1900, **33.** 3028.)

Nitrogen *mon*oxide, N_2O.

(a.) *Liquid.* Miscible with alcohol or ether.
(b.) *Gas.*

1 vol. H_2O absorbs 0.78–0.86 vol. N_2O at ordinary temp. (Henry); 0.80 vol. at ordinary temp. (Dalton); 0.76 vol. at ordinary temp. (de Saussure); 0.708 vol. at 18° (Pleisch); 0.54 vol. (Davy).

1 vol. H_2O at t° and 760 mm. absorbs V vols. N_2O, reduced to 0° and 760 mm.

t°	V	t°	V
0	1.3052	13	0.8304
1	1.2605	14	0.8034
2	1.2172	15	0.7778
3	1.1752	16	0.7535
4	1.1346	17	0.7306
5	1.0954	18	0.7090
6	1.0575	19	0.6888
7	1.0210	20	0.6700
8	0.9858	21	0.6525
9	0.9520	22	0.6364
10	0.9196	23	0.6216
11	0.8885	24	0.6082
12	0.8588	..	...

(Bunsen's Gasometry.)

1 vol. H_2O absorbs $1.30521-0.0453620t+0.00068430t^2$ vols. N_2O at t° and 760 mm. (Bunsen.)

Coefficient of absorption by H_2O = 0.01883 at 15°. (Steiner, Z. phys. Ch. 1895, **18.** 14.)

Coefficient of absorption by H_2O = 0.600 at 23.5°; 0.773 at 15.5°; 0.951 at 8.1°. (Gordon, Z. phys. Ch. 1895, **18.** 4.)

Absorption of N_2O by H_2O at t°.

t°	Coefficient of absorption
25	0.5752
20	0.6654
15	0.7896
10	0.9479
5	1.1403

(Roth, Z. phys. Ch. 1897, **24.** 123.)

Solubility in H_2O at 25° = 0.5942; at 20° = 0.6756; at 15° = 0.7784; at 10° = 0.9101; at 5° = 1.067. (For formula for "solubility," see under oxygen.) (Geffcken, Z. phys. Ch. 1904, **49.** 278.)

Solubility of N_2O in H_2O = 0.592 at 25° and 758–1362 mm. pressure. (Findlay and Creighton, Chem. Soc. 1910, **97.** 538.)

100 vols. H_2SO_4 (sp. gr. = 1.84) absorb 75.7 vols. N_2O; 100 vols. H_2SO_4+Aq (sp. gr. = 1.80) absorb 66.0 vols. N_2O; 100 vols. H_2SO_4+Aq (sp. gr. = 1.705) absorb 39.1 vols. N_2O; 100 vols. H_2SO_4+Aq (sp. gr. = 1.45) absorb 41.6 vols. N_2O; 100 vols. H_2SO_4+Aq (sp. gr. = 1.25) absorb 33.0 vols. N_2O.

$CaCl_2$+Aq, and NaCl+Aq absorb considerable amounts of N_2O. (Lunge, B. **14.** 2188.)

Absorption by acids+Aq.

M = content in gram-equivalents per liter.
S = solubility (see under Oxygen).

Absorption of N_2O by HNO_3+Aq.

M	S 25°	S 15°
0.610	0.5969	0.7770
0.614	0.5980	0.7766
1.253	0.6045	0.7767
1.254	0.6061	0.7767
2.405	0.6156	0.7735
2.435	0.6149	0.7737

(Geffcken, Z. phys. Ch. 1904, **49.** 278.)

Absorption of N_2O by HCl+Aq.

M	S 25°	S 15°
0.549	0.5775	0.7550
0.550	0.5759	0.7528
1.089	0.5670	0.7360
1.093	0.5657	0.7347
2.300	0.5546	0.7103
2.340	0.5564	0.7122

(Geffcken.)

Absorption of N_2O by $\frac{H_2SO_4}{2}$+Aq.

M	S 25°	S 15°
0.523	0.5648	0.7328
0.526	0.5657	0.7340
1.050	0.5426	0.6997
1.054	0.5419	0.6984
2.042	0.5083	0.6440
2.047	0.5087	0.6428
2.971	0.4819	0.6024
2.963	0.4820	0.6030
3.897	0.4569	0.5648
3.973	0.4577	0.5640

(Geffcken.)

Absorption of N_2O by H_3PO_4+Aq at t°.

t°	% of H_3PO_4				
	3.38%	4.72%	8.84%	9.89%	13.35%
5	1.057	1.0365	0.9883	0.9635	0.9171
10	0.8827	0.8665	0.8296	0.8101	0.7711
15	0.7388	0.7258	0.6977	0.6826	0.6505
20	0.6253	0.6147	0.5926	0.5810	0.5555
25	0.5427	0.5329	0.5143	0.5054	0.4860

(Roth, Z. phys. Ch. 1897, **24.** 134.)

100 vols. conc. $FeSO_4$+Aq absorb 19.5 vols. N_2O.

Solubility of N_2O in a solution containing 47.7 g. $Fe(OH)_3$ per litre at 25° = 0.5799; 47.9 g. $Fe(OH)_3$ per litre at 25° = 0.5787. (Geffcken, Z. phys. Ch. 1904, **49.** 299.)

100 vols. KOH+Aq (sp. gr. = 1.12) absorb 18.7 vols. N_2O; 100 vols. KOH+Aq sat. with pyrogallol absorb 18.1 vols. N_2O; 100 vols. NaOH+Aq (sp. gr. = 1.1) (7% NaOH) absorb 23.1 vols. N_2O; 100 vols. NaOH+Aq sat. with pyrogallol absorb 28.0 vols. N_2O.

Absorption of N_2O by KOH+Aq.

M = content in gram-equivalents per litre.
S = solubility (see under oxygen).

M	S 25°	S 15°
0.541	0.5087	0.6591
0.542	0.5093	0.6595
1.074	0.4252	0.5427
1.082	0.4221	0.5392

(Geffcken, Z. phys. Ch. 1904, **49.** 278.)

Coefficient of solubility of N_2O in salts+Aq at t°.

Salt	Concentration of salt		Coeff. of absorption at			
	G. per 100 g. solution	G. mol. per l.	5°	10°	15°	20°
$CaCl_2$	5.79	0.547	0.819	0.697	0.591	0.500
	9.86	0.964	0.608	0.586	0.509	0.435
	13.99	1.416	0.510	0.441	0.380	0.328
LiCl	1.35	0.319	0.986	0.831	0.700	0.599
	3.85	0.928	0.878	0.743	0.629	0.536
	11.48	2.883	0.606	0.512	0.437	0.382
Li_2SO_4	2.37	0.219	0.934	0.792	0.670	0.569
	5.46	0.521	0.795	0.665	0.557	0.474
	8.56	0.836	0.646	0.555	0.477	0.415
$MgSO_4$	5.90	0.521	0.766	0.664	0.561	0.471
	7.66	0.687	0.708	0.586	0.486	0.414
	10.78	0.997	0.569	0.491	0.417	0.346
KCl	4.90	0.676	0.879	0.751	0.643	0.555
	7.64	1.037	0.799	0.693	0.591	0.494
	14.58	2.187	0.654	0.574	0.500	0.430
	22.08	3.414	0.544	0.459	0.390	0.339
K_2SO_4	2.62	0.154	0.986	0.831	0.701	0.605
	4.78	0.285	0.918	0.763	0.637	0.542
NaCl	6.20	1.107	0.800	0.682	0.585	0.509
	8.88	1.614	0.713	0.603	0.510	0.434
	12.78	2.391	0.634	0.532	0.449	0.386
Na_2SO_4	5.76	0.427	0.808	0.677	0.584	0.495
	8.53	0.646	0.692	0.574	0.482	0.416
	12.44	0.974	0.559	0.486	0.417	0.354
$SrCl_2$	3.31	0.215	0.928	0.788	0.671	0.578
	5.73	0.380	0.848	0.709	0.610	0.556
	13.24	0.939	0.644	0.547	0.463	0.390

(Gordon, Z. phys. Ch. 1895, **18.** 5.)

Absorption of N_2O by salts+Aq at 15°.
M = number of molecules of salt per litre.
α = coefficient of absorption.

Salt	M	α
KCl	3.554	0.0892
	2.909	0.1012
	1.755	0.1279
	1.051	0.1489
	0.526	0.1667
KNO_3	2.430	0.1180
	1.820	0.1311
	1.541	0.1391
	0.879	0.1559
	0.482	0.1683
K_2CO_3	4.352	0.0160
	2.939	0.0285
	2.156	0.0462
	1.376	0.0761
	0.690	0.1183
	0.341	0.1501
	0.209	0.1628
NaCl	4.815	0.0595
	2.801	0.0925
	2.049	0.1130
	0.825	0.1548
$NaNO_2$	5.711	0.0578
	3.980	0.0810
	2.656	0.1052
	1.413	0.1370
	0.679	0.1603
Na_2CO_3	1.218	0.0839
	0.819	0.1082
	0.438	0.1385
	0.207	0.1639
Na_2SO_4	1.364	0.0775
	0.638	0.1254
	0.335	0.1519
LiCl	3.734	0.0990
	1.800	0.1370
	0.835	0.1619
$MgSO_4$	2.501	0.0499
	1.631	0.0797
	0.936	0.1159
	0.433	0.1501
$ZnSO_4$	2.180	0.0605
	1.277	0.0961
	0.899	0.1175
	0.397	0.1525
$CaCl_2$	2.962	0.0519
	2.556	0.0619
	1.827	0.0839
	1.122	0.1138
	0.578	0.1450
	0.321	0.1619

(Steiner, Z. phys. Ch. 1895, **18.** 14–5.)

Coefficient of absorption of N_2O by NaCl+Aq at t°.

t°	Per cent of NaCl			
	0.990	1.808	3.886	5.865
5	1.0609	1.0032	0.9131	0.8428
10	0.8812	0.8383	0.7699	0.7090
15	0.7339	0.7026	0.6495	0.5976
20	0.6191	0.5962	0.5520	0.5088
25	0.5363	0.5190	0.4775	0.4424

(Roth, Z. phys. Ch. 1897, **24.** 139.)

Absorption of N_2O by salts+Aq at 20°.

C = concentration of the solution in terms of normal.

α = coefficient of absorption.

Absorption of N_2O by KNO_3+Aq at 20°.

P	C	α
0	...	0.6270
1.063	0.1061	0.6173
2.720	0.2764	0.6002
5.389	0.5630	0.5713
10.577	1.1683	0.5196

Absorption of N_2O by $NaNO_3$+Aq at 20°.

P	C	α
0	...	0.6270
1.124	0.1336	0.6089
2.531	0.3052	0.5876
5.077	0.6286	0.5465
8.701	1.1200	0.4926

(Knopp, Z. phys. Ch. 1904, **48.** 107.)

Absorption of N_2O by salts+Aq.

M = content in gram-equivalents per litre.

S = solubility.

Salt	M	S 25°	S 15°
NH_4Cl	0.598	0.5532	0.7203
	0.600	0.5504	0.7185
	1.158	0.5223	0.6800
	1.166	0.5200	0.6775
KI	0.550	0.5367	0.6950
	0.557	0.5344	0.6916
	0.886	0.5025	0.6466
	0.913	0.5012	0.6442
	0.514	0.5428	0.7074
	0.545	0.5406	0.7036
LiCl	0.558	0.5276	0.6884
	0.561	0.5278	0.6877
	1.057	0.4760	0.6163
	1.059	0.4773	0.6146

Absorption of N_2O by salts+Aq.—*Continued.*

Salt	M	S 25°	S 15°
KBr	0.546	0.5306	0.6877
	0.550	0.5318	0.6892
	0.937	0.4908	0.6352
	0.959	0.4899	0.6334
RbCl	0.439	0.5399	0.7050
	0.444	0.5386	0.7053
	0.977	0.4873	0.6306
	0.993	0.4846	0.6276
	0.558	0.5218	0.6782
	0.559	0.5217	0.6787
	1.070	0.4673	0.6046
	1.102	0.4639	0.6020

(Geffcken, Z. phys. Ch. 1904, **49.** 278.)

Solubility of N_2O in a solution containing 39.6 g. As_2S_3 per litre at 25° = 0.5819; 42.4 g. As_2S_3 per litre at 25° = 0.5833. (Geffcken.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. N_2O gas reduced to 0° and 760 mm.

t°	V	t°	V
0	4.1780	13	3.3734
1	4.1088	14	3.3200
2	4.0409	15	3.2678
3	3.9741	16	3.2169
4	3.9085	17	3.1672
5	3.8442	18	3.1187
6	3.7811	19	3.0714
7	3.7192	20	3.0253
8	3.6585	21	2.9805
9	3.5990	22	2.9368
10	3.5408	23	2.8944
11	3.4838	24	2.8532
12	3.4279	..	...

(Bunsen's Gasometry.)

Coefficient of absorption = $4.17805 - 0.0698160t + 0.0006090t^2$. (Carius.)

At 18° and 760 mm., 100 vols. H_2O absorb 76 vols. N_2O: 100 vols. alcohol of 0.840 sp. gr. absorb 153 vols.; 100 vols. rectified naphtha of 0.784 sp. gr. absorb 254 vols.; 100 vols. oil of lavender of 0.880 sp. gr. absorb 275 vols.; 100 vols. olive oil of 0.915 sp. gr. absorb 150 vols.; 100 vols. sat. KCl+Aq (26% KCl) of 1.212 sp. gr. absorb 29 vols. (de Saussure, **1814**.)

1 vol. oil of turpentine absorbs 2.5–2.7 vols. N_2O. (de Saussure.)

Absorption of N_2O by glycerine+Aq at t°.

t°	% by weight of glycerine			
	3.460%	6.726%	12.120%	16.244%
25	0.5558	0.5415	0.5268	0.5083
20	0.6468	0.6303	0.6050	0.5851
15	0.7672	0.7454	0.7098	0.6857
10	0.9172	0.8871	0.8411	0.8102
5	1.0967	1.0552	0.9990	0.9586

(Roth, Z. phys. Ch. 1897, **24.** 128.)

Absorption of N_2O by urea+Aq at t°.

t°	% by weight of urea				
	3.312%	4.974%	6.366%	7.296%	9.966%
25	0.5686	0.5669	0.5588	0.7502	0.5689
20	0.6533	0.6558	0.6539	0.6553	0.6508
15	0.7708	0.7732	0.7605	0.7722	0.7614
10	0.9209	0.9201	0.9086	0.9208	0.9007
5	1.1040	1.0964	1.0880	1.1012	1.0685

(Roth, Z. phys. Ch. 1897, **24.** 124.)

Absorption of N_2O by sugar+Aq at 15°.

Number of molecules of $C_{12}H_{22}O_{11}$ per litre	Coefficient of absorption
1.699	0.0892
0.993	0.1284
0.520	0.1561

(Steiner, Z. phys. Ch. 1895, **18.** 15.)

Absorption of N_2O by organic substances+Aq.

C = concentration of the solution in terms of normal.

α = coefficient of absorption.

Absorption of N_2O by chloral hydrate+Aq at 20°.

P	C	α
0	...	0.6270
2.947	0.184	0.6182
6.848	0.445	0.6128
13.48	0.942	0.5960
16.15	1.165	0.5891
19.60	1.474	0.5793
24.02	1.911	0.5675

(Knopp, Z. phys. Ch. 1904, **48.** 106.)

Absorption of N_2O by propionic acid+Aq at 20°.

P	C	α
0	...	0.6270
1.492	0.2045	0.6323
5.702	0.816	0.6369
13.680	2.140	0.6504
15.011	2.385	0.6534
25.589	4.645	0.7219

(Knopp, Z. phys. Ch. 1904, **48.** 107.)

Absorption of N_2O by oxalic acid+Aq at t°.

t°	Coeff. of abs. in $H_2C_2O_4$+Aq of given % strength	
	8.122%	3.699%
25	0.5786	0.5643
20	0.6694	0.6538
15	0.7940	0.7745
10	0.9526	0.9264
5	1.1450	1.1094

(Roth, Z. phys. Ch. 1897, **24.** 130.)

Coefficient of absorption for petroleum = 2.11 at 20°; 2.49 at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

The solubility of N_2O in various colloidal solutions has been determined by Findlay and Creighton (Chem. Soc. 1910, **97.** 538), for which see original article.

Nitrogen *di*oxide, NO.

1 vol. H_2O absorbs 0.1 vol. NO gas at ordinary temp. (Davy); 1 vol. absorbs 0.05 vol. (Henry); 1 vol. absorbs 1/27 vol. (Dalton.)

Absorption of NO by H_2O at 760 mm. pressure.

β = Coefficient of absorption.

β' = "Solubility."

t°	β	β'	t°	β	β'
0	0.07381	0.07337	55	0.03040	0.02570
5	6461	6406	60	2954	2375
10	5709	5640	65	2877	2169
15	5147	5061	70	2810	1947
20	4706	4599	75	2751	1706
25	4323	4189	80	2700	1439
30	4004	3838	85	2665	1146
35	3734	3529	90	2648	0817
40	3507	3254	95	2638	0439
45	3311	3000	100	2628	0000
50	3152	2771			

(Winkler, B. 1901, **34.** 1414.)

205.69 cc. H_2O absorb 9.6798 cc. NO at 20° and 760 mm. (Hüfner, Z. phys. Ch. 1907, **59.** 420.)

Sol. in conc. HNO_3+Aq.

100 vols. HNO_3+Aq of 1.3 sp. gr. agitated with NO gas take up 20 vols. NO. If acid is twice as strong or one-half as strong, the quantity NO is proportional to the amount of HNO_3. Very dil. HNO_3+Aq absorbs scarcely more NO than pure H_2O. (Dalton.)

100 pts. HNO_3+Aq of 1.4 sp. gr. absorb 90 pts. NO (Dalton); sol. in Br_2, and very sl. sol. in conc. H_2SO_4. (Berthelot.)

1 ccm. conc. H_2SO_4 of 1.84 sp. gr. absorbs 0.035 ccm. NO; of 1.50 sp. gr., 0.017 ccm. NO. (Lunge, B. **18.** 1391.)

Absorption of NO by H_2SO_4+Aq at 18° and 760 mm.

a = Coefficient of solubility.

H_2SO_4	a	H_2SO_4	a
98%	not constant	70%	0.0115
90%	0.0193	60%	0.0118
80%	0.0117	50%	0.0120

(Tower, Z. anorg. 1906, **50.** 387.)

Very sol. in aqueous solutions of ferrous salts, especially the sulphate. (Priestley.)

1 vol. $FeSO_4$+Aq of 1.081 sp. gr., containing 1 grain $FeSO_4$ to 6 grains H_2O, absorbs 6 vols. NO. (Dalton.)

Absorption by ferrous salts+Aq is proportional to the amount of Fe present, irrespective of the acid or concentration of the solution. Between 0° and 10°, about 2 mols. NO are absorbed for each atom of Fe; between 10° and 15°, 1 mol. NO for 2 atoms of Fe; and at 25°, only 1 mol. NO for 2½ to 3 atoms of Fe. The amount of NO absorbed also varies with the pressure. The sp. gr. of the ferrous salt solution is greater after the absorption of NO than before. The solutions are decomp. by heat, and at 100° all NO is given off. (Gay, A. ch. (6) **5.** 145.)

Absorption of NO by $FeSO_4$+Aq at 25°.

A = vol. H_2O (in litres) containing 1 mol. $FeSO_4$.
V = vol. NO (in litres) absorbed.

A	V	A	V
1.2	1.47	7.2	5.52
1.8	2.01	12.0	6.46
2.4	2.55	18.6	8.01
4.82	4.40	36.0	10.40

(Kohlschütter, B. 1907, **40.** 877.)

Absorption of NO by $FeSO_4$+Aq at t°.

205.69 cc. $FeSO_4$+Aq contain 0.0221 g. Fe. Coefficient of absorption = 0.06067 at 20.09°.

t°	Pressure mm.	NO absorbed ccm.
20.1	704.9	14.42
20.1	683.5	14.10
20.1	668.6	13.80
20.2	651.9	13.58
20.05	632.9	13.15
20.0	613.7	12.98

Absorption of NO by $FeSO_4$+Aq at t°.—*Continued.*

205.69 cc. of $FeSO_4$+Aq contain 0.0296 g. Fe.
Coefficient of absorption = 0.06505.

t°	Pressure mm.	NO absorbed ccm.
20.05	677.5	14.30
20.05	655.3	14.07
20.04	639.1	13.81
20.00	620.2	13.39
20.15	600.5	13.20
20.14	581.2	12.92

205.69 cc. of $FeSO_4$+Aq contain 0.0409 g. Fe.
Coefficient of absorption = 0.06684.

t°	Pressure mm.	NO absorbed ccm.
20.04	667.6	16.79
20.02	650.6	16.65
20.00	613.1	15.71
20.00	594.6	15.41
20.10	577.1	15.32

205.69 cc. of $FeSO_4$+Aq contain 0.0513 g. Fe.
Coefficient of absorption = 0.07981.

t°	Pressure mm.	NO absorbed ccm.
20.10	644.8	18.82
20.10	623.8	18.47
20.08	606.4	18.02
20.10	589.7	17.56
20.10	571.1	17.19
20.10	553.1	16.95

205.69 cc. of $FeSO_4$+Aq contain 0.0663 g. Fe.
Coefficient of absorption = 0.08059.

t°	Pressure mm.	NO absorbed ccm.
20.10	697.3	21.91
20.10	678.9	21.60
20.10	660.4	21.18
20.08	638.2	20.71
20.04	620.7	20.28
20.00	602.5	19.87

205.69 cc. of $FeSO_4$+Aq contain 0.099 g. Fe.
Coefficient of absorption = 0.11661.

t°	Pressure mm.	NO absorbed ccm.
20.10	649.9	34.26
20.15	631.1	33.82
20.20	618.4	33.26
20.00	603.3	32.76
19.85	588.6	32.34
19.85	574.2	31.95

(Hüfner, Z. phys. Ch. 1907, **59.** 419.)

Absorption of NO by $NiSO_4$+Aq at t°.
205.69 cc. $NiSO_4$+Aq contain 0.0506 g. Ni.
Coefficient of absorption = 0.08311.

t°	Pressure mm.	NO absorbed ccm.
20.2	654.7	23.00
20.2	629.8	22.54
20.2	609.5	22.03
20.15	591.7	21.65
20.14	573.4	21.18

(Hüfner, *l. c.*)

Absorption of NO by $CoSO_4$+Aq at t°.
205.69 cc. $CoSO_4$+Aq contain 0.0598 g. Co.
Coefficient of absorption = 0.09146.

t°	Pressure mm.	NO absorbed ccm.
20.15	678.3	23.47
20.16	653.5	23.01
20.20	636.6	22.55
20.30	615.9	21.99
20.40	600.0	21.56

(Hüfner, *l. c.*)

Absorption of NO by $MnCl_2.4H_2O$+Aq at t°.
205.69 cc. $MnCl_2.4H_2O$+Aq contain 0.0697 g. Mn.
Coefficient of absorption = 0.06111.

t°	Pressure mm.	NO absorbed ccm.
20.0	711.96	14.25
20.05	686.5	13.99
20.2	657.4	13.49
20.3	638.9	13.05
20.45	621.0	12.81

(Hüfner, *l. c.*)

Coefficient of absorption for $FeSO_4$+Aq of concentration used by Hüfner (Z. phys. Ch. 1907, **59.** 417) = 0.180 at 20°. Hüfner's results are incorrect because he assumed that the absorption-coefficient of NO always had the same value, whereas it does not. NO is reduced by $FeSO_4$+Aq. (Usher, Z. phys. Ch. 1908, **62.** 624.)

Coefficient of absorption for $CoSO_4$+Aq sat. at 20° = 0.0288. (Usher, Z. phys. Ch. 1908, **62.** 624.)

Coefficient of absorption for $NiSO_4$+Aq of the concentration used by Hüfner (*cf.* Z. phys. Ch. 1907, **59.** 422) = 0.048 at 20°.

Coefficient of absorption for $NiSO_4$+Aq sat. at 20° = 0.0245. (Usher, *l. c.*)

Coefficient of absorption for $MnCl_2$+Aq. sat. at 20° = 0.0082. (Usher, Z. phys. Ch. 1908, **62.** 624.)

Absorption of NO by $FeCl_2$+Aq at 22°.
A = vol. H_2O (in litres) containing 1 mol. $FeCl_2$.
V = vol. NO (in litres) absorbed.

A	V
2.5	3.30
5.18	4.83
10.35	6.56
20.7	8.32
51.8	11.89

(Kohlschütter, B. 1907, **40.** 878.)

Absorption by HCl+$FeCl_2$+Aq.
10.37 l. 30% HCl containing 1 mol. $FeCl_2$ in solution absorb 15.64 l. NO.
10.37 l. 10% HCl containing 1 mol. $FeCl_2$ in solution absorb 6.17 l. NO.

(Kohlschütter, *l. c.*)

Absorption by salts+$FeCl_2$+Aq.
10.37 l. sat. NaCl+Aq containing 1 mol. $FeCl_2$ in solution absorb 6.549 l. NO.
10.37 l. sat. NH_4Cl+Aq containing 1 mol. $FeCl_2$ in solution absorb 6.549 l. NO.

(Kohlschütter, *l. c.*)

Solubility of NO in $Fe(NO_3)_2$+Aq at 23°.
A = vol. H_2O (in litres) containing 1 mol. $Fe(NO_3)_2$.
V = vol. NO (in litres) absorbed.

A	V
3.25	2.77
6.50	4.16
13.00	5.54
26.00	6.61

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+Aq.
A = vol. H_2O (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V
0.231	0.120
0.277	0.098
0.371	0.052

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+conc. HCl.
A = vol. conc. HCl (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V	A	V
0.389	0.801	7.499	3.931
0.410	0.933	12.500	3.606
0.840	2.838	18.750	3.153
1.230	3.426	28.650	1.976
2.462	3.989		

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+acetic acid.

A = vol. acetic acid (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V
252	51.77
504	39.67
1269	81.60

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+98% formic acid.

A = vol. 98% formic acid (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V
27.9	12.76
56.0	13.17
140.0	14.34
280.0	18.68
1400.0	27.29

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+acetone.

A = vol. acetone (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V	A	V
4.667	14.04	291.60	40.99
29.16	24.01	583.20	67.22
58.33	24.60	1166.40	81.96

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+methyl alcohol.

A = vol. methyl alcohol (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V	A	V
1.60	3.30	20.50	6.15
8.22	5.60	82.25	4.90

(Kohlschütter, *l. c.*)

Absorption of NO by $CuCl_2$+ethyl alcohol.

A = vol. ethyl alcohol (in litres) containing 1 mol. $CuCl_2$.
V = vol. NO (in litres) absorbed.

A	V	A	V
1.50	8.70	38.41	18.15
3.84	12.38	76.83	18.05
12.80	15.43	192.10	15.92

(Kohlschütter, *l. c.*)

Absorption of NO by $CuBr_2$+Aq.

A = vol. H_2O (in litres) containing 1 mol. $CuBr_2$.
V = vol. NO (in litres) absorbed.

A	V
0.37	0.515
0.62	0.120
0.925	0.000

(Kohlschütter, *l. c.*)

Absorption of NO by $CuBr_2$+ethyl alcohol.

A = vol. alcohol (in litres) containing 1 mol. $CuBr_2$.
V = vol. NO (in litres) absorbed.

A	V	A	V
2.625	16.02	131.20	22.23
5.25	19.26	262.50	23.46
13.12	20.51	656.10	30.46
43.74	21.13		

(Kohlschütter, *l. c.*)

Sol. in stannous and chromous salts+Aq. (Peligot.)

Not absorbed by $Fe_2(SO_4)_3$+Aq. (Dalton.)

1 vol. absolute alcohol absorbs $0.31606-0.003487t+0.000049t^2$ vols. NO between 0° and 25°. (Bunsen.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. NO gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0.31606	13	0.27901
1	0.31262	14	0.27685
2	0.30928	15	0.27478
3	0.30604	16	0.27281
4	0.30290	17	0.27094
5	0.29985	18	0.26917
6	0.29690	19	0.26750
7	0.29405	20	0.26592
8	0.29130	21	0.26444
9	0.28865	22	0.26306
10	0.28609	23	0.26178
11	0.28363	24	0.26060
12	0.28127	..	...

(Bunsen's Gasometry.)

Abundantly absorbed by CS_2. (Friedburg, C. N. **48.** 97.)

Nitrogen *tri*oxide, N_2O_3.

Sol. in H_2O at 0°. If large amt. of H_2O is present, the solution is quite stable at ordinary temp. (Fremy, C. R. **79.** 61.)

Sol. in HNO_3+Aq.

Sol. in conc. H_2SO_4 to form $HNOSO_4$.

Sol. in ether.

Nitrogen *tri***oxide stannic chloride,** N_2O_3, $SnCl_4$.

Decomp. by H_2O. (Weber, Pogg. **118.** 471.)

Nitrogen *tetr***oxide,** NO_2 or N_2O_4.

Sol. in H_2O at 0° with decomp. Miscible with very conc. HNO_3. Absorbed abundantly by CS_2, $CHCl_3$, and C_6H_5Cl. (Friedburg, C. N. **47.** 52.)

Sol. in $C_6H_5NO_2$.

Sl. sol. in H_2S+Aq.

Sol. in H_2SO_4 or conc. HNO_3+Aq.

H_3PO_4 absorbs some liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1362.)

Nitrogen *pent***oxide,** N_2O_5.

Very deliquescent. Combines with H_2O to form HNO_3 with evolution of heat.

Nitrogen *hex***oxide,** NO_3.

Decomposes upon air or with H_2O. (Hautefeuille and Chappins, C. R. **92.** 80, 134; **94.** 1111, 1306.)

Nitrogen oxybromide.

See **Nitrosyl** *and* **Nitroxyl bromide.**

Nitrogen oxychloride.

See **Nitrosyl** *and* **Nitroxyl chloride.**

Nitrogen oxyfluoride.

See **Nitrosyl fluoride** *and* **Nitroxyl fluoride.**

Nitrogen phosphochloride, $P_3N_3Cl_6$.

See **Nitrogen chlorophosphide.**

Nitrogen selenide, NSe.

Very explosive. Insol. in H_2O. Sol. in HNO_3+Aq, and NaClO+Aq. (Espenschied, A. **113.** 101.)

Insol. in H_2O, ether, absolute alcohol; very sl. sol. in CS_2, C_6H_6, and glacial acetic acid. Decomp. by HCl or KOH+Aq. (Verneuil, Bull. Soc. (2) **38.** 548.)

Nitrogen sulphide, N_4S_4.

Insol. in H_2O. Decomp. by hot H_2O. Sl. sol. in alcohol, ether, wood alcohol, oil of turpentine. Easily sol. in CS_2. Slowly decomp. by HCl+Aq or KOH+Aq, rapidly by HNO_3+Aq. 15 g. dissolve in 1 kilo. of CS_2. (Fordos and Gélis, C. R. **31.** 702.)

Sol. in $CHCl_3$. (Demarçay, C. R. **91.** 854.)

Sol. in warm glacial acetic acid with decomp. on boiling. (Ruff and Geisel, B. 1904, **37.** 1591.)

Nitrogen *penta***sulphide,** N_2S_5.

Sol. in ether and most organic solvents; insol. in H_2O; fairly stable in ethereal solution, but decomp. by light. (Muthmann, Z. anorg. 1897, **13.** 206.)

Nitrogen sulphobromide, N_3S_4Br.

Decomp. by boiling H_2O and by dil. alkalies, also by boiling with alcohol. (Muthmann, B. 1897, **30.** 630.)

$N_4S_4Br_4$. Decomp. by moist air. (Clever, B. 1896, **29.** 340–341.)

$N_4S_4Br_6$. Decomp. by moist air. Very unstable. (Clever.)

$N_4S_5Br_2$. Insol. most solvents; unstable. (Clever.)

Nitrogen sulphochloride, $N_4S_4Cl_4$.

Unstable on air. Sol. in warm $CHCl_3$; crystallizes out on cooling. (Demarçay, C. R. **91.** 854, 1066.)

Demarçay calls this comp. thiazyl chloride.

Sol. in hot dry benzene, and in CCl_4; decomp. by moist air. (Andreocci, Z. anorg. 1897, **14.** 249.)

$N_4S_6Cl_2$. Partly sol. in H_2O. (Demarçay, C. R. **92.** 726.)

Demarçay calls this compound *di*thio*tetra*thiazyl *di*chloride.

$N_2S_3Cl_2 = N_2S_2$, SCl_2. Decomp. on air. (Fordos and Gélis.)

Demarçay (C. R. **92.** 726) calls this comp. thio*di*thiazyl *di*chloride.

$N_2S_4Cl_2$. Sol. in H_2O with subsequent decomp. More sol. than S in CS_2. (Soubeiran, A. ch. **67.** 71.)

Is a mixture of S_2Cl_2 and N_4S_4. (Fordos and Gélis, C. R. **31.** 702.)

N_3S_3Cl. Sl. sol. in warm, insol. in cold $CHCl_3$. (Demarçay, C. R. **92.** 726.)

"Thio*tri*azyl chloride." (Demarçay.)

N_3S_4Cl. Sol. in H_2O. Insol. in most solvents. Sl. sol. in $CHCl_3$. Easily sol. in thionyl chloride. (Demarçay, C. R. **91.** 854, 1066.)

Demarçay calls the compound thio*tri*thiazyl chloride $= (NS)_3 \equiv S{-}Cl$.

$N_4S_5Cl_2 = 2N_2S_2$, SCl_2. Decomp. on air. (Michaelis.)

$N_6S_7Cl_2 = 3N_2S_2$, SCl_2. Not decomp. on air. Decomp. by H_2O containing ammonia.

Nitrogen sulphoiodide, N_3S_4I.

Readily decomp. by H_2O. (Muthmann and Seitter, B. 1897, **30.** 627.)

Nitrohydroxylaminic acid, $H_2N_2O_3$.

Known only in solution. (Angeli, Gazz. ch. it. 1897, **27** (2) 357.)

Barium nitrohydroxylaminate, $BaN_2O_3+H_2O$.

Ppt. More stable in the air than the sodium salt. Not decomp. by prolonged boiling with H_2O. (Angeli, Gazz. ch. it. 1896, **26.** 17–25.)

Cadmium nitrohydroxylaminate, $CdN_2O_3+H_2O$.

As Ba salt. (Angelico and Fanara, Gazz. ch. it. 1901, **31.** (2) 21.)

Calcium nitrohydroxylaminate, $CaN_2O_3+\frac{1}{2}H_2O$.

(Angeli, Gazz. ch. it. 1900, **30.** (1) 593.)

Calcium nitrohydroxylaminate, $CaN_2O_3+3\frac{1}{2}H_2O$.

(Angelico and Fanara, Gazz. ch. it. 1901, **31.** (2) 15.)

Lead nitrohydroxylaminate, PbN_2O_3.

(Angeli, Gazz. ch. it. 1900, **30.** (1) 593.)

Potassium nitrohydroxylaminate, $K_2N_2O_3$.

Like Na salt. More hygroscopic. (Angeli, Gazz. ch. it. 1897, **27.** (2) 357.)
Sol. in H_2O. (Angeli, Gazz. ch. it. 1900, **30.** (1) 593.)

Silver nitrohydroxylaminate, $Ag_2N_2O_2$.

Ppt. (Angeli, C. C. **1901,** I. 1192.)

Sodium nitrohydroxylaminate, $Na_2N_2O_3$.

Very sol. in H_2O. Pptd. by alcohol. Aqueous solution is readily decomp. by boiling. (Angeli, Gazz. ch. it. 1896, **26.** (2) 17.)

Strontium nitrohydroxylaminate, $SrN_2O_3+H_2O$.

(Angeli, Gazz. ch. it. 1900, **30.** (1) 593.)
$+1\frac{1}{2}H_2O$. (Angelico and Fanara, Gazz. ch. it. 1901, **31.** (2) 15.)

Nitroiodic acid, $I_2O_4(NO)_2$

See **Nitrosoiodic acid.**

Nitronitrous acid.

Platinum potassium nitronitrite, $K_2Pt(NO_2)_4.N_2O_4$.

Decomp. by heat. (Miolati, C. C. **1896,** II. 1088.)

Nitroplatinous acid.

See **Platonitrous acid.**

Nitroprussic acid, $H_2FeC_5N_6O+H_2O=H_2Fe(CN)_5NO+H_2O$.

Deliquescent. Easily sol. in H_2O, alcohol, or ether. (Playfair, A. **74.** 317.)

Nitroprussides.

The alkali and alkali-earth nitroprussides are sol. in H_2O, and the solutions are not pptd. by alcohol. The others are mostly insol. in H_2O.

Ammonium nitroprusside, $(NH_4)_2Fe(CN)_5(NO)$.

Deliquescent. Very sol. in H_2O; not pptd. therefrom by alcohol. (Playfair.)

Barium nitroprusside, $BaFe(CN)_5NO+4H_2O$.

Very sol. in H_2O.
$+6H_2O$.

Cadmium nitroprusside, $CdFe(CN)_5NO$.

Insol. in H_2O. Sol. in HCl+Aq. Insol. in dil. or conc. HNO_3+Aq even when boiling. Not attacked by NH_4OH or KOH+Aq. (Norton, Am. Ch. J. **10.** 222.)

Calcium nitroprusside, $CaFe(CN)_5NO+4H_2O$

Very sol in H_2O. (Playfair.)

Cobalt nitroprusside, $CoFe(CN)_5NO$.

Ppt. (Norton, Am. Ch. J. **10.** 222.)
$+4H_2O$.

Copper nitroprusside, $CuFe(CN)_5NO+2H_2O$.

Insol. in H_2O or alcohol.

Ferrous nitroprusside, $FeFe(CN)_5NO+xH_2O(?)$.

Insol. in H_2O.

Mercurous nitroprusside, $Hg_2Fe(CN)_5NO$.

Insol. in H_2O. Unstable. (Norton, Am. Ch. J. **10.** 222.)

Nickel nitroprusside, $NiFe(CN)_5NO$.

As the Co salt. (Norton.)

Potassium nitroprusside, $K_2Fe(CN)_5NO+2H_2O$.

Sl. deliquescent. Sol. in 1 pt. H_2O at 16°.
$K_2Fe(CN)_5NO, 2KOH$. Very sol. in H_2O.

Silver nitroprusside, $Ag_2Fe(CN)_5NO$.

Insol. in H_2O, alcohol, or HNO_3+Aq. Sol. in NH_4OH+Aq.

Sodium nitroprusside, $Na_2Fe(CN)_5NO+2H_2O$.

Sol. in $2\frac{1}{2}$ pts. H_2O at 16°, and in less hot H_2O.

Zinc nitroprusside, $ZnFe(CN)_5NO$.

Very sl. sol. in cold, more in hot H_2O.

Nitrosisulphonic acid.

Cupric nitrosisulphonate, $NO\left\langle\begin{matrix}O\\SO_3\end{matrix}\right\rangle Cu$.

Decomp. by H_2O. (Raschig, B. 1907, **40.** 4583.)

Nitrosobromoruthenic acid.

Silver nitrosobromoruthenate ammonia, $Ag_2Ru(NO)Br_5, NH_3$.

Decomp. by H_2O. Sl. sol. in NH_4OH+Aq. Very sol. in $Na_2S_2O_3$+Aq. (Brizard, Bull. Soc. 1895, (3) **13.** 1093.)

Nitrosobromosmic acid.

Potassium nitrosobromosmate, $K_2Os(NO)Br_5$.
Stable in aqueous solution. (Wintrebert, A. ch. 1903, (7) **28.** 132.)

Nitrosochloroplatinic acid.

Potassium nitrosochloroplatinate, $K_2PtCl_5(NO)$.
Sol. in H_2O. (Vèzes, C. R. **110.** 757.)

Nitrosochlororuthenic acid.

Ammonium nitrosochlororuthenate, $(NH_4)_2Ru(NO)Cl_5$.
Sol. in H_2O. (Joly, C. R. **107.** 991.)
5 pts. are sol. in 100 pts. H_2O at 25°.
22 " " " " " " " " 60°.
(Howe, J. Am. Chem. Soc. 1894, **16.** 390.)

Cæsium nitrosochlororuthenate, $Cs_2Ru(NO)Cl_5$.
0.20 pt. is sol. in 100 pts. H_2O at 25°.
0.56 " " " " " " " " 100°.
(Howe.)
$+2H_2O$. Very sol. in H_2O. 105.8 pts. are sol. in 100 pts. H_2O. (Howe.)

Potassium nitrosochlororuthenate, $K_2Ru(NO)Cl_5$.
Sol. in H_2O. (Joly.)
12 pts. are sol. in 100 pts. H_2O at 25°.
80 " " " " " " " " 60°.
(Howe.)

Rubidium nitrosochlororuthenate, $Rb_2Ru(NO)Cl_5$.
Sol. in boiling H_2O without decomp.
0.57 pt. is sol. in 100 pts. H_2O at 25°.
2.13 " " " " " " " " 60°.
(Howe.)

Silver nitrosochlororuthenate ammonia, $Ag_2Ru(NO)Cl_5, NH_3$.
Decomp. by H_2O. Sl. sol. in NH_4OH+Aq. Very sol. in $Na_2S_2O_3$+Aq. (Brizard, Bull. Soc. 1895, (3) **13.** 1092.)

Nitrosoiodic acid, $I_2O_4(NO)_2$ (?)

Decomp. with H_2O, alcohol, ether, or acetic ether. Slowly sol. in H_2SO_4. (Kämmerer, J. pr. **83.** 65.)

Nitrososulphonic acid.

Potassium *di*nitrososulphonate, $N_2O.OK.SO_3K$.
Sol. in H_2O. Very unstable. (Hantzsch, B. 1894, **27.** 3268.)

Potassium nitroso*di*sulphonate, $ON(SO_3K)_2$.
Sol. in H_2O. Very explosive. (Hantzsch, B. 1895, **28.** 996 and 2744.)

Potassium nitroso*tri*sulphonate, $ON(SO_3K)_3+H_2O$.
Sol. in H_2O. (Hantzsch, B. 1895, **28.** 2750.)

Sodium nitroso*tri*sulphonate, $NO_2(SO_3)_3Na$.
Decomp. by H_2O. (Traube, B. 1913, **46.** 2521.)

Nitrososulphuric acid, $H_2N_2SO_5=H_2SO_3(NO)_2$.

Not known in free state.

Ammonium *di*nitrososulphate, $(NH_4)_2(NO)_2SO_3$.
Sol. in H_2O. Insol. in hot alcohol. (Pelouze, A. **15.** 240.)

Barium ——, $Ba(NO)_2SO_3$.
Sol. in H_2O. (Divers and Haga, Chem. Soc. **47.** 364.)

Barium potassium ——, $BaK_2(SN_2O_5)_2$.
Sol. in much H_2O to form a clear liquid, but the solution gradually deposits $BaSO_4$. (Hantzsch, B. 1894, **27.** 3271.)

Cupric nitroso*di*sulphate, $Cu(NO)(SO_3)_2$.
(Sabatier, Bull. Soc. 1897, (3) **17.** 787.)

Lead *di*nitrososulphate.
Insol. in H_2O. (Divers and Haga, Chem. Soc. **47.** 364.)

Potassium ——, $K_2(NO)_2SO_3$.
Decomp. by H_2O at ordinary temp. Insol. in alcohol. (Pelouze, A. ch. **60.** 160.)
Sol. in about 8 pts. H_2O at 14.5°. Less sol. in presence of KOH. (Divers and Haga, Chem. Soc. 1895, **67.** 455.)

Sodium ——, $Na_2(NO)_2SO_3$.
More sol. than K salt. (Pelouze.)
Sl. sol. in H_2O; very unstable moist or dry; decomp. by H_2O. (Divers, C. N. 1895, **72.** 266.)

Nitrososulphurous acid.

Ruthenium sodium nitrososulphite, $O[Ru(SO_3)_2(NO)Na_2]+2H_2O$.
Sl. sol. in cold H_2O. (Miolati, Gazz. ch. it. 1900, **30.** 511.)

Nitrosulphide of iron.

See **Ferro*tetra*nitrososulphonic acid.**

***B*initrosulphide of iron.**
Roussin's comp. is ammonium ferro*hepta*nitrososulphonate, which see.

Nitrosulphonic acid, $HNSO_5 = \frac{HO}{NO_2} SO_2$.

(*Lead chamber crystals.*) Rapidly sol. in H_2O with decomp. When brought into large amount of H_2O, no gas is evolved. (Fremy, C. R. **70.** 61.)

Sol. in H_2SO_4 without decomp. Sol. in cold H_2SO_4+Aq of sp. gr. 1.7–1.55. (Weber, J. pr. **100.** 37.)

Sl. sol. in H_2SO_4+Aq of 1.6 sp. gr. (Dana.)

More difficultly sol. in dil. than conc. H_2SO_4+Aq. (Müller.)

Potassium nitrosulphonate, $KOSO_2NO_2$(?).

Decomp. by H_2O. (Schultz-Sellack, B. **4.** 113.)

Nitrosulphonic anhydride (?), N_2O_3, $2SO_3 = S_2O_5(NO_2)_2$.

Rapidly sol. in H_2O with decomp. Abundantly sol. in cold H_2SO_4. (Rose, Pogg. **47.** 605.)

Insol. in cold, slowly sol. in warm H_2SO_4. (Prevostaye, A. ch. **73.** 362.)

Nitrosulphonic chloride, $NO_4SCl = NO_2SO_2Cl$ (?).

Decomp. by H_2O. Sol. in fuming H_2SO_4 without decomp. Decomp. by conc. H_2SO_4. (Weber, Pogg. **123.** 333.)

***Di*nitrosulphuric acid.**

See ***Di*nitrososulphuric acid.**

Nitrosyl bromide, NOBr.

Decomp. with cold H_2O. (Landolt, A. **116.** 177.)

Nitrosyl *tri*bromide, $NOBr_3$.

Decomp. by H_2O or cold alcohol.

Miscible with ether. (Landolt, A. **116.** 177.)

Mixture of NOBr and Br_2. (Fröhlich, A. **224.** 270.)

Nitrosyl platinic bromide, 2NOBr, $PtBr_4$.

Deliquescent. Decomp. by H_2O. (Topsoë, J. B. **1868.** 274.)

Nitrosyl chloride, NOCl.

Decomp. by H_2O. Absorbed by fuming H_2SO_4 without decomp.

Nitrosyl boron chloride, NOCl, BCl_3.

See **Boron nitrosyl chloride.**

Nitrosyl platinic chloride, 2NOCl, $PtCl_4$.

Very deliquescent, and sol. in H_2O with evolution of NO. (Rogers and Boye, Phil. Mag. J. **17.** 397.)

Nitrosyl thallium chloride, 2NOCl, TlCl, $TlCl_3$.

Very deliquescent, and sol. in H_2O with decomp. (Sudborough, Chem. Soc. **59.** 657.)

Nitrosyl stannic chloride, 2NOCl, $SnCl_4$.

Decomp. by H_2O, chloroform, or benzene, not by carbon disulphide. (Jörgensen.)

Nitrosyl titanium chloride, 2NOCl, $TiCl_4$.

Decomp. by H_2O. (Weber, Pogg. **118.** 476.)

Nitrosyl zinc chloride, NOCl, $ZnCl_2$.

Very deliquescent, and sol. in H_2O with evolution of NO. (Sudborough, Chem. Soc. **59.** 656.)

Nitrosyl chloride sulphur *tri*oxide, NOCl, SO_3.

Decomp. by H_2O. Sol. in conc. H_2SO_4 with evolution of HCl. (Weber, Pogg. **123.** 233.)

Nitrosyl fluoride, NOF.

Sol. in H_2O. Solution decomp. on standing with formation of NO and HNO_3. (Ruff and Stäuber, Z. anorg. 1905, **47.** 190.)

Nitrosyl sulphate, acid, $H(NO)SO_4$.

See **Nitrosulphonic acid.**

Nitrosyl sulphate, anhydro, $(NO)_2S_2O_7$.

See **Nitrosulphonic anhydride.**

Nitrosyl selenic acid, $SeO_2(ONO)_2$.

Decomp. by H_2O. (Lenher and Mathews, J. Am. Chem. Soc. 1906, **28.** 516.)

Nitrosyl sulphuric acid, $H(NO)SO_4$

See **Nitrosulphonic acid.**

Nitrous acid, HNO_2.

Known only in aqueous solution.

See **Nitrogen *tri*oxide.**

Nitrites.

Normal nitrites, except $AgNO_2$, are sol. in H_2O and alcohol; but, as a rule, they are less sol. than the corresponding nitrates.

Ammonium nitrite, NH_4NO_2.

Very deliquescent, and sol. in H_2O.

H_2O solution decomp. at 50°. (Berzelius.) Very dil. solution can be evaporated on water bath without decomp. (Bohlig, A. **125.** 25.) Solution containing $^1/_{100,000}$ pt. NH_4NO_2 can be evaporated to ½ its vol. without decomp. Solution containing $^1/_{500}$ pt. gives a distillate containing 8.6% of NH_4NO_2, while residue contains 82% of original quantity, 9.4% being lost. (Schöyen.)

Very deliquescent, sol. in H_2O; slowly but easily sol. in alcohol; insol. in ether. (Sörensen, Z. anorg. 1894, **7.** 38.)

Ammonium barium cupric nitrite, $(NH_4)_2BaCu(NO_2)_6$.

Ppt.; decomp. readily. (Przibylla, Z. anorg. 1897, **15.** 424.)

Ammonium bismuth silver nitrite, $(NH_4)_2BiAg(NO_2)_6$.

Moderately sol. in H_2O. Rapidly hydrolyzed by H_2O. (Ball and Abram, Chem. Soc. 1913, **103.** 2120.)

Ammonium bismuth sodium nitrite, $2NH_4NO_2$, $Bi(NO_2)_3$, $NaNO_2$.

Easily decomp. (Ball, Chem. Soc. 1905, **87.** 761.)

Ammonium cadmium nitrite ammonia, basic, $2NH_4NO_2$, $Cd(NO_2)_2$, $Cd(OH)_2$, $2NH_3$.

Decomp. by H_2O. (Morin, C. R. **100.** 1497.)

Ammonium calcium cupric nitrite, $(NH_4)_2CaCu(NO_2)_6$.

Ppt.; decomp. easily. Sol. in H_2O. Sl. sol. in alcohol. (Przibylla, Z. anorg. 1897, **15.** 423.)

Ammonium cobaltic nitrite, $3(NH_4)_2O$, Co_2O_3, $6N_2O_3+1\frac{1}{2}H_2O$.

Sl. sol. in H_2O, decomp. in aq. solution on heating. (Rosenheim, Z. anorg. 1898, **17.** 45.)

$+3H_2O$.

Somewhat sol. in cold H_2O; decomp. by boiling. Decomp. by conc. H_2SO_4, not by acetic or dil. mineral acids. (Erdmann, J. pr. **97.** 405.)

Ammonium cupric lead nitrite, $CuPb(NH_4)_2(NO_2)_6$.

Stable at ordinary temp.; sol. in HNO_3 with decomp.

2.575 pts. are sol. in 100 pts. H_2O at 20°, or 2.51% salt in sat. solution at 20°. (Przibylla, Z. anorg. 1897, **15.** 420.)

Ammonium cupric strontium nitrite, $(NH_4)_2CuSr(NO_2)_6$.

Ppt.; sol. in H_2O with decomp. (Przibylla, *l. c.*)

Ammonium iridium nitrite.

See **Iridonitrite, ammonium.**

Ammonium lead nickel nitrite, $(NH_4)_2PbNi(NO_2)_6$(?).

Ppt. (Przibylla, Z. anorg. 1897, **15.** 433.)

Ammonium osmium nitrite.

See **Osminitrite, ammonium.**

Ammonium osmyl oxynitrite.

See **Osmyloxynitrite, ammonium.**

Ammonium platinum nitrite.

See **Platonitrite, ammonium.**

Ammonium rhodium nitrite.

See **Rhodonitrite, ammonium.**

Ammonium ruthenium hydrogen nitrite, $Ru_2H_2(NO_2)_4$, $3NH_4NO_2+3H_2O$.

See **Rutheninitrite, ammonium hydrogen.**

Barium nitrite, $Ba(NO_2)_2+H_2O$.

Permanent. Very sol. in H_2O.

Solubility in H_2O at t°.

t°	G. in 100 cc. $Ba(NO_2)_2$	Sp. gr.
0	58	1.40
20	63	1.45
25	71	1.50
30	82	1.52
35	97	1.61

(Vogel, Z. anorg. 1903, **35.** 389.)

100 pts. H_2O dissolve at:

0°	10°	20°	30°	
63.5	69.5	79.5	93	pts. $Ba(NO_2)_2+H_2O$,
40°	50°	60°	70°	
113	136	170	202	pts. $Ba(NO_2)_2+H_2O$,
80°	90°	100°	110°	
254	331	461	765	pts. $Ba(NO_2)_2+H_2O$.

The sat. solution at 17° contains 40% $Ba(NO_2)_2$, and has sp. gr. 17°/0° = 1.4897. (Oswald, A. ch. 1914, (9) **1.** 62.)

100 g. H_2O at 13.5° dissolve 64 g. $Ba(NO_2)_2$ +10.2 g. $AgNO_2$ with excess of $AgNO_2$, and 75.6 g. $Ba(NO_2)_2$+9.5 g. $AgNO_2$, with excess of $AgNO_2$. (Oswald.)

Sol. in 64 pts. 94% alcohol; nearly insol. in absolute alcohol. (Lang, Pogg. **118.** 285.)

Solubility in alcohol+Aq at t°.

t°	Solvent	100 ccm. of the sat. solution contain g. $Ba(NO_2)_2+H_2O$
19.5	10% alcohol	49.30
21.0	20% "	29.30
20.5	30% "	18.41
20.5	40% "	13.33
20.5	50% "	9.11
20.0	60% "	4.84
19.0	70% "	2.66
19.5	80% "	0.98
20.0	90% "	0.00
20.0	absolute alcohol	0.00

(Vogel, Z. anorg. 1903, **35.** 390.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Barium cæsium nitrite, $CsBa_2(NO_2)_5$.

Sol. in H_2O. (Jamieson, Am. Ch. J. 1907, **38.** 616.)

$Cs_2Ba(NO_2)_4+H_2O$. Very sol. in H_2O. (Jamieson, Am. Ch. J. 1907, **38.** 616.)

Barium cæsium silver nitrite, $Cs_3AgBa(NO_2)_6$ $+2H_2O$.

Decomp. by cold H_2O. (Jamieson. Am. Ch. J. 1907, **38.** 616.)

Barium cobaltic nitrite, $2BaO, Co_2O_3, 4N_2O_3$ $+10H_2O$.

Sol. in moderately warm H_2O without decomp. but not recryst. therefrom. (Rosenheim, Z. anorg. 1898, **17.** 51–54.)

$3BaO, Co_2O_3, 6N_2O_3+H_2O$. Ppt.; very unstable. Nearly insol. in H_2O. (Rosenheim, Z. anorg. 1898, **17.** 47.)

Barium cobaltous potassium nitrite, $Ba(NO_2)_2$, $Co(NO_2)_2$, $2KNO_2$.

Decomp. by H_2O. (Erdmann, J. pr. **97.** 385.)

Barium cupric nitrite, $Ba[Cu(OH)(NO_2)_2]_2$.

Ppt. Insol. in H_2O. Decomp. by H_2O. Insol. in alcohol, but slowly decomp. by it. (Kurtenacker, Z. anorg. 1913, **82.** 208.)

Barium cupric potassium nitrite, $BaCuK_2(NO_2)_6$.

Stable when dry, easily decomp. when moist; sol. in H_2O with decomp.

45.86 pts. are sol. in 100 pts. H_2O at 20°, or 31.45% salt is contained in sat. solution at 20°. (Przibylla, Z. anorg. 1897, **15.** 424.)

Barium cupric thallium nitrite, $BaCuTl_2(NO_2)_6$.

Sl. sol. in H_2O. (Przibylla, Z. anorg. 1898, **18.** 461.)

Barium iridium nitrite.

See **Iridonitrite, barium.**

Barium mercuric nitrite, $2Ba(NO_2)_2$, $3Hg(NO_2)_2+5H_2O$.

Very sol. in H_2O and easily decomp. (Rây, Chem. Soc. 1910, **97.** 327.)

Barium nickel nitrite, $2Ba(NO_2)_2$, $Ni(NO_2)_2$.

Somewhat more easily sol. in H_2O than nickel potassium nitrite. (Lang.)

Barium nickel potassium nitrite, $Ba(NO_2)_2$, $Ni(NO_2)_2$, $2KNO_2$.

Sl. sol. in cold, easily in hot H_2O without apparent decomp. (Lang.)

Barium nickel thallium nitrite, $NiBaTl_2(NO_2)_6$

Ppt. (Przibylla, Z. anorg. 1898, **18.** 462.)

Barium osmium nitrite.

See **Osminitrite, barium.**

Barium osmyl oxynitrite.

See **Osmyloxynitrite, barium.**

Barium potassium nitrite, $Ba(NO_2)_2$, $2KNO_2$ $+H_2O$.

Easily sol. in H_2O; insol. in alcohol. (Lang, Pogg, **118.** 293.)

Barium rhodium nitrite, $3Ba(NO_2)_2$, $Rh_2(NO_2)_6$.

See **Rhodonitrite, barium.**

Barium silver nitrite, $Ba(NO_2)_2$, $2AgNO_2+$ H_2O.

Resembles the potassium salt. (Fischer.) Less stable than the Na salt. (Oswald.)

Bismuth nitrite, basic, $(BiO)NO_2+\frac{1}{2}H_2O$.

Sol. in HCl. (Vanino, J. pr. 1906, (2) **74.** 150.)

Bismuth cæsium silver nitrite, $Cs_2BiAg(NO_2)_6$.

Very sl. sol. in H_2O. Slowly decomp. by H_2O. (Ball and Abram, Chem. Soc. 1913, **103.** 2122.)

Bismuth potassium nitrite, $Bi(NO_2)_3$, $3KNO_2$ $+H_2O$.

Decomp. by H_2O. (Ball, Chem. Soc. 1905, **87.** 762.)

Bismuth potassium silver nitrite, $K_2BiAg(NO_2)_6$.

Less sol. in H_2O than NH_4 salt. (Ball and Abram, Chem. Soc. 1913, **103.** 2121.)

Bismuth rubidium silver nitrite, $Rb_2BiAg(NO_2)_6$.

Sl. sol. in H_2O with slow hydrolysis. (Ball and Abram.)

Bismuth silver thallous nitrite, $BiAgTl_2(NO_2)_6$.

Insol. in H_2O, but decomp. thereby. (Ball and Abram.)

Cadmium nitrite, basic, $2CdO$, N_2O_3.

Insol. in H_2O. (Hampe, A. **125.** 335.)

Cadmium nitrite, $Cd(NO_2)_2+H_2O$.

Deliquescent. Sol. in H_2O. (Lang, J. B. **1862.** 99.)

Cadmium potassium nitrite, $Cd(NO_2)_2$, KNO_2.

Easily sol. in H_2O. Very difficultly sol. in absolute alcohol, and only sl. sol. in 90% alcohol. (Hampe, A. **125.** 334.)

$Cd(NO_2)_2$, $2KNO_2$. Easily sol. in H_2O. Insol. in alcohol. (Lang, J. B. **1862. 99.**)

$Cd(NO_2)_2$, $4KNO_2$. More sol. in H_2O than the above salt. (Lang.)

Cæsium nitrite, $CsNO_2$.

Very hydroscopic. Very sol. in H_2O. (Ball, Chem. Soc. 1913, **103.** 2130.)

Cæsium calcium nitrite, $Cs_2Ca(NO_2)_4+H_2O$.

Ppt. (Jamieson, Am. Ch. J. 1907, **38.** 617.)

Cæsium cobaltic nitrite, $Cs_3Co(NO_2)_6+H_2O$.

Sol. in 20,100 pts. H_2O at 17°. (Rosenbladt, B. **19.** 2531.)

Cæsium lead nitrite, $CsPb(NO_2)_3+H_2O$.

Sol. in cold H_2O without decomp. When solution is heated, some basic lead salt separates. (Jamieson, Am. Ch. J. 1907, **38.** 618.)

Cæsium lead silver nitrite, $Cs_3AgPb(NO_2)_6+2H_2O$.

Ppt. (Jamieson.)

Cæsium silver nitrite, $CsAg(NO_2)_2$.

Decomp. by H_2O. (Jamieson.)

Cæsium silver strontium nitrite, $Cs_3AgSr(NO_2)_6+2H_2O$.

Partially decomp. by H_2O. (Jamieson.)

Cæsium strontium nitrite, $CsSr(NO_2)_3+H_2O$.

Ppt. Sol. in H_2O. (Jamieson.)

Calcium nitrite, $Ca(NO_2)_2+H_2O$.

Very deliquescent. Insol. in dil. alcohol. (Fischer, Pogg. **74.** 115.)

100 ccm. of the sat. solution contain 111.6 g. $Ca(NO_2)_2+H_2O$ at 20.5°. (Vogel, Z. anorg. 1903, **35.** 395.)

Solubility in H_2O at t°.

t°	% $Ca(NO_2)_2$	Solid phase
0	38.3	$Ca(NO_2)_2$, $4H_2O$
18.5	43	"
42	51.8	"
44	53.5	" $+Ca(NO_2)_2$, H_2O
54	55.2	$Ca(NO_2)_2$, H_2O
64	58.4	"
70	60.3	"
73	61.5	"
91	71.2	"

(Oswald, A. ch. 1914, (9) **1.** 32.)

Sat. solution of $Ca(NO_2)_2+AgNO_2$ contains 92.4 g. $Ca(NO_2)_2$ and 11.2 g. $AgNO_2$ per 100 g. H_2O at 14°. (Oswald.)

Solubility in alcohol.

100 ccm. of sat. solution in 90% alcohol contain 39.0 g. $Ca(NO_2)_2+H_2O$ at 20°.

100 ccm. of sat. solution in absolute alcohol contain 1.1 g. $Ca(NO_2)_2+H_2O$ at 20°. (Vogel.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+4H_2O$. The sat. solution at 16° contains 42.3% $Ca(NO_2)_2$ and has sp. gr. at 16°/0° = 1.4205. (Oswald, A. ch. 1914, (9) **1.** 66.)

Calcium cobaltous potassium nitrite, $Ca(NO_2)_2$, $Co(NO_2)_2$, $2KNO_2$.

Decomp. by H_2O. (Erdmann.)

Calcium cupric potassium nitrite, $CaCuK_2(NO_2)_6$.

Ppt., insol. in alcohol; sol. in H_2O with. decomp.

14.97 pts. are sol. in 100 pts. H_2O at 20°, or 13.02 per cent of salt is contained in sat. solution. (Przibylla, Z. anorg. 1897, **15.** 422.)

Calcium mercuric nitrite, $Ca(NO_2)_2$,$Hg(NO_2)_2$ $+5H_2O$.

Very sol. in H_2O. (Rây, Chem. Soc. 1910, **97.** 327.)

Calcium nickel potassium nitrite, $Ca(NO_2)_2$, $Ni(NO_2)_2$, $2KNO_2$.

Very sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. Sl. sol. in dil. $HC_2H_3O_2+$Aq. (Erdmann.)

Calcium osmium nitrite.

See **Osminitrite, calcium.**

Calcium potassium nitrite, $CaK(NO_2)_3+3H_2O$.

Sol. in H_2O. (Topsoë, W. A. B. **73, 2.** 112.)

Deliquescent. (Lang.)

Cobaltous nitrite.

Known only in solution.

Cobaltic lead nitrite, $3PbO$, Co_2O_3, $6N_2O_3+12H_2O$.

Insol. in H_2O. (Rosenheim, Z. anorg. 1898, **17.** 48.)

Cobaltic lead potassium nitrite, $3K_2O$, $3PbO$, $2Co_2O_3$, $10N_2O_3+4H_2O$.

Sol. by boiling in much H_2O. Sol. in hot acids with evolution of N_2O_3. (Stromeyer, A. **96.** 228.)

Cobaltous potassium nitrite, $2Co(NO_2)_2$, $2KNO_2+H_2O$.

Ppt. (Sadtler.)

$Co(NO_2)_2$, $2KNO_2+H_2O$. Ppt. (Sadtler.)

$3Co(NO_2)_2$, $6KNO_2+H_2O$. Insol. in cold, sol. in hot H_2O. Sl. sol. in $KC_2H_3O_2+$Aq. (Erdmann, J. pr. **97.** 397.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Cobaltic potassium nitrite (cobalt yellow), $Co_2(NO_2)_6$, $6KNO_2+3H_2O$.

Very sl. sol. in cold H_2O. Insol. in alcohol and ether. Sol. in traces in CS_2. (St. Evre,

C. R. **35.** 552.) Insol. in boiling conc. K_2SO_4, KCl, KNO_3, or $KC_2H_3O_2$+Aq.

Sol. in 1120 pts. H_2O at 17°. (Rosenbladt, B. 1886, **19.** 2535.)

Decomp. when heated in aq. solution. (Rosenheim, Z. anorg. 1898, **17.** 42.)

More sol. in NH_4Cl or NaCl+Aq than in H_2O. (Stromeyer.)

Sl. decomp. by KOH+Aq, except when very conc.; easily decomp. by NaOH or $Ba(OH)_2$+Aq.

Very sl. sol. in $KC_2H_3O_2$+Aq, or KNO_2+Aq. (Fresenius.) Sol. in HCl+Aq.

Sol. in $HC_2H_3O_2$, or $H_2C_2O_4$+Aq. (Stromeyer.)

Small quantity of $HC_2H_3O_2$+Aq does not dissolve. (Fresenius.)

Cobaltic potassium silver nitrite, $KCoAg_2(NO_2)_6$, and $K_2CoAg(NO_2)_6$.

Very sl. sol. in H_2O. Less sol. than Na comp. (Burgess and Karum, J. Am. Chem. Soc. 1912, **34.** 653.)

Cobaltous potassium strontium nitrite, $Co(NO_2)_2$, $2KNO_2$, $Sr(NO_2)_2$.

Decomp. by H_2O. (Erdmann, J. pr. **97.** 385.)

Cobaltic rubidium nitrite, $Rb_3Co(NO_2)_6+H_2O$.

Sol. in 19,800 pts. H_2O. (Rosenbladt, B. **19.** 2531.)

Cobaltic silver nitrite, $CoAg_3(NO_2)_6$.

Fairly sol. in H_2O. (Cunningham and Perkin, Chem. Soc. 1909, **95.** 1568.)

$2Ag_2O$, Co_2O_3, $3N_2O_3+3H_2O$. Sl. sol. in H_2O; decomp. by boiling H_2O. (Rosenheim, Z. anorg. 1898, **17.** 56.)

Cobaltic silver hydroxynitrite, $Co_2Ag_3(OH)_3(NO_2)_6$.

Sl. sol. in H_2O. (Suzuki, Chem. Soc. 1910, **97.** 729.)

Cobaltic silver nitrite ammonia, Co_2O_3, Ag_2O, $4N_2O_3$, $4NH_3$.

See **Cobalt ammonium comps.**

Cobaltic sodium nitrite, $2Na_2O$, Co_2O_3, $4N_2O_3$.

Sol. in H_2O and alcohol. (Rosenheim, Z. anorg. 1898, **17.** 50.)

$+H_2O$. Ppt. (Sadtler, Sill. Am. J. (2) **49.** 196).

$3Na_2O$, Co_2O_3, $6N_2O_3+xH_2O$. Sol. in H_2O; decomp. on heating; insol. in alcohol. (Rosenheim, Z. anorg. 1898, **17.** 43.)

Cobaltic strontium nitrite, $2SrO$, Co_2O_3, $4N_2O_3+11H_2O$.

Ppt. (Rosenheim, Z. anorg. 1898, **17.** 54.)

Cobaltic thallium nitrite, $Co_2(NO_2)_6$, $6TlNO_2$.

Sol. in 23,810 pts. H_2O at 17°. (Rosenbladt, B. **19.** 2531.)

Cobaltic zinc nitrite, $2ZnO$, Co_2O_3, $3N_2O_3+11H_2O$.

Sol. in dil. acetic acid. (Rosenheim, Z. anorg. 1898, **17.** 56.)

Cobalt nitrite nitrate. $2CoO$, Co_2O_3, $3N_2O_3$, $Co(NO_3)_2+14H_2O$.

Ppt. (Rosenheim, Z. anorg. 1898, **17.** 58.)

Cupric nitrite, basic, $2CuO$, N_2O_3.

(Hampe, A. **125.** 345.)

$Cu(NO_2)_2$, $3Cu(OH)_2$. Very sl. sol. in H_2O or alcohol. Easily sol. in dil. acids or ammonia. (van der Meulen, B. **12.** 758.)

Cupric nitrite.

Known only in solution.

Cupric lead potassium nitrite, $CuPbK_2(NO_2)_6$.

(van Lessen, R. t. c. **10.** 13.)

3.056 pts. are sol. in 100 pts. H_2O at 20°, or 2.51% salt is contained in sat. solution at 20° p. 429. (Przibylla, Z. anorg. 1897, **15.** 429.)

Cupric potassium strontium nitrite, $CuSrK_2(NO_2)_6$.

Sol. in H_2O with decomp. 10.82 pts. are sol. in 100 pts. H_2O at 20°, or 9.77 per cent salt is contained in sat. solution at 20°. (Przibylla, Z. anorg. 1897, **15.** 425.)

Cupric rubidium nitrite, $Rb_3Cu(NO_2)_5$.

Easily sol. in H_2O. Sol. in alcohol. (Kurtenacker, Z. anorg. 1913, **82.** 206.)

Cupric nitrite ammonia, $Cu(NO_2)_2$, $2NH_3+2H_2O$.

Sol. in little H_2O with absorption of much heat. Decomp. by much H_2O. (Peligot, C. R. **53.** 209.)

$3CuO$, N_2O_3, $2NH_3+H_2O$. As above. (Peligot.)

Iridium hydrogen nitrite, $Ir_2H_6(NO_2)_{12}$.

See **Iridonitrous acid.**

Iridium nitrite *with* **MNO_2.**

See **Iridonitrite, M.**

Iron (ferrous) lead potassium nitrite, $FePbK_2(NO_2)_6$.

Ppt.; insol. in cold H_2O; stable at ordinary temp. (Przibylla, Z. anorg. 1897, **15.** 439.)

Iron (ferrous) lead thallous nitrite, $FePbTl_2(NO_2)_6$.

Ppt. (Przibylla, Z. anorg. 1898, **18.** 463.)

Lead nitrite, basic, $4PbO$, $N_2O_3+H_2O = Pb(OH)NO_2$, PbO.

Sol. in 143 pts. H_2O at 23°, and 33 pts. at 100°. (Chevreul.)

Sol. in 1250 pts. cold H_2O, and 34.5 pts. at 100°. (Peligot.)

Sol. in cold HNO_3 or $HC_2H_3O_2$+Aq.

Composition is $3PbO$, $N_2O_3+H_2O$. (Meissner, J. B. **1876.** 194.)

Composition is as above. (v. Lorenz, W. A. B. **84, 2.** 1133.)

$3PbO$, $N_2O_3=Pb(NO_2)_2$, $2PbO$. Sol. in H_2O. (Bromeis, A. **72.** 38; v. Lorenz.)

$2PbO$, $N_2O_3+H_2O$. Sl. sol. in H_2O. (Bromeis.)

$+3H_2O$. (Meissner.)

$4PbO$, $3N_2O_3+2H_2O$. Sol. in H_2O. (Meissner, J. B. **1876.** 195.)

Lead nitrite, $Pb(NO_2)_2+H_2O$.

Easily sol. in H_2O. (Peligot, A. ch. **77.** 87.)

Lead nickel potassium nitrite, $Pb(NO_2)_2$, KNO_2, $Ni(NO_2)_2$.

Insol. in H_2O. (Baubigny, A. ch. (6) **17.** 111.)

Ppt. (Przibylla, Z. anorg. 1897, **15.** 432.)

Lead nickel thallous nitrite, $NiPbTl_2(NO_2)_6$.

Ppt. (Przibylla, Z. anorg. 1898, **18.** 462.)

Lead potassium nitrite, $4Pb(NO_2)_2$, $6KNO_2+3H_2O$.

Easily sol. in H_2O and in absolute alcohol. (Hampe, A. **125.** 334.)

$Pb(NO_2)_2$, $2KNO_2+H_2O$. Easily sol. in H_2O. Insol. in alcohol. (Lang, J. B. **1862.** 102.)

Lead potassium silver nitrite, $K_3AgPb(NO_2)_6+2H_2O$.

Ppt. (Jamieson, Am. Ch. J. 1907, **38.** 619.)

Lead nitrite nitrate.

See **Nitrate nitrite, lead.**

Lithium nitrite, $LiNO_2+\frac{1}{2}H_2O$.

Deliquescent. Easily sol. in alcohol and H_2O. (Vogel, Z. anorg. 1903, **35.** 403.)

Sat. solution of $LiNO_2+\frac{1}{2}H_2O$ in H_2O contains at:

65°	81.5°	91°	96°	92.5°
63.8	68.7	72.4	91.8	94.3% $LiNO_2$.

(Oswald.)

$+H_2O$. Very sol. in H_2O, readily forming supersat. solutions. Very sol. in abs. alcohol. (Ball, Chem. Soc. 1913, **103.** 2133.)

100 pts. H_2O dissolve at:

0°	10°	20°
125	156	189 pts. $LiNO_2+H_2O$.

30°	40°	50°
242	316	459 pts. $LiNO_2+H_2O$.

$LiNO_2$, H_2O+Aq sat. at 19° contains 48.9% $LiNO_2$ and has sp. gr. =1.3186. (Oswald, A. ch. 1914, (9) **1.** 61.)

100 g. H_2O dissolve 78.5 g. $LiNO_2$+10.5 g. $AgNO_2$ at 14°. (Oswald.)

Lithium mercuric nitrite, $LiNO_2$, $Hg(NO_2)_2+H_2O$.

(Rây, Chem. Soc. 1907, **91.** 2033.)

$4LiNO_2$, $Hg(NO_2)_2+4H_2O$. Extremely deliquescent. (Rây.)

Magnesium nitrite, $Mg(NO_2)_2+2H_2O$.

Deliquescent, and sol. in H_2O. Solution decomp. by boiling. Easily sol. in absolute alcohol. (Hampe, A. **125.** 334.)

Insol. in absolute alcohol. (Fischer.)

$+3H_2O$. Sol. in H_2O and absolute alcohol. Very deliquescent. (Vogel, Z. anorg. 1903, **35.** 397.)

Magnesium osmium nitrite.

See **Osminitrite, magnesium.**

Magnesium potassium nitrite.

Deliquescent, and easily sol. in H_2O. Insol. in alcohol. (Lang.)

Magnesium silver nitrite.

Sol. in H_2O with decomp. (Spiegel, Ch. Z. 1895, **19.** 1423.)

Manganous nitrite.

Deliquescent, and sol. in H_2O. (Mitscherlich.) Not obtained in a solid state, as the solution decomp. on evaporation. (Lang, Pogg. **118.** 290.)

Mercurous nitrite, $Hg_2(NO_2)_2$.

Sol. in H_2O with partial decomp. to **Hg** and $Hg(NO_2)_2$. (Rây, A. 1901, **316.** 252.)

Sol. in cold conc. HNO_3. Very slowly sol. in cold dil. HNO_3. (Rây, Chem. Soc. 1897, **71.** 339.)

Decomp. by boiling H_2O and by cold dil. H_2SO_4. (Rây, Z. anorg. 1896, **12.** 366.)

$+H_2O$. Slowly decomp. by H_2O. (Rây, Chem. Soc. 1897, **71.** 340.)

Mercuric nitrite, basic, $Hg(NO_2)_2$, $2HgO+H_2O$.

Ppt. (Lang.)

$12HgO$, $5N_2O_3+24H_2O$. (Rây, Chem. Soc. 1897, **71.** 341.)

Mercuric nitrite, $Hg(NO_2)_2$.

Deliquescent. Partly sol. in boiling H_2O, but the greater part is decomp. into $HgO+HNO_2$. (Rây, Proc. Chem. Soc. 1904, **20.** 57.)

Mercuromercuric nitrite, basic.

α. $9Hg_2O$, $4HgO$, $5N_2O_3+8H_2O$.

β. Hg_2O, $2HgO$, $N_2O_3+2H_2O$.

(Rây, Chem. Soc. 1897, **71.** 341.)

Mercuric potassium nitrite, $Hg(NO_2)_2$, $2KNO_2$.

Easily sol. in H_2O. Insol. in alcohol. (Lang, **1860.**)

$KHg(NO_2)_3$. Obtained from $K_3Hg(NO_2)_5$, H_2O+Aq containing a small excess of KNO_2. Decomp. by H_2O. (Rosenheim, Z. anorg. 1901, **28.** 173.)

$K_3Hg(NO_2)_5+H_2O$. Sol in H_2O. Formula of Lang is incorrect. (Rosenheim, Z. anorg. 1901, **28.** 172.)

Mercuric sodium nitrite, $Na_2Hg(NO_2)_4$.

Very hydroscopic. Decomp. by hot H_2O. (Rosenheim, Z. anorg. 1901, **28.** 173.)

$+2H_2O$. Deliquescent. (Rây, Chem. Soc. 1907, **91.** 2032.)

$2Hg(NO_2)_2$, $3NaNO_2$. Decomp. by H_2O. (Rây, Chem. Soc. 1907, **91.** 2032.)

Mercuric strontium nitrite, $3Hg(NO_2)_2$, $2Sr(NO_2)_2+5H_2O$.

Very sol. in H_2O. (Rây, Chem. Soc. 1910, **97.** 327.)

Mercuric nitrite hydrazine, $Hg(NO_2)_2$, N_2H_4.

Ppt. Decomp. by H_2O. (Hofmann and Marburg, A. 1899, **305.** 215.)

Nickel nitrite, basic, $2NiO$, N_2O_3.

Ppt. (Hampe, A. **125.** 343.)

Nickel nitrite, $Ni(NO_2)_2$.

Sol. in H_2O and alcohol. (Lang, J. B. **1862.** 100.)

Nickel potassium nitrite, $Ni(NO_2)_2$, $4KNO_2$.

Moderately sol. in H_2O. (Fischer, Pogg. **74.** 115.) Extremely sol. in H_2O. (Hampe, A. **125.** 346.) Insol. in absolute alcohol.

Nickel potassium strontium nitrite, $Ni(NO_2)_2$, $2KNO_2$, $Sr(NO_2)_2$.

Sl. sol. in cold, easily sol. in hot H_2O.

Nickel nitrite ammonia, $Ni(NO_2)_2$, $4NH_3$.

Sol. in cold H_2O. Decomp. on standing or by heating. Insol. in alcohol. Can be recrystallized by dissolving in NH_4OH+Aq, and adding much absolute alcohol. (Erdmann, J. pr. **97.** 395.)

$Ni(NO_2)_2$, $5NH_3$. Decomp. in the air giving $Ni(NO_2)_2$, $4NH_3$. (Ephraim, B. 1913, **46.** 3110.)

Osmium nitrite, $Os(NO_2)_3$.

Ppt. (Wintrebert, C. R. 1905, **140.** 587.)

Osmium nitrite *with* **MNO_2.**

See **Osminitrite, M.**

Osmyl nitrite *with* **MNO_2.**

See **Osmylnitrite, M.**

Osmyl oxynitrite *with* **MNO_2.**

See **Osmyloxynitrite, M.**

Osmyl nitrite ammonia, $OsO_2(NO_2)_2$, $4NH_3$.

(Wintrebert, A. ch. 1903, (7) **28.** 56.)

Palladious nitrite *with* **MNO_2.**

See **Palladonitrite, M.**

Platinous hydrogen nitrite, $H_2Pt(NO_2)_4$.

See **Platonitrous acid.**

Platinous nitrite *with* **MNO_2.**

See **Platonitrite, M.**

Potassium nitrite, KNO_2.

Deliquescent. Sol. in H_2O.

Pure KNO_2 is not deliquescent. (Oswald, A. ch. 1914, (9) **1.** 32.)

Sol. in about $^1/_3$ its wt. of H_2O. (Divers, Chem. Soc. 1899, **75.** 86.)

100 pts H_2O dissolve at:

0°	10°	20°	30°	40°
281	291	302	313	325 pts. KNO_2,
50°	60°	70°	80°	90°
337.5	351	365	380	396 pts. KNO_2,
100°	110°	120°	130°	
413	432	451	473 pts. KNO_2.	

Bpt. of sat. KNO_2+Aq is 132° at 758.5 mm. pressure.

(Oswald, A. ch. 1914, (9) **1.** 58.)

Sp. gr. of KNO_2+Aq at 17.5° containing:

10	20	30	40% KNO_2,
1.049	1.126	1.208	1.295
50	60	70	74.5% KNO_2.
1.377	1.491	1.599	1.646

(Oswald.)

100 g. H_2O at 13.5° dissolve 18 g. KNO_2+2.36 g. $AgNO_2$; at 25°, 23.1 g. KNO_2+5.3 g. $AgNO_2$ with excess of $AgNO_2$.

100 g. H_2O at 13.5° dissolve 276 g. KNO_2+26.3 g. $AgNO_2$; at 25°, 279 g. KNO_2+39.3 g. $AgNO_2$ with excess of KNO_2. (Oswald.)

See also under $AgNO_2$.

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Deliquesces in 90% alcohol; insol. in cold 94% alcohol. More sol. in H_2O than KNO_3, but less sol. in alcohol. (Fischer.)

Ppt. from its conc. aq. solution by the addition of methyl alcohol. Addition of ethyl alcohol to a conc. aq. solution of KNO_2 causes separation into two layers, of which the lower aq. solution contains 71.9% KNO_2 while the upper alcoholic layer contains 6.9% KNO_2. (Donath, Ch. Z. 1911, **35.** 773.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Potassium rhodium nitrite, $6KNO_2$, $Rh_2(NO_2)_6$.
See **Rhodonitrite, potassium.**

Potassium ruthenium nitrite.
See **Ruthenonitrite, potassium.**

Potassium silver nitrite, KNO_2, $AgNO_2+\frac{1}{2}H_2O$.
Completely sol. in a little H_2O, but decomp. by more H_2O. Sol. in KNO_2+Aq without decomp. Insol. in alcohol. (Lang.)

Potassium strontium nitrite, $2KNO_2$, $Sr(NO_2)_2$.
Sol. in H_2O; insol. in alcohol. (Lang, Pogg. **118.** 293.)

Potassium zinc nitrite, $2KNO_2$, $Zn(NO_2)_2+H_2O$.
Deliquescent. Easily sol. in H_2O. (Lang, J. B. **1862.** 101.)
$K_3Zn(NO_2)_5+3H_2O$. Very hydroscopic. Decomp. by H_2O. (Rosenheim, Z. anorg. 1901, **28.** 174.)

Rhodium nitrite *with* $\mathbf{MNO_2}$.
See **Rhodonitrite, M.**

Rubidium nitrite, $RbNO_2$.
Deliquescent; very sol. in H_2O; sl. sol. in hot alcohol, almost insol. in acetone. (Ball, Chem. Soc. 1913, **103.** 2131.)

Ruthenium nitrite *with* $\mathbf{MNO_2}$.
See **Ruthenonitrite, M.**

Silver nitrite, $AgNO_2$.
Sol. in 120 pts. cold H_2O (Mitscherlich), in 300 pts. (Fischer), and more abundantly in hot H_2O.
1 l. H_2O dissolves 3.1823 g. or 0.02067 g. mols. at 18°. (Naumann and Rücker, B. 1905, **38.** 2294.)
1 litre H_2O dissolves at—

0°	0.0113 mol. $AgNO_2$
8°	0.0159 " "
14°	0.0189 " "
16°	0.0203 " "
18°	0.0216 " "
25°	0.0260 " "
33°	0.0370 " "

(Pick and Abegg, Z. anorg. 1906, **51.** 3.)

1 l. H_2O dissolves 3.609 g. $AgNO_2$ at 21°. (Oswald, A. ch. 1914, (9) **1.** 33.)

Solubility in H_2O at t°.

t°	% $AgNO_2$
1	0.1589
15	0.2752
25	0.4125
35	0.6016
51	1.0240
60	1.3625

(Creighton and Ward, J. Am. Chem. Soc. 1915, **37.** 2335.)

Solubility in $AgNO_3$+Aq at 18°.

Mols. $AgNO_3$ per l. of the solution	Mols. $AgNO_2$ dissolved per l.
0.	0.0207
0.0026	0.0198
0.0052	0.0190
0.0103	0.0169
0.0207	0.0144
0.0413	0.0117
0.0827	0.0096

(Abegg and Pick, B. 1905, **38.** 2573.)

1 l. 0.2-N $NaNO_3$+Aq dissolves 4.956 g. $AgNO_2$ at 25°. (Ley and Schaefer, B. 1906, **39.** 1263.)
1 l. sat. KNO_2+Aq dissolves 26% $AgNO_2$ at 13.5°. (Oswald, A. ch. 1914, (9) **1.** 33.)

Solubility in salts+Aq at 25°.

Salt	Conc. of the salt mols. per l.	G. $AgNO_2$ in 100 g. of solution
		0.4135
$AgNO_3$	0.00258	0.3991
	0.00588	0.3735
	0.01177	0.3432
	0.02355	0.2943
	0.04710	0.2498
KNO_2	0.00258	0.3974
	0.00588	0.3820
	0.01177	0.3560
	0.02355	0.3119
	0.04710	0.2765

(Creighton and Ward, J. Am. Chem. Soc. 1915, **37.** 2336.)

See also under KNO_2.
$AgNO_2+NaNO_2$.
1 l. 0.02 N-$NaNO_2$+Aq dissolves 3.185 g. $AgNO_2$ at 25°; 0.2-N $NaNO_2$, 3.016 g. $AgNO_2$. (Ley and Schaefer, B. 1906, **39.** 1263.)
100 g. H_2O sat. with $AgNO_2$ and $Sr(NO_3)_2$ contain 10.9 g. $AgNO_2$ and 78.3 g. $Sr(NO_3)_2$ at 14°. (Oswald.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol.

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

100 pts. acetonitrile dissolve 23 pts. at ord. temp.; 40 pts. at 81.6°. (Scholl and Steinkopf, B. 1906, **39.** 4393.)

Sl. sol. in methyl acetate. (Bezold, Dissert. **1906.**)

Insol. in ethyl acetate. (Hamers, Dissert. **1906;** Naumann, B. 1910, **43.** 314.)

Silver sodium nitrite, $AgNO_2$, $NaNO_2$.

Completely sol. in a little H_2O, but decomp. by more H_2O. (Fischer.)

$+\frac{1}{2}H_2O$. (Oswald, A. ch. 1914, (9) **1.** 75.)

Silver nitrite ammonia, $AgNO_2$, NH_3.

Sl. sol. in H_2O; less sol. in alcohol; nearly insol. in ether. (Reychler, B. **16.** 2425.)

$AgNO_2$, $2NH_3$. (Reychler.)

$AgNO_2$, $3NH_3$. Deliquescent. Sol. in H_2O. (Reychler.)

Sodium nitrite, $NaNO_2$.

Not deliquescent. Very sol. in H_2O.

More sol. in H_2O than $NaNO_3$, but less in alcohol.

6 pts. H_2O dissolve 5 pts. $NaNO_2$ at 15°. (Divers, Chem. Soc. 1899, **75.** 86.)

100 g. H_2O dissolve 83.25 g. $NaNO_2$ at 15°. (Niementowski and Roszkowski, J. phys. Ch. 1897, **22.** 146.)

100 pts. H_2O dissolve at:

0°	10°	20°	30°	40°	
73	78	84	91.5	98.5	pts. $NaNO_2$,
50°	60°	70°	80°		
107	116	125.5	136		pts. $NaNO_2$,
90°	100°	110°	120°		
147	160.5	178	198.5		pts. $NaNO_2$.

B-pt. of sat. $NaNO_2$+Aq=128° at 761.5 mm. pressure. Sat. solution at 20° has a sp. gr.=1.3585. (Oswald, A. ch. 1914, (9) **1.** 59.)

Solubility in $NaNO_3$+Aq at t°.

t°	100 pts. H_2O dissolve	
	$NaNO_2$	$NaNO_3$
0	73	0
	68.5	19
	67.1	36.3
	64.9	41.7*
	50.3	46.8
	30.2	55.4
	0	74.2
21	84.75	0
	81.1	9.6
	79.7	23.5
	73.8	50.8
	73.1	54.5*
	6[illegible].2	56.7
	40.8	62.8
	21.6	74.7
	0	89.3
52	108.8	0
	107.9	6.7
	104.3	20.6
	101.8	34.5
	99.5	43.2
	98.0	62.6*
	97.8	82.0
	65.2	88.0
	44.2	92.9
	27.2	101.4
	14.7	109
	0	118
75	120.7	0
	111.5	34.8
	108.5	62.8
	107.8	90.6*
	78.3	96
	49.5	104.1
	28.4	113.4
	14.7	121.4
	0	131
81	137.1	0
	125.7	38.8
	122.7	69.8
	122.6	101.0*
	79.1	111.5
	50.0	121.0
	27.2	131.7
	0	150
92	149.7	0
	141.2	23.6
	134.6	57.6
	132.3	107.8*
	60.2	130.6
	30.3	145.0
	0	163.5
103	166	0
	153.3	33.2
	148.8	58.8
	142.4	116.0*
	100.0	126.8
	60.1	142.9
	0	181.2

* Both salts in solid phase.

(Oswald, A. ch. 1914, (9) **1.** 71.)

Solubility in H_2O is decreased by presence of Na_2SO_4. 100 pts. H_2O dissolve 11.8 pts. Na_2SO_4+53.9 pts. $NaNO_2$. (Oswald.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Neither dissolved nor attacked by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Sol. in warm 90% alcohol. (Hampe, A. **125.** 336.)

100 pts. absolute methyl alcohol dissolve 4.43 pts. at 19.5°; 100 pts. absolute ethyl alcohol dissolve 0.31 pt. at 19.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Strontium nitrite, $Sr(NO_2)_2$.

Very sol. in H_2O, and very sl. sol. in boiling alcohol. (Lang, Pogg. **118.** 287.)

Easily sol. in 90% alcohol. (Hampe, A. **125.** 340.)

$+H_2O$. Hydroscopic. 100 ccm. of the sat. solution contain 62.83 g. $Sr(NO_2)_2+H_2O$ at 19.5°. (Vogel, Z. anorg. 1903, **35.** 393.)

100 pts. H_2O dissolve at:

0°	10°	20°	30°
58.9	67.6	75.5	84 pts. $Sr(NO_2)_2+H_2O$,
40°	50	60°	70°
94	105	116	130 pts. $Sr(NO_2)_2+H_2O$,
80°	90°	100°	
145	162	182 pts. $Sr(NO_2)_2+H_2O$.	

Bpt. of sat. solution is 112.5° at 763 mm. pressure. The sat. solution at 19° contains 39.3% $Sr(NO_2)_2$ and has sp. gr. at 19°/0° = 1.4461. (Oswald, A. ch. 1914, (9) **1.** 64.)

Solubility in alcohol. 100 ccm. of the solution in 90% alcohol contain 0.42 g. $Sr(NO_2)_2+H_2O$ at 20°. 100 ccm. of the solution in absolute alcohol contain 0.04 g. $Sr(NO_2)_2+H_2O$ at 20°. (Vogel, Z. anorg. 1903, **35.** 393.)

Thallous nitrite, $TlNO_2$.

Sol. in H_2O. Ppt. from solution in H_2O by absolute alcohol. (Vogel, Z. anorg. 1903, **35.** 404.)

Very sol. in H_2O; insol. in alcohol. (Ball, Chem. Soc. 1913, **103.** 2131.)

Zinc nitrite, basic, $2ZnO, N_2O_3$.

(Hampe, A. **125.** 334.)

Zinc nitrite, $Zn(NO_2)_2+3H_2O$.

Deliquescent. Sol. in H_2O and alcohol. (Lang, J. B. **1862.** 99.)

Nitrous oxide, N_2O.

See **Nitrogen *mon*oxide.**

Nitroxyl bromide, NO_2Br.

Decomp. spontaneously or with H_2O. (Hasenbach, J. pr. (2) **4.** 1.)

Does not exist. (Fröhlich, A. **224.** 270.)

Nitroxyl chloride, NO_2Cl.

Decomp. by H_2O without evolution of gas.

Probably does not exist. (Geuther, A. **245.** 98.)

Nitroxyl fluoride, NO_2F.

Absorbed by H_2O with formation of HNO_3 and HF. Decomp. by H_2O, alcohol, and ether. (Moissan and Lebeau, C. R. 1905, **140.** 1624.)

Nitroxypyrosulphuric acid,
$(HO)S_2O_5(NO_3), H_2O$.

Very deliquescent. Sol. in H_2O with decomp. (Weber, Pogg. **142.** 602.)

Nitryl chloride, NO_2Cl.

See **Nitroxyl chloride.**

Octamine cobaltic compounds.

The formulæ of the following octamine cobaltic compounds should be reduced one-half, and they should be classed with the tetramine cobaltic compounds. (Jörgensen, Z. anorg. **2.** 279.)

Octamine cobaltic carbonate,
$Co_2(NH_3)_8(CO_3)_6+3H_2O$.

Easily sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2654.)

See **Carbonatotetramine carbonate.**

$Co_2(NH_3)_8O_3(CO_3)_4+3H_2O$. Rather difficultly sol. in H_2O.

—— —— **chloride** (?), $Co_2(NH_3)_8(OH)_2Cl_4+2H_2O$.

Ppt.

$Co_2(NH_3)_8(OH)_2Cl_4, 2HgCl_2$.

$Co_2(NH_3)_8(OH)_2Cl_4, PtCl_4+H_2O$. (Vortmann and Blasberg, B. **22.** 2654.)

—— —— **mercuric chloride,** $Co_2(NH_3)_8Cl_6, 3HgCl_2+H_2O$.

$Co_2(NH_3)_8Cl_6, HgCl_2$. Difficultly sol. in cold H_2O, decomp. on warming. (Vortmann.)

—— —— **chlorosulphite,** $Co_2(NH_3)_8(SO_3)_2Cl_2+4H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2635.)

—— —— **chromate,**
$Co_2(NH_3)_8(CrO_4)_3(H_2O)_2+2H_2O$.

Sol. in H_2O or acetic acid.

$+8H_2O$. Sol. in warm H_2O or acetic acid.

$Co_2(NH_3)_8(CrO_4)_2Cr_2O_7(H_2O)_2+H_2O$. Easily sol. in H_2O, from which it is precipitated by dil. HNO_3+Aq. (Vortmann, B. **15.** 5895.)

Octamine cobaltic nitrate, $Co_2(NH_3)_8(NO_3)_6$ $+2H_2O$.

Sol. in H_2O; precipitated by conc. HNO_3+ Aq. (Vortmann.)

—— —— **nitratocarbonate,**
$Co_2(NH_3)_8(NO_3)_2(CO_3)_2+H_2O$.

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. **22.** 2650.)
See **Carbonatotetramine cobaltic nitrate.**

—— —— **purpureochloride,**
$Co_2(NH_3)_8Cl_6(H_2O)_2$.

Easily sol. in H_2O; partly precipitated from aqueous solution by conc. HCl+Aq. (Vortmann, B. **10.** 1451.)
=Chlorotetramine cobaltic chloride, $ClCo(NH_3)_4(OH_2)Cl_2$, wich see. (Jörgensen, J. pr. (2) **42.** 211.)

—— —— **purpureomercuric chloride,**
$Co_2(NH_3)_8Cl_6(H_2O)_2$, $6HgCl_2$.

Sl. sol. in cold, easily in hot H_2O. (Vortmann.)
=Chlorotetramine cobaltic mercuric chloride. (Jörgensen, J. pr. (2) **42.** 211.)

—— —— **purpureomercuric hydroxychloride,**
$Co_2N_8H_{16}(HgCl)_4(HgOH)_4Cl_6$.

Ppt. (Vortmann and Morgulis, B. **22.** 2647.)
$Co_2N_8H_{16}(HgOH)_8Cl_6$. (V. and M.)
$Co_2N_8H_{16}(HgOH)_8Cl_4(OH)_2$. (V. and M.)

—— —— **purpureomercuriodide, basic,**
$Co_2N_8H_{18}(HgOH)_6I_6$.

(Vortmann and Borsbach, B. **23.** 2805.)

—— —— **purpureochloroplatinate.**

Very sl. sol. in H_2O. (Vortmann.)
=Chlorotetramine cobaltic chloroplatinate, $ClCo(NH_3)_4(OH_2)PtCl_6+2H_2O$. (Jörgensen, J. pr. (2) **42.** 215.)

—— —— **roseochloride,** $Co_2(NH_3)_8Cl_6(H_2O)_2$ $+2H_2O$, or $4H_2O$.

Sol. in H_2O. (Vortmann, B. **15.** 1891.)
See **Roseotetramine cobaltic chloride.**

—— —— **roseomercuric chloride,**
$Co_2(NH_3)_8Cl_6(H_2O)_2$, $6HgCl_2+3H_2O$.

Ppt. (Vortmann.)

—— —— **roseomercuric hydroxychloride,**
$Co_2N_8H_{16}(HgCl)_6(HgOH)_2Cl_6$.

(Vortmann and Morgulis, B. **22.** 2647.)
$Co_2N_8H_{16}(HgOH)_8Cl_6$. (V. and M.)
$Co_2N_8H_{16}(HgOH)_8Cl_4(OH)_2$. (V. and M.)

—— —— **roseomercuric iodide,**
$Co_2N_8H_{21}(HgI)_3I_6$.

Ppt. Sol. in HCl or HNO_3. (Vortmann and Borsbach, B. **23.** 2806.)
$Co_2N_8H_{20}(HgI)_4I_6$. Ppt. (V. and B.)
$Co_2N_8H_{20}(HgI)_4I_4(OH)_2$. Ppt. (V. and B.)

Octamine cobaltic sulphate,
$Co_2(NH_3)_8(OH)_2(SO_4)_2+3H_2O$. (?).

Insol. in H_2O or dil. H_2SO_4+Aq. Sol. in moderately conc. HCl+Aq. (Vortmann and Blasberg, B. **22.** 2653.)
$Co_2(NH_3)_8(SO_4)_3+6H_2O$. Sol. in H_2O. (Vortmann.)
$+4H_2O$. Easily sol. in H_2O.
See **Roseotetramine cobaltic sulphate.**

—— —— **sulphatocarbonate,**
$Co_2(NH_3)_8SO_4(CO_3)_2+3H_2O$.

Sol in H_2O. (Vortmann, B. **10.** 1458.)
See **Carbonatotetramine cobaltic sulphate.**
$Co_2(NH_3)_8(SO_4)_2CO_3+4H_2O$. Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2650.)

—— —— **ammonium sulphite,**
$Co_2(NH_3)_8(SO_3NH_4)_6+10H_2O$.

See **Octamine cobaltisulphite, ammonium.**

Octamine cobaltisulphurous acid.

Ammonium octamine cobaltisulphite,
$Co_2(NH_3)_8(SO_3NH_4)_6+10H_2O$.

Sol. in H_2O. (Vortmann and Magdeburg, B. **22.** 2632.)
$Co_2(NH_3)_8(SO_3)_2(SO_3NH_4)_2+4H_2O$.

Ammonium barium —— ——,
$Co_2(NH_3)_8(SO_3)_6Ba_2(NH_4)_2+7H_2O$.

Ppt. (V. and M.)

Barium —— ——, $Co_2(NH_3)_8(SO_3)_6Ba_3+$ $7H_2O$.

Ppt. (V. and M.)

Cobaltic —— ——,
$Co_2(NH_3)_8(SO_3)_6Co_2+36H_2O$, and $24H_2O$.

Luteocobaltic —— ——,
$Co_2(NH_3)_8(SO_3)_6(NH_3)_{12}Co_2+8H_2O$

Ppt. (V. and M.)

Octamine iridium chloride,
$Ir_2(NH_3)_8Cl_6$.

Very sol. in H_2O. (Palmaer, B. **22.** 16.)

Octamine iridium chlorosulphate,
$Ir_2(NH_3)_8Cl_4SO_4+4H_2O$.
(Palmaer.)

Osmiamic acid, $H_2N_2Os_2O_6$, or
$H_2N_2Os_2O_5$(?).

Known only in aqueous solution, which is unstable.

Ammonium osmiamate.
Easily sol. in H_2O or alcohol. (Fritzsche and Struve, J. pr. **41.** 97.)

Barium osmiamate, $BaN_2Os_2O_5$.
Moderately sol. in H_2O.

Lead osmiamate.
Ppt. Sol. in acids without decomp.

Lead osmiamate chloride.
Ppt.

Mercurous osmiamate.
Ppt.

Mercuric osmiamate.
Ppt.

Potassium osmiamate, $K_2N_2Os_2O_5$, or $K_2N_2Os_2O_6$.
Sl. sol. in cold, much more easily in hot H_2O. Sl. sol. in alcohol. Insol. in ether.

Silver osmiamate, $Ag_2N_2Os_2O_5$.
Extremely sl. sol. in H_2O or cold HNO_3+Aq. Sol. in NH_4OH+Aq.

Sodium osmiamate.
Easily sol. in H_2O or alcohol.

Zinc osmiamate, $ZnN_2Os_2O_5$.
Decomp. by H_2O. Nearly insol. in NH_4OH +Aq.

Osmic acid, H_2OsO_4.

Stable in H_2O containing alcohol. Sol. in HNO_3 or HCl+Aq. Not attacked by H_2SO_4 +Aq. (Moraht and Wischin, Z. anorg. **3.** 153.)
100 g. H_2O dissolve 5.88 g. H_2OsO_4 at 15°. (Squire and Cains, Pharm. J. 1905, 74. 720.)
Attacked by liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Barium osmate, $BaOsO_4+H_2O$.
Insol. in H_2O. (Claus, Pogg. **65.** 205.)

Calcium osmate, $CaOsO_4$.
Insol. in H_2O. (Fremy, J. pr. **33.** 411.)

Lead osmate.
Insol. in H_2O. (Fremy.)

Potassium osmate, $K_2OsO_4+2H_2O$.
Sl. sol. in cold, much more sol. in hot H_2O, but is decomp. thereby. Sl. sol. in KNO_2+Aq. Insol. in dil. or conc. alcohol and ether. Fremy, A. ch. (3) **12.** 516.)
Insol. in conc. saline solutions. (Gibbs, Am. J. Sci. (2) **31.** 70.)

Sodium osmate, Na_2OsO_4.
Sol. in H_2O; insol. in alcohol and ether. (Fremy, *l. c.*)

*Per*osmic acid.

See Perosmic acid.

Osminitrous acid.

Ammonium osminitrite, $(NH_4)_2Os(NO_2)_5+2H_2O$.
Sol. in H_2O. Decomp. when solution is warmed. (Wintrebert, C. R. 1905, **140.** 586.)

Barium osminitrite, $BaOs(NO_2)_5$.
$+H_2O$; $+4H_2O$. (Wintrebert.)

Calcium osminitrite, $CaOs(NO_2)_5+4H_2O$.
(Wintrebert.)

Magnesium osminitrite, $MgOs(NO_2)_5+4H_2O$.
(Wintrebert.)

Potassium osminitrite, $K_2Os(NO_2)_5$.
Very hygroscopic. Very sol. in H_2O. Decomp. by HCl, HBr and HI. (Wintrebert, A. ch. 1903, (7) **28.** 135.)

Silver osminitrite, $Ag_2Os(NO_2)_5+2H_2O$.
Sl. sol. in H_2O with partial decomp. (Wintrebert, C. R. 1905, **140.** 586.)

Sodium osminitrite, $Na_2Os(NO_2)_5+2H_2O$.
Sol. in H_2O. (Wintrebert.)

Strontium osminitrite, $SrOs(NO_2)_5+2H_2O$.
(Wintrebert.)

Zinc osminitrite, $ZnOs(NO_2)_5+\frac{1}{2}H_2O$.
(Wintrebert.)

Osmyloxynitrous acid.

Ammonium osmyloxynitrite, $(NH_4)_2OsO_3(NO_2)_2$.
Decomp. by boiling conc. HCl and by KOH +Aq. (Wintrebert, A. ch. 1903, (7) **28.** 107.)

Barium osmyloxynitrite, $BaOsO_3(NO_2)_2+4H_2O$. (Wintrebert.)

Potassium osmyloxynitrite, $K_2OsO_3(NO_2)_2+3H_2O$.
Sl. sol. in cold H_2O. Aqueous solution decomp. slowly. Sol. with decomp. in dil. KOH +Aq. (Wintrebert.)

Silver osmyloxynitrite, $Ag_2OsO_3(NO_2)_2+H_2O$.
(Wintrebert.)

Strontium osmyloxynitrite, $SrOsO_3(NO_2)_2+3H_2O$. (Wintrebert.)

Osmylnitrous acid.

Potassium osmylnitrite, $K_2OsO_2(NO_2)_4$.

Decomp. by H_2O and by excess of KOH+Aq. (Weinland, A. ch. 1903, (7) **28.** 54.)

Osmisulphurous acid.

Potassium osmisulphite, $[Os(H_2O)(SO_3)_5]K_8+4H_2O$.

Ppt. (Rosenheim, Z. anorg. 1899, **21.** 144.)

Potassium hydrogen osmisulphite, $[Os_2(H_2O)(SO_3)_{11}]K_{11}H_3+5H_2O$.

Sol. in H_2O without decomp. (Rosenheim.)

$[Os(SO_3)_6]K_6H_2+2H_2O$ Sol. in H_2O without decomp. (Rosenheim.)

Sodium osmisulphite, $[Os(SO_3)_6]Na_8+8H_2O$.

Only sl. sol. in H_2O.

$[Os(H_2O)(SO_3)_5]Na_6+4H_2O$. Ppt.

$[OsO(SO_3)_4]Na_6+3H_2O$. Ppt. (Rosenheim.)

Osmium, Os.

When finely divided and not ignited to a very high temperature, Os is sol. in HNO_3+Aq or aqua regia. When ignited it is not attacked by any acid.

Insol. in liquid NH_3. (Gore, Am. ch. J. 1898, **20.**. 828)

Osmium ammonium comps.

See—

Oxyosmiumamine comps., $OsO(NH_3)_2X$.

Oxyosmium*di*amine comps., $OsO_2(NH_3)_4X_2$.

Osmium bromide *with* MBr.

See **Bromosmate, M.**

Osmium *di*chloride, $OsCl_2$.

Deliquescent. Sol. in little, but decomp. by more H_2O, with pptn. of Os. Sol. in conc. alkali chlorides+Aq with combination and partial decomp. (Berzelius.)

Sol. in alcohol and ether.

Insol. in H_2O. Insol. in HCl and H_2SO_4. Sl. sol. in HNO_3 and aqua regia. Slowly sol. in strong alkali. Insol. in liquid Cl_2. Insol. in alcohol and formaldehyde. (Ruff, Z. anorg. 1910, **65.** 455.)

Osmium *tri*chloride, $OsCl_3$.

Hydroscopic. Sol. in conc. H_2SO_4, HCl and conc. HNO_3. Sol. in alkali and in NH_4OH. Insol. in liquid Cl_2. Easily sol. in alcohol. Sl. sol. in ether. (Ruff, Z. anorg. 1910, **65.** 453.)

$+3H_2O$. Sol. in H_2O. (Moraht and Wischin, Z. anorg. **3.** 153.)

Osmium *tetra*chloride, $OsCl_4$.

Sol. in a little H_2O, but decomp. by further addition of that solvent. Sol. in conc. HCl+Aq.

Osmium *tri*chloride *with* MCl.

See **Chlorosmite, M.**

Osmium *tetra*chloride *with* MCl.

See **Chlorosmate, M.**

Osmium sodium chloride, $Na_2OsCl_6+2H_2O$.

Very sol. in H_2O and in alcohol. (Rosenheim, Z. anorg. 1899, **21.** 133.)

Osmium *tetra*fluoride, OsF_4.

Sol. in H_2O. (Ruff, B. 1913, **46.** 948.)

Osmium *hexa*fluoride, OsF_6.

Decomp. by H_2O and conc. H_2SO_4. Sol. in NaOH+Aq. (Ruff, B. 1913, **46.** 945.)

Osmium *octo*fluoride, OsF_8.

Sol. in H_2O, but is somewhat hydrolyzed. Sol. in conc. H_2SO_4 with decomp. Sol. in NaOH+Aq. (Ruff, B. 1913, **46.** 944.)

Osmium *mono*hydroxide, OsO, xH_2O.

Insol. in H_2O. Sl. sol. in KOH+Aq. Slowly but completely sol. in acids. (Berzelius.)

Osmium *di*hydroxide, OsO_2, H_2O.

Sol. in HCl+Aq while still moist. Insol. in H_2SO_4 or HNO_3+Aq.

$+2H_2O$. Sol. in HCl, HNO_3, or H_2SO_4+Aq while still moist. (Claus and Jacoby.)

Osmium *sesqui*hydroxide, $Os_2O_6H_6$.

Sol. in acids, and partly sol. in KOH+Aq. (Claus and Jacoby.)

Osmium iodide, OsI_4.

Extremely deliquescent. Sol. in H_2O of alcohol, but solution is unstable. (Moraht and Wischin, Z. anorg. **3.** 153.)

Osmium potassium nitrosochloride, $K_2Os(NO)Cl_5$.

Stable in aqueous solution. Only sl. attacked by hot HNO_3. (Wintrebert, A. ch. 1903, (7) **28.** 132.)

Osmium *mon*oxide, OsO.

Insol. in H_2O or acids. (Claus and Jacoby.)

Osmium *di*oxide, OsO_2.

Insol. in H_2O or acids.

Osmium *sesqui*oxide, Os_2O_3.

Insol. in acids. (Claus and Jacoby.)

Osmium *tri*oxide, "Osmic acid," OsO_3.
See **Osmic acid.**

Osmium *tetr*oxide, "Perosmic acid," OsO_4.
Slowly but abundantly sol. in H_2O. Sol. in alcohol and ether with gradual decomposition. Sol. in NH_4OH+Aq, the solution undergoing decomposition on heating.

Osmium oxide ammonia, OsO_2, $2NH_3+H_2O$.
See **Oxyosmiumamine hydroxide.**

Osmium oxysulphide, $Os_3S_7O_5+2H_2O$.
Unstable.
$OsSO_3+1\frac{1}{2}H_2O$. Insol. in H_2O. (v. Meyer, J. pr. (2) **16**. 77.)
$Os_2O_2S_2+H_2O$. Decomp. and dissolved by HNO_3, HCl, or H_2SO_4+Aq. (Moraht and Wischin, Z. anorg. **3**. 153.)

Osmium sulphide, Os_2S_3 (?).
(Berzelius.)
Min. *Laurite*. Insol. in all acids, even in aqua regia.

Osmium *di*sulphide, OsS_2.
Sl. sol. in H_2O; not more sol. in alkali hydrates or carbonates+Aq. Insol. in alkalies after drying. (Fremy, A. ch. (3) **12**. 521.)

Osmium *tetra*sulphide, OsS_4+xH_2O.
Insol. in alkali sulphides, carbonates, or hydroxides+Aq. Sol. in cold dil. HNO_3+Aq. (Claus.)

Osmocyanhydric acid, $H_4Os(CN)_6$.
Easily sol. in H_2O and alcohol. Insol. in ether. (Martius, A. **117**. 361.)

Barium osmocyanide, $Ba_2Os(CN)_6+6H_2O$.
Easily sol. in H_2O and dil. alcohol. (M.)

Barium potassium osmocyanide, $BaK_2Os(CN)_6+3H_2O$.
Efflorescent. Sl. sol. in cold, easily in hot H_2O.

Ferric osmocyanide, $Fe_4[Os(CN)_6]_3+xH_2O$.
Insol. in H_2O.

Potassium osmocyanide, $K_4Os(CN)_6+3H_2O$.
Moderately sol. in boiling, less in cold H_2O. Insol. in alcohol and ether.

Osmosyl ammonium comps.
See **Oxyosmium amine comps.**

Osmyl pottasium bromide, $K_2OsO_2Br_4+2H_2O$.
Same properties as the chloride. (Wintrebert, A. ch. 1903, (7) **28**. 94.)

Osmyl potassium chloride, $K_2OsO_2Cl_4$.
Very sol. in H_2O. Solution is stable only in the presence of a small amt. of HCl. Decomp. by hot conc. HCl.
$+2H_2O$. As the anhydrous salt. (Wintrebert, A. ch. 1903, (7) **28**. 86.)

Osmyl *di*tetramine comps.
See **Oxyosmium *di*amine comps.**

Oxamidosulphonic acid.
See **Hydroxylamine *mono*sulphonic acid.**

Oximidosulphonic acid.
See **Hydroxylamine *di*sulphonic acid.**

Oxyamidosulphonic acid.
See **Hydroxylamine sulphonic acid.**

Oxyammonium salts.
See **Hydroxylamine salts.**

Oxycobaltamines, acid comps.
(Maquenne, C. R. **96**. 344.)
Are anhydrooxycobaltamine comps., which see. (Vortmann, M. ch. **6**. 404.)

Oxycobaltamine chloride,
$$Co_2(NH_3)_{10}O\begin{matrix}OH\\(OH)\end{matrix}Cl_4.$$
(Vortmann, M. ch. **6**. 404.)
$Co_2(NH_3)_{10}O_2Cl_4$, $HCl+3H_2O$. Is anhydrooxycobaltamine chloride, which see.

—— **chloronitrate hydrochloride,** $Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_2Cl_2$, $4HCl+3H_2O$.
Is anhydrooxycobaltamine chloronitrate, which see.

—— **chlorosulphate,**
$$Co_2(NH_3)_{10}\begin{pmatrix}OH\\O(OH)\end{pmatrix}(SO_4)Cl_2,\ 4HCl.$$
Easily decomp.

—— **iodide,** $Co_2(NH_3)_{10}\begin{pmatrix}OH\\O(OH)\end{pmatrix}I_4$.
Sl. sol. in H_2O. Decomp. by much H_2O. (Vortmann.)

—— **nitrate,** $Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_4+H_2O$.
Decomp. by H_2O.
$Co_2(NH_3)_{10}(OH)(O.OH)(NO_3)_4$, HNO_3+2H_2O. Decomp. by H_2O.

—— **nitratosulphate,** $Co_2(NH_3)_{10}(OH)(O.OH)(SO_4)(NO_3)_2$, $4HNO_3$.
Decomp. at once by H_2O.

Oxycobaltamine sulphate,
$Co_2(NH_3)_{10}O_2(SO_4)_2, H_2SO_4+H_2O$.

Very sl. sol. in H_2O with decomp.; more easily sol. in acidified H_2O. Sol. in acids. (Maquenne, C. R. **96.** 344.)

$Co_2(NH_3)_{10}\begin{pmatrix}OH\\O(OH)\end{pmatrix}(SO_4)_2+3H_2O$.

$Co_2(NH_3)_{10}\begin{pmatrix}OH\\O(OH)\end{pmatrix}(HSO_4)_4$. Decomp. violently by H_2O.

Oxygen, O_2.

100 vols. H_2O absorb 4.6 vols. O gas at ord temp. (Otto-Graham.)
Sol. in 27 pts. H_2O at ord. temp. (Pelouze and Fremy.)
100 vols. H_2O dissolve 0.925 vol. O. (Gay-Lussac.)

1 vol. H_2O at t° and 760 mm. absorbs V vols. O gas, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0.04114	7	0.03465	14	0.03034
1	0.04007	8	0.03389	15	0.02989
2	0.03907	9	0.03317	16	0.02949
3	0.03810	10	0.03250	17	0.02914
4	0.03717	11	0.03189	18	0.02884
5	0.03628	12	0.03133	19	0.02858
6	0 03544	13	0.03082	20	0.02838

(Bunsen's Gasometry.)

Coefficient of absorption of O by $H_2O = 0.04115-0.0010899t+0.000022563t^2$. (Bunsen and Pauli, A. **93.** 21.)

Coefficient of absorption of O in H_2O at 6.4° = 0.041408; at 12.6° = 0.036011. (Timofejew, Z. phys. Ch. **6.** 148.)

Absorption of O by H_2O. β_1 = "solubility," *i. e.*, the amount of gas (reduced to 0° and 760 mm.) which is absorbed by 1 vol. of the liquid when the barometer indicates 760 mm. pressure; β = coefficient of absorption, *i. e.*, amount absorbed by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm.; $\beta_1=\beta\frac{760-f}{760}$, when f = vapor tension of solvent at t°.

t°	β	β_1
0	0.04890	0.04860
1	4759	4728
2	4633	4601
3	4512	4479
4	4397	4362
5	4286	4250
6	4181	4142
7	4080	4040
8	3983	3941
9	3891	3847
10	3802	3756
11	3718	3670
12	3637	3587
13	3560	3507

Absorption of O by H_2O.—*Continued*

t°	β	β_1
14	0.3486	0.3431
15	3415	3358
16	3347	3288
17	3283	3220
18	3220	3155
19	3161	3093
20	3102	3031
21	3044	2970
22	2988	2911
23	2934	2853
24	2881	2797
25	2831	2743
26	2783	2691
27	2736	2641
28	2691	2592
29	2649	2545
30	2608	2500
31	2572	2459
32	2537	2419
33	2503	2380
34	2471	2342
35	2440	2306
36	2410	2270
37	2382	2236
38	2355	2203
39	2330	2171
40	2306	2140
41	2280	2107
42	2256	2075
43	2232	2043
44	2209	2012
45	2187	1981
46	2166	1952
47	2145	1922
48	2126	1894
49	2108	1865
50	2090	1837
52	2057	1782
54	2026	1728
56	1998	1674
58	1971	1619
60	1946	1565
62	1921	1508
64	1897	1450
66	1874	1392
68	1853	1332
70	1833	1270
72	1815	1208
74	1799	1144
76	1785	1078
78	1772	1010
80	1761	0939
82	1752	0865
84	1743	0788
86	1736	0707
88	1729	0622
90	1723	0532
92	1717	0437
94	1712	0337
96	1708	0231
98	1704	0119
100	7001	0000

(Winkler, B. **24.** 3609.)

Absorption of O by H_2O at t° and 760 mm.

β = coefficient of absorption.

t°	β	t°	β	t°	β
0	0.04961	23	0.03006	46	0.02163
1	4838	24	2956	47	2139
2	4720	25	2904	48	2115
3	4606	26	2855	49	2092
4	4496	27	2808	50	2070
5	4389	28	2762	51	2049
6	4286	29	2718	52	2029
7	4186	30	2676	53	2009
8	4089	31	2635	54	1990
9	3994	32	2596	55	1972
10	3903	33	2558	56	1955
11	3816	34	2521	57	1938
12	3732	35	2486	58	1922
13	3651	36	2452	59	1907
14	3573	37	2419	60	1893
15	3497	38	2387	65	1832
16	3425	39	2356	70	1787
17	3357	40	2326	75	1752
18	3292	41	2297	80	1726
19	3230	42	2269	85	1707
20	3171	43	2241	90	1693
21	3114	44	2214	95	1684
22	3059	45	2188	100	1679

(Bohr and Bock, W. Ann. (2) **44.** 318.)

Coefficient of absorption of O by H_2O between 0° and 30° = $0.04890 - 0.0013413t + 0.0000283t^2 - 0.00000029534t^3$. (Winkler, *l. c.*)

Solubility in H_2O at 25° = 0.03080; at 15° = 0.03630. (Geffcken, Z. phys. Ch. 1904, **49.** 269.)

Absorption of O_2 by distilled H_2O at t°.

a = ccm. of O_2 absorbed by 1 l. of H_2O at t° and 760 mm.

t°	a	t°	a	t°	a
0	49.24	17	33.21	34	25.19
1	47.94	18	32.58	35	24.85
2	46.65	19	32.01	36	24.52
3	45.45	20	31.44	37	24.20
4	44.31	21	30.91	38	23.89
5	43.21	22	30.38	39	23.59
6	42.15	23	29.86	40	23.30
7	41.15	24	29.38	41	23.02
8	40.19	25	28.90	42	22.75
9	39.28	26	28.42	43	22.49
10	38.37	27	27.94	44	22.24
11	37.51	28	27.51	45	22.00
12	36.75	29	27.08	46	21.77
13	35.98	30	26.65	47	21.55
14	35.26	31	26.27	48	21.34
15	34.55	32	25.90	49	21.14
16	33.88	33	25.54	50	20.95

(Fox, Trans. Faraday Soc. 1909, **5.** 74.)

Solubility in H_2O at various pressures.

V = volume of the absorbing liquid.
P = Hg-pressure in metres.
λ = coefficient of solubility.

V	t°	P	λ
33.320 ccm.	23°	0.9595	0.02937
		1.0941	0.02939
		1.2883	0.02938
		1.4976	0.02935
		1.7638	0.02939
		2.0838	0.02931
		2.5011	0.02928
		3.0402	0.02909
		3.8675	0.02886
		4.2504	0.02872
		4.6301	0.02855
		5.1360	0.02832
		5.6973	0.02818
		6.1857	0.02797
		6.7343	0.02772
		7.3051	0.02741
		7.7138	0.02729
		8.1406	0.02708
32.003 ccm.	25.9°	0.8611	0.02848
		0.9808	0.02849
		1.0833	0.02846
		1.2039	0.02842
		1.4112	0.02845
		1.6602	0.02847
		2.3854	0.02831
		2.6482	0.02826
		2.8995	0.02816
		3.2883	0.02803
		3.9133	0.0279[illegible]
		4.2720	0.02785
		4.6905	0.027[illegible]
		5.0559	0.02762
		5.6141	0.02749
		6.0120	0.02734
		6.5687	0.02719
		7.1056	0.02687
		7.4729	0.02676
		8.1889	0.02645

(Cassuto, Phys. Zeit. 1904, **5.** 236.)

Solubility of O in H_2O at 25° = 0.0294. (Findlay and Creighton, Bioch. J. 1911, **5.** 294.)

Coefficient of absorption for H_2O = 0.03398 at 15°; 0.03375 at 15.3°; 0.03330 at 16.2°. (Müller, Z. phys. Ch. 1912, **81.** 494.)

Solubility in H_2O at t°.

l_{760} = solubility of atmospheric O_2 in H_2O at 760 mm. and t°.

t°	l_{760}	t°	l_{760}
0	10.26	13	7.51
1	9.99	14	7.36
2	9.73	15	7.21
3	9.48	16	7.07
4	9.25	17	6.93
5	9.02	18	6.80
6	8.80	19	6.67
7	8.59	20	6.55
8	8.39	21	6.43
9	8.20	22	6.32
10	8.02	23	6.21
11	7.84	24	6.10
12	7.67	25	6.00

(Carlson, Zeit. angew. Ch. 1913, **26.** 714.)

Solubility of atmospheric O_2 in mixtures of distilled H_2O with sea water diminishes regularly with the proportion of sea water present. (Clowes, J. Soc. Chem. Ind. 1904, **23.** 359.)

No. of ccm. of O_2 absorbed by 1 l. of sea water from a free dry atmosphere of 760 mm. pressure.

Cl per 1000	t = 0°	4°	8°	12°	16°	20°	24°	28°
0	10.29	9.26	8.40	7.68	7.08	6.57	6.14	5.75
4	9.83	8.85	8.04	7.36	6.80	6.33	5.91	5.53
8	9.36	8.45	7.68	7.04	6.52	6.07	5.67	5.31
12	8.90	8.04	7.33	6.74	6.24	5.82	5.44	5.08
16	8.43	7.64	6.97	6.43	5.96	5.56	5.20	4.86
20	7.97	7.23	6.62	6.11	5.69	5.31	4.95	4.62

(Fox, Trans. Faraday Soc. 1909, **5.** 77.)

For O absorbed from the air, see also air, atmospheric, p. 1.

Absorption of O_2 by acids+Aq.

M = content in gram-equivalents per litre.
S = solubility.

HNO_3+Aq.

M	S 25°	S 15°
0.492	0.03021	0.03478
0.494	0.03016	0.03490
1.00	0.02954	0.03354
1.008	0.02963	0.03365
1.88	0.02853	0.03175
1.901	...	0.03166

Absorption of O_2 by acids+Aq.—*Continued.*

HCl+Aq.

M	S 25°	S 15°
0.578	0.02963	0.03431
0.579	0.02960	0.03410
1.170	0.02817	0.03217
1.176	0.028[illegible]3	0.03109
1.736	0.02733	0.03069
1.982	0.02374	0.02988

$\frac{H_2SO_4}{2}$+Aq.

M	S 25°	S 15°
0.489	0.02887	0.03366
0.527	0.02875	0.03375
0.977	0.02757	0.03210
1.017	0.02745	0.03217
1.896	0.02545	0.02886
1.829	0.02577	0.02930
2.947	0.02285	0.02584
3.512	0.02198	0.02399
4.951	...	0.02174
5.293	0.01918	0.02067

(Geffcken, Z. phys. Ch. 1904, **49.** 269.)

Absorption of O_2 by H_2SO_4+Aq at t°.

α = coefficient of absorption.

Normality of the acid	t°	α
0	20.9	0.0310
4.9	20.9	0.0195
8.9	20.9	0.0155
10.7	21.2	0.0143
20.3	21.1	0.0119
24.8	21.5	0.0103
29.6	20.8	0.0117
34.3	20.9	0.0201
35.8	21.2	0.0275

(Bohr, Z. phys. Ch. 1910, **71.** 49.)

Absorption of O_2 by NaOH+Aq.

M = content in gram-equivalents per litre.
S = solubility.

M	S 25°	S 15°
0.559	0.02434	0.02777
0.601	0.02424	0.02784
1.033	0.02020	0.02291
1.059	0.01991	0.02262
2.077	0.01295	0.01479
2.089	0.01272	0.01456

Absorption of O_2 by KOH+Aq.

M	S 25°	S 15°
0.577	0.02447	0.02791
0.579	0.02435	0.02791
1.157	0.01920	0.02191
1.170	0.01914	0.02181

(Geffcken, Z. phys. Ch. 1904, **49.** 270.)

NaCl+Aq with a chlorine content of 1,930 per 100,000 dissolved 82.9% of the amount of O_2 dissolved by distilled H_2O alone. (Clowes, J. Soc. Chem. Ind. 1904, **23.** 359.)

Absorption of O_2 by salts+Aq.

M = content in gram-equivalents per litre.
S = solubility.

Absorption of O = by $\frac{K_2SO_4}{2}$+Aq.

M	S 25°	S 15°
0.499	0.02528	0.02944
0.506	0.02530	0.02922
0.968	...	0.02395
0.970	0.02096	0.02377

Absorption of O_2 by NaCl+Aq.

M	S 25°	S 15°
0.530	0.02598	0.03045
0.535	0.02604	0.03052
1.020	0.02226	0.02601
1.034	0.02202	0.02557
1.880	..	0.01898
1.890	0.01663	0.01904
1.921	0.01654	0.01869

(Geffcken, Z. phys. Ch. 1904, **49.** 270.)

Solubility of O_2 in NaCl+Aq.

Data indicate cc. O_2 dissolved per l. at 760 mm. and 0°.

t°	NaCl+Aq 1 g. mol. per l.	NaCl+Aq 2 g. mol. per l.	NaCl+Aq sat. at 20°
0	6.50	3.14	1.27
5	5.80	2.84	1.22
10	5.25	2.59	1.17
15	4.77	2.41	1.12
20	4.39	2.25	1.07
25	4.06	2.13	1.02
30	3.76	2.01	0.97

(Winkler, Z. anorg. 1911, **24.** 342.)

Solubility of O_2 in KCN+Aq at 20°.

% KCN	1	10	20	30	50
Coeff. of abs.	0.029	0.018	0.013	0.008	0.003

(McLaurin, J. S. C. I. 1893, **63.** 737.)

1 vol. alcohol absorbs 0.28397 vol. O at all temperatures between 0° and 24°. (Bunsen.)

Absorption by alcohol (99.7%) at t°.

β = coefficient of absorption;
β_1 = solubility. (See p. 635.)

t°	β	β_1
0	0.23370	0.22978
1	0.23296	0.22878
2	0.23222	0.22777
3	0.23149	0.22675
4	0.23077	0.22572
5	0.23005	0.22469
6	0.22934	0.22365
7	0.22863	0.22260
8	0.22793	0.22155
9	0.22724	0.22047
10	0.22656	0.21937
11	0.22588	0.21827
12	0.22521	0.21715
13	0.22455	0.21601
14	0.22389	0.21484
15	0.22324	0.21365
16	0.22259	0.21245
17	0.22195	0.21122
18	0.22132	0.20994
19	0.22069	0.20862
20	0.22007	0.20733
21	0.21946	0.20600
22	0.21886	0.20459
23	0.21826	0.20317
24	0.21767	0.20172

(Timofejew, Z. phys. Ch. **6.** 151.)

Solubility of O_2 in alcohol at 20° and 760 mm.

Wt. % alcohol	Vol. % abs. O_2	Wt. % alcohol	Vol. % abs. O_2
0.0	2.98	33.33	2.67
9.09	2.78	50.0	3.50
16.67	2.63	66.67	4.95
23.08	2.52	80.0	5.66
28.57	2.49		

(Lubarsch, W. Ann. 1889, (2) **37.** 525.)

Solubility of O_2 in methyl alcohol at t°.

t°	l.	t°	l.
0	0.31864	25	0.23642
5	0.30506	30	0.21569
10	0.29005	40	0.16990
15	0.27361	50	0.11840
20	0.25574		

(Levi, Gazz. ch. it. 1901, **31.** II, 513.)

Solubility of O_2 in ether at 0° = 0.4235; at 10° = 0.4215. (Christoff, Z. phys. Ch. 1912, **79.** 459.)

Solubility of O_2 in acetone at t°.

t°	l.	t°	l.
0	0.2997	25	0.2127
5	0.2835	30	0.1835
10	0.2667	40	0.1533
15	0.2493	50	0.1057
20	0.2313		

(Levi, Gazz. ch. it. 1901, **31.** II, 513.)

Absorption of O_2 by chloralhydrate+Aq.

t° = temp. of the solution.
P = % chloralhydrate in the solution.
β t° = coefficient of absorption at t°.
β 15° = coefficient of absorption at 15°.
β 20° = coefficient of absorption at 20°.

t°	P	β t°	β 15°
18.3	22.9	0.02759	0.02940
16.9	28.0	0.02690	0.02800
15.4	36.6	0.02590	0.02560
16.6	38.6	0.02402	0.02477
12.8	51.3	0.02439	0.02339
16.2	58.44	0.02350	0.02407
15.9	70.0	0.02659	0.02710
17.2	80.85	0.03200	0.03300
16.9	80.9	0.03140	0.03250
			β 20°
20.0	16.9	0.02795	0.02795
21.0	32.0	0.02443	0.02495
21.0	52.9	0.02375	0.02325
20.4	61.08	0.02390	0.02410
21.8	65.5	0.02500	0.02580
21.0	71.4	0.02680	0.02730
22.2	78.0	0.03090	0.03280

(Müller, Z. phys. Ch. 1912, **81.** 499.)

Absorption of O_2 by glycerine+Aq.

t° = temp. of the solution.
P = % glycerine in the solution.
β t° = coefficient of absorption at t°.
β 15° = coefficient of absorption at 15°.

t°	P	β t°	β 15°
12.2	20.5	0.02904	0.02742
12.5	25.0	0.02654	0.02521
14.6	37.3	0.02038	0.02022
13.5	45.0	0.01800	0.01744
12.4	52.0	0.01623	0.01570
12.1	71.5	0.01010	0.00950
13.3	88.5	0.00906	0.00886

(Müller.)

Absorption of O_2 by glucose+Aq.

t° = temp. of the solution.
P = % glucose in the solution.
β t° = coefficient of absorption at t°.
β 20° = coefficient of absorption at 20°.

t°	P	β t°	β 20°
21.2	10.84	0.02650	0.02690
21.5	20.7	0.02202	0.02250
19.9	33.8	0.01814	0.01815
20.5	51.9	0.01378	0.01390
21.7	58.84	0.01221	0.01250

(Müller.)

Absorption of O_2 by sucrose+Aq.

t° = temp. of the solution.
P = % sucrose in the solution.
β t° = coefficient of absorption at t°.
β 15° = coefficient of absorption at 15°.

t°	P	β t°	β 15°
15.5		0.03375	0.03400
16.2		0.03330	0.03397
16.0	12.1	0.02911	0.02969
15.6	24.38	0.02367	0.02396
16.6	28.44	0.02113	0.02181
15.6	42.96	0.01582	0.01600
16.2	49.25	0.01348	0.01380
17.2	50.0	0.01302	0.01359

(Müller.)

Abundantly absorbed by oil of turpentine. Oil of turpentine absorbs its own vol. O when exposed two weeks to the air, but does not give it off on boiling. (Brandes.)

Absorbed by other oils, but this is decomposition rather than absorption, as the oils are oxidized. (See Storer's Dict.)

100 vols. arterial blood dissolve 10–13 vols. O. (Magnus.)

Coefficient of absorption for petroleum = 0.202 at 20°; 0.229 at 10°. (Gniewasz and Walfisz, Z. phys. Ch. **1.** 70.)

The author examined the solubility of O_2 and N_2 at low temp. in alcohols, ethers, acetone, $CHCl_3$, petroleum, benzene and various inorganic liquids; at low temp. the solubility of the N_2 increases at the same rate as that of the O_2. (Claude, C. R. 1900, **131.** 448.)

Oxy*di*mercuriammonium bromate, $(NHg_2OH_2)BrO_3$.

(Rammelsberg, Pogg. **55.** 82.)

—— **carbonate,** $(NHg_2OH_2)_2CO_3+\frac{1}{2}H_2O$.

Insol. in H_2O. Decomp. by HCl+Aq only when conc. Not decomp. by boiling KOH+Aq. Decomp. by KI or K_2S+Aq. (Hirzel.)

+H_2O. As above. (Hirzel.)

Oxy*di*mercuriammonium chloride, $(NHg_2OH_2)Cl$.

Is *di*mercuriammonium chloride, NHg_2Cl+H_2O, which see.

—— **oxy*tri*mercuriammonium chloride,** $(NHg_2OH_2)Cl$, $(NHg_3O_2H_2)Cl$ (?).

Insol. in H_2O. Easily sol. in dil. HCl+Aq. More difficultly sol. in very dil. H_2SO_4 or HNO_3+Aq. Insol. in conc. H_2SO_4. Sol. in boiling NH_4Cl+Aq, or $(NH_4)_2SO_4$+Aq. Decomp. by KOH+Aq. (Schmieder.)

—— **chromate,** $(NHg_2OH_2)_2CrO_4$.

Not decomp. by KOH+Aq. (Hirzel, J. B. **1852.** 421.)

—— **mercuric chromate,** $(NHg_2OH_2)_2CrO_4$, 4HgO, $3CrO_3$.

Decomp. by HNO_3 without going into solution. Easily sol. in HCl. (Hirzel.)

Composition is $(NHg_2OH_2)_2O$, $2CrO_3$, $3[(NH_4)_2O, 2Cr_2O_3]$ = $(NHg_2OH_2)_2Cr_2O_7$, $3(NH_4)_2Cr_2O_7$. (Hensgen, R. t. c. **5.** 187.)

Probably $(NHg_2)_2Cr_2O_7$, $3(NH_4)_2Cr_2O_7+2H_2O$.

—— **fluoride, acid,** $(NHg_2OH_2)F$, HF.

(Finkener, Pogg. **110.** 632.)

Probably NHg_2F, HF+H_2O.

—— **hydroxide,** $(NHg_2OH_2)OH = NHg_2OH + H_2O$.

(Millon's base.) Sl. sol. in H_2O, especially if warm. Sol. in 13,000 pts. H_2O at 17°, and 1700 pts. at 80°. Insol. in alcohol or ether. (Gerresheim, A. **195.** 373.)

+H_2O. Insol. in H_2O or alcohol. Sol. in traces in NH_4OH+Aq. Not decomp. by cold KOH+Aq; sl. decomp. if hot. (Millon.)

—— **ammonium iodate,** $(NHg_2OH_2)IO_3$, $2NH_4IO_3$.

Insol. in H_2O. (Millon, A. ch. (3) **18.** 410.)

—— **iodide,** $(NHg_2OH_2)I$.

Sol. in warm HCl+Aq. Not decomp. by boiling KOH+Aq. Sol. in warm KI+Aq. (Rammelsberg, Pogg. **48.** 170.)

Correct formula is NHg_2I+H_2O. (Rammelsberg.)

—— **nitrate,** $(NHg_2OH_2)NO_3$.

Insol. in H_2O; not decomp. by boiling KOH+Aq. Sol. in cold HCl+Aq, from which it is precipitated by H_2O. Sl. sol. without decomp. in HNO_3 or H_2SO_4+Aq. Easily sol. in NH_4OH+Aq. (Soubeiran.)

Is *di*mercuriammonium nitrate, NHg_2NO_3. (Pesci, Gazz. ch. it. **20.** 485.)

—— **ammonium nitrate,** $NHg_2OH_2)NO_3$, $2NH_4NO_3+H_2O$.

Decomp. by H_2O. Kane, A. ch. **72.** 242.)

Is *di*mercuriammonium ammonium nitrate, NHg_2NO_3, $2NH_4NO_3+2H_2O$. (Pesci.)

Oxy*di*mercuriammonium oxide, $(NHg_2OH_2)_2O$.

Insol. in H_2O or alcohol; not attacked by boiling conc. KOH+Aq. Sol. in hot NH_4NO_3 + Aq, NH_4Cl + Aq, $(NH_4)_2SO_4$ + Aq, $NH_4C_2H_3O_2$+Aq, $(NH_4)_2C_2O_4$+Aq. (Millon, A. ch. (3) **18.** 397.)

—— **mercuric phosphate,** $Hg(NHg_2OH_2)PO_4$.

Insol. in H_2O. Slowly sol. in hot HNO_3+Aq; not decomp. by boiling with KOH+Aq, but by KI or K_2S+Aq. Sol. in HCl+Aq or much hot $(NH_4)_2HPO_4$+Aq. (Hirzel.)

—— **mercuric sulphite,** $(NHg_2OH_2)_2SO_3$, $HgSO_3$.

Insol. in H_2O. Sol. in much $(NH_4)_2SO_3$+Aq. Sol. in HCl+Aq with decomposition. Insol. in boiling KOH+Aq. (Hirzel.)

—— **sulphate,** $(NHg_2OH_2)_2SO_4$.

Sol. in traces in H_2O. Easily sol. in HCl or HNO_3+Aq. (Kane.)

Insol. in HNO_3+Aq. (Hirzel.)

Slowly sol. in boiling conc. H_2SO_4. (Hirzel.)

Insol. in conc., easily sol. in dil. H_2SO_4+Aq. (Schmieder, J. pr. **75:** 147.)

Moderately sol. in much $(NH_4)_2SO_4$ or boiling NH_4Cl+Aq. Not decomp. by boiling KOH+Aq. (Hirzel.)

Easily decomp. by boiling with dil. KOH+Aq. (Schmieder.)

Does not exist. (Pesci.)

$2NH_3$, 2HgO, SO_3.

*See Di*mercuriammonium **sulphate.**

Oxy*tri*mercuriammonium chloride, $(NHg_3O_2H_2)Cl$ (?).

Insol. in H_2O.

—— **nitrate,** $(NHg_3O_2H_2)NO_3$.

Sol. in cold HCl+Aq, from which it is precipitated by NH_4OH+Aq. Sol. in NH_4OH+Aq without decomp. Not decomp. by H_2SO_4 or warm KOH+Aq. (Pagenstecher.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

Oxy*tri*mercuri*di*ammonium sulphate, $2NH_3$, 3HgO, SO_3.

*See Tri*mercuriammonium **sulphate.**

Oxy*tri*mercurioxy*di*mercuriammonium sulphate, $\genfrac{}{}{0pt}{}{NH_2Hg_3O_2}{NH_2Hg_2O} > SO_4$.

Completely sol. in NH_4Cl+Aq, or $(NH_4)_2SO_4$+Aq. Sol. in dil. or conc. HCl+Aq, and very dil. H_2SO_4+Aq. Insol. in HNO_3+Aq or conc. H_2SO_4. (Schmieder.)

Does not exist. (Pesci.)

Oxy*tetra*mercuriammonium mercuric nitrate (?), $2(NHg_4O_2)NO_3, HgNO_3$ (?).

Completely insol. in HNO_3+Aq. Sol. in warm HCl+Aq. Slowly decomp. by boiling KOH+Aq. Gradually sol. in hot conc. NH_4NO_3+Aq. (Hirzel.)

Does not exist. (Pesci, Gazz. ch. it. **20.** 485.)

Oxynitrosulphonic anhydride,

$S_2O_5{<}{NO_2 \atop ONO_2}$ (?).

Sol. in H_2O with decomp. (Weber, Pogg. **123.** 339.)

Oxyosmiumamine hydroxide (Osmosyl*di*amine hydroxide),

$OsO(NH_3OH)_2$.

Insol. in H_2O. Sl. sol. in acids. Sol. in KOH+Aq. When moist, sol. in NH_4OH+Aq.

Oxyosmium*di*amine chloride (Osmyl*tetr*amine chloride), $OsO_2(N_2H_6Cl)_2$.

Sl. sol. in cold, more easily in hot H_2O. Insol. in NH_4Cl+Aq. (Gibbs, Am. Ch. J. **3.** 233.)

—— **chloroplatinate,** $OsO_2(N_2H_6Cl)_2, PtCl_4$.

Sl. sol. in H_2O. (Gibbs.)

—— **hydroxide,** $OsO_2(N_2H_6OH)_2$.

Known only in solution.

—— **nitrate,** $OsO_2(N_2H_6NO_3)_2$.

—— **sulphate,** $OsO_2(N_2H_6)_2SO_4+H_2O$.

(Gibbs, Am. Ch. J. **3.** 233.)

Oxyphosphuretted hydrogen (?), $P_4H(OH)$.

P_4O of Leverrier, and Goldschmidt has this formula according to Franke (J. pr. (2) **35.** 341). Decomp. slowly by H_2O or alkalies. Forms potassium salt, $P_4H(OK)$, sol. in H_2O.

—— **hydroiodide,** $P_4H(OH), HI$.

Decomp. at 80°.

***Sesqui*oxyplatisulphuric acid,** $Pt_2O_3, 3SO_3, SO_4H_2+11\frac{1}{2}H_2O$.

Sol. in H_2O. (Blondel, A. ch. 1905. (8) **6.** 113.)

Barium *sesqui*oxyplatisulphate, $Pt_2O_3, 3SO_3, SO_4Ba+8H_2O$.

Very sol. in H_2O. (Blondel.)

Potassium *sesqui*oxyplatisulphate, $Pt_2O_3, 3SO_3, SO_4K_2+2H_2O$.

(Blondel.)

Sodium *sesqui*oxyplatisulphate, $Pt_2O_3, 3SO_3, SO_4Na_2+8H_2O$.

Very sol. in H_2O. (Blondel.)

Oxysulphantimonic acid.

See **Sulphoxyantimonic acid.**

Oxysulpharsenic acid.

See **Sulphoxyarsenic acid.**

Oxysulphazotic acid, $H_4S_4N_2O_{14}$ =

$(SO_3H)_3{=}N\overset{O}{\frown}NO{-}SO_3H$.

Known only in its salts. (Claus, A. **158.** 52, 194.)

Has formula $(SO_3H)_2N{\begin{matrix}/O\backslash\\ \backslash O/\end{matrix}}N(SO_3H)_2$.

(Raschig, A. **241.** 161.)

Potassium oxysulphazotate, $NO(SO_3K)_2$.

Insol. in alcohol. (Fremy, A. ch. (3) **15.** 451.)

According to Raschig the formula is

$(SO_3K)_2N{\begin{matrix}/O\backslash\\ \backslash O/\end{matrix}}N(SO_3K)_2$.

Very sol. in water, with rapid decomposition. (Raschig.)

See also **Peroxylaminesulphonate, potassium.**

Oxysulphotungstic acid.

See **Sulphotungstic acid.**

Oxysulphovanadic acid.

See **Sulphoxyvanadic acid.**

Ozone, O_3.

Not appreciably sol. in H_2O. (Schönbein.)

Imparts its taste and properties to H_2O. (Williamson.)

Later, Carius (B. **5.** 520) found that 1000 vols. H_2O at 1–2.5° absorb 5.11 vols. O_3 (red. to 0° and 760 mm.). He also still later (A. **174.** 1) found, by conducting the gas for 9–12 hours through H_2O, that 1000 vols. H_2O absorb a maximum of 28.160 vols. O_3. The ozonized oxygen used contained 3.44 vols. O_3 in 100 vols. O_2. Since gases are absorbed in proportion to their partial pressure, which is very small for the O_3, the amount of absorption of water for the gas is very considerable. Carius calculated the coefficient of absorption at +1° to be 0.834.

Ozone is *not at all* absorbed by H_2O; the H_2O through which ozone had been passed gave no reactions for ozone. (Rammelsberg, B. **6.** 603.)

Schöne (B. **6.** 1224) corroborates Carius, and finds 8.81 vols. to 1000 vols. H_2O as a maximum amount absorbed.

Sol. in H_2O. (Leeds, B. **12.** 1831.)

H_2O takes up $^2/_3$ of its vol. of O_3 at 0° and 760 mm. pressure and ½ of its vol. at 12°, or about 15 times that of oxygen at the same pressure and temp. (Mailfert, C. R. 1894, **119.** 951.)

Solubility in H_2O at t°.

Temp.	Wt. O_3 dissolved in 1 l. H_2O	Wt. O_3 in gaseous mixture above the solution	Coefficient of solubility of O_3
0	39.4 mgr.	61.5 mgr.	0.641
6	34.3	61	0.562
11.8	29.9	59.6	0.500
13	28	58.1	0.482
15	25.9	56.8	0.456
19	21	55.2	0.381
27	13.9	51.4	0.270
32	7.7	39.5	0.195
40	4.2	37.6	0.112
47	2.4	31.2	0.077
55	0.6	19.2	0.031
60	0.0	12.3	0.000

(Mailfert, C. R. 1894, **119.** 952.)

Solubility of ozone in acidulated H_2O.

Temp.	Coefficient of solubility of ozone	Composition of solution
30°	0.240	1 l. H_2O+0.7 cc. H_2SO_4
33	0.224	1 l. H_2O+0.7 cc. H_2SO_4
42.7	0.174	1 l. H_2O+0.7 cc. H_2SO_4
49	0.156	1 l. H_2O+0.9 cc. "
57	0.096	1 l. " +0.3 cc. "

(Mailfert.)

0.00002 pt. by weight is sol. in 1 pt. by weight H_2O at ordinary temp. and pressure. Ladenburg, B. 1898, **31.** 2510.)

The solution of O_3 in H_2O cannot be brought into equilibrium, because when the gas is blown through the liquid, a portion is continually decomposed, although the concentration remains constant. (Inglis, Chem. Soc. 1903, **83.** 1012.)

About 10 mg. ozone are sol. in 1 l. H_2O at +2°; 1.5 mg. ozone are sol. at +28°. (Moufang, C. C. 1911, II. 1674.)

Solubility in 0.1-N H_2SO_4.

C solution: C gas = 0.23 at 20°; 0.44 at 0°. (Luther, Z. Elektrochem. 1905, **11.** 833.)

The absorption coefficient of the gas in 0.1 N H_2SO_4 solution is 0.487. (Rothmund, C. C. **1912.** I, 1261.)

Sol. in $H_2C_2O_4$+Aq. (Jeremin, B. **11.** 988.)

Completely absorbed by oil of turpentine and oil of cinnamon. (Soret, A. ch. (4) **17.** 113.)

_Di_palladamine chloride, $Cl_2Pd_2(NH_3)_4Cl_4$=

$$
\begin{array}{l}
Cl{-}Pd{<}\begin{array}{l}NH_3Cl\\NH_3Cl\end{array}\\
\quad\;\;|\\
Cl{-}Pd{<}\begin{array}{l}NH_3Cl\\NH_3Cl.\end{array}
\end{array}
$$

Sl. sol. in H_2O. (Deville and Debray, C. R. **86.** 296.)

Palladium, Pd.

Not attacked by H_2O. Sl. attacked by HC+Aq, but Pd sponge or filings are easily dissolved in warm HCl+Aq, with access of air. HNO_3+Aq of 1.2 sp. gr. dissolves Pd slightly, but it is easily sol. in HNO_3+Aq of 1.35 sp. gr. (Rose.)

Easily sol. in aqua regia. Sl. sol. in conc., but insol. in dil. HI+Aq. Sol. in conc. boiling H_2SO_4. Sol. in boiling $FeCl_3$+Aq. Sol. in HBr+Aq with a little HNO_3.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.

Palladium ammonium compounds.

See—
_Di_palladamine comps., $Cl_2Pd_2(NH_3)_4Cl_4$.
Pallado_diamine_ " $Pd(NH_3)_4Cl_2$.
Palladosamine " $Pd(NH_3)_2Cl_2$.

Palladium _di_bromide.

Not known in pure state.

Palladium bromide _with_ MBr.

See **Bromopalladite, M.**

Palladium _tetra_bromide _with_ MBr.

See **Bromopalladate, M.**

Palladous phosphorus bromide, $Pd_2P_2Br_{10}$.

Properties as the corresponding chloride. (Strecker, B. 1909, **42.** 1776.)

Palladium _sub_chloride, Pd_2Cl_2.

Deliquescent. Decomp. by H_2O, NH_4Cl, KI, or NH_4OH+Aq. Kane.)

Sol. in acetone. Naumann, B. 1904, **37.** 4328.)

Palladium _di_chloride, $PdCl_2$.

Slowly but completely sol. in H_2O.

+$2H_2O$. Not deliquescent when pure. Slowly sol. in H_2O. Much more sol. in H_2O containing HCl.

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in ethyl acetate. Naumann, B. 1904, **37.** 3601.)

Palladium _di_chloride _with_ MCl.

See **Chloropalladite, M.**

Palladium _tetra_chloride _with_ MCl.

See **Chloropalladate, M.**

Palladous phosphorus chloride, $PdCl_2$, PCl_3.

Decomp. by H_2O into deliquescent $P(OH)_3$, $PdCl_2$. Decomp. by alcohol. (Fink, C. R. **115.** 176.)

Decomp. by H_2O. Sol. in $CHCl_3$ and C_6H_6. Insol. in ligroin and CCl_4. (Strecker, B. 1909, **42.** 1775.)

$PdCl_2$, $2PCl_3$. Sol. in C_6H_6, and decomp. by H_2O. (Fink.)

Palladous chloride carbon *mono*oxide, $PdCl_2$, $2CO$.

Decomp. by heat. (Fink, C. R. 1898, **126.** 648.)

$2PdCl_2$, $3CO$. Decomp. by H_2O. Sol. in CCl_4. (Fink.)

Palladium *di*fluoride, PdF_2.

Sl. sol. in H_2O or HF+Aq. Sl. sol. while moist, in NH_4OH+Aq; insol. after drying, in NH_4OH+Aq. Insol. in boiling NaF or $NaHF_2$+Aq. (Berzelius.)

Palladium hydride, Pd_2H (?).

Palladous hydroxide, PdO, xH_2O (?).

Easily sol. in acids or excess of alkali hydrates, and carbonates+Aq. Sol. in hot NH_4Cl+Aq. (Rose.)

Insol. in $Na_2B_4O_7$, and Na_2HPO_4+Aq. (Claus.)

Palladic hydroxide, PdO_2, xH_2O.

Slowly sol. in acids. Sol. in conc. HCl+Aq without decomp. With dil. HCl+Aq, Cl_2 is evolved. (Berzelius.)

Palladous hydroxide hydroxylamine, $Pd(NH_3O)_4(OH)_2$.

Sl. sol. in H_2O. Sol. in dil. HCl and in dil. H_2SO_4. (Zeisel, A. 1907, **351.** 445.)

Palladous iodide, PdI_2.

Insol. in H_2O. Can be detected as a brown coloration in presence of 400,000 pts. H_2O. (Lassaigne.)

Sl. sol. in HI+Aq. Easily sol. in KI+Aq. (Lassaigne, J. ch. méd. **11.** 57.)

Insol. in dil. HCl+Aq, but slightly sol. in saline solutions. (Fresenius.)

Sl. sol. in hot conc. HNO_3+Aq. Sol. in H_2SO_3+Aq, Cl_2+Aq, Br_2+Aq, I_2+Aq, and CN+Aq; also in HCN, and MCN+Aq. Insol. in dil. H_2SO_4, HCl, H_3PO_4, HNO_3, or $HC_2H_3O_2$+Aq, or in the K, Na, or NH_4 salts of those acids. Insol. in $CuCl_2$, $ZnCl_2$, or $Pb(C_2H_3O_2)_2$+Aq. Insol. in KBr+Aq except in presence of a free mineral acid, but not $HC_2H_3O_2$. Insol. in sugar or starch+Aq, uric acid, alcohol, ether, or oil of lemon. Somewhat sol. in urine. Easily sol. in NH_4OH+Aq, even when dil., with evolution of heat and decomposition. (Kersten, A. **87.** 28.)

Insol. in alcohol or ether.

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Palladous potassium iodide.

See **Iodopalladite, potassium.**

Palladium *sub*oxide, Pd_2O.

Decomp. by acids into palladious salt and Pd. (Kane, Phil. Trans. **1842, 1.** 276.)

Insol. in acids, even boiling aqua regia. (Willm. B. **25.** 220.)

Palladous oxide, PdO.

Slowly sol. in acids by boiling. (Wöhler, A. **174.** 160.)

Palladic oxide, PdO_2.

Very sl. attacked by acids.

Palladopalladic oxide, 4PdO, PdO_2.

Not attacked by aqua regia. (Schneider, Pogg. **141.** 528.)

Palladous oxychloride, 3PdO, $PdCl_2$+$4H_2O$(?).

Sol in dil. acids. (Kane.)

Palladous oxychloride ammonia, PdO, $PdCl_2$, $6NH_3$(?).

Sol. in HCl+Aq.

3PdO, $PdCl_2$, $2NH_3$+$3H_2O$ (?). Ppt. (Kane.)

Palladium selenide, PdSe.

Insol. in HNO_3 and aqua regia. (Rössler, A. **180.** 240.)

Palladium *sub*sulphide, Pd_2S.

Not attacked by acids except aqua regia, which attacks slightly. (Schneider, Pogg. **141.** 530.)

Palladium *mono*sulphide, PdS.

Insol. in H_2O or $(NH_4)_2S$+Aq. Sol. in HCl+Aq. Pptd. in presence of 10,000 pts. H_2O. (Fellenberg, Pogg. **50.** 65.)

Sol. in potassium thiocarbonate+Aq. (Rosenbladt, Z. anal. **26.** 15.)

A sol. colloidal form was obtained in very dilute solution. (Winnsinger, Bull. Soc. (2) **49.** 452.)

Does not exist. (Kritschenko, Z. anorg. **4.** 247.)

Palladium *di*sulphide, PdS_2.

HNO_3 dissolves out part of the S. Easily sol. in aqua regia without separation of S. (Schneider.)

Palladium sulphide *with* M_2S.

See **Sulphopalladate, M.**

Pallado*di*amine bromide, $Pd(N_2H_6Br)_2$.

Easily sol. in H_2O.

—— **bromopalladite,** $Pd(N_2H_6Br)_2$, $PdBr_2$.

Properties as the corresponding chloropalladite.

—— **carbonate.**

Sol. in H_2O.

—— **chloride,** $Pd(N_2H_6Cl)_2$.

Easily sol. in H_2O.

Pallado*diamine* chloropalladite, $Pd(N_2H_6Cl)_2$, $PdCl_2$.

"Vauquelin's red salt." Insol. in cold H_2O. (Fischer.)

Sol. in boiling H_2O with decomp. Sol. in HCl or HNO_3+Aq.

—— fluoride.

Easily sol. in H_2O. (Müller.)

—— fluosilicate.

Sl. sol. in cold, easily in warm H_2O. Insol. in alcohol.

—— hydroxide, $Pd(N_2H_6OH)_2$.

Sol. in H_2O.

—— iodide, $Pd(N_2H_6I)_2$.

Sol. in H_2O.

—— nitrate, $Pd(N_2H_6NO_3)_2$.

Easily sol. in H_2O, HNO_3, or NH_4OH+Aq. Insol. in alcohol.

—— palladous nitrite, $Pd(N_2H_6NO_2)_2$, $Pd(NO_2)_2$.

Easily sol. in H_2O.

—— sulphate, $Pd(N_2H_6)_2SO_4+H_2O$.

Easily sol. in H_2O. Insol. in alcohol.

—— sulphite, $Pd(N_2H_6)_2SO_3$.

Sl. sol. in H_2O.

Palladochloronitrous acid.

Potassium palladochloronitrite, $Pd(NO_2)_2Cl_2K_2$.

Sol. in 2 pts. hot, and 3 pts. cold H_2O. (Vézes, C. R. **115.** 111.)

Palladocyanhydric acid.

Ammonium palladocyanide, $(NH_4)_2Pd(CN)_4$ (?).

Sol. in hot H_2O. (Rössler, Z. ch. **1866.** 175.)

Barium ——, $BaPd(CN)_4+4H_2O$.

Not efflorescent. Sol. in H_2O.

Calcium ——, $CaPd(CN)_4+4H_2O$.

Sol. in H_2O.

Cupric ——, $CuPd(CN)_4$.

Ppt.

Lead ——, $PbPd(CN)_4$.

Ppt.

Magnesium ——, $MgPd(CN)_4$

Very sol. in H_2O.

Magnesium —— platinocyanide, $MgPd(CN)_4$, $MgPt(CN)_4+14H_2O$.

Extremely sol. in H_2O.

Potassium ——, $K_2Pd(CN)_4+3H_2O$.

Efflorescent. Sol. in H_2O.

$+H_2O$. Not efflorescent.

Silver ——, $Ag_2Pd(CN)_4$.

Ppt.

Sodium ——, $Na_2Pd(CN)_4$.

Not efflorescent. Sol. in H_2O.

$+H_2O$.

Palladoiodonitrous acid.

Potassium palladoiodonitrite, $Pd(NO_2)_2I_2K_2+3H_2O$.

Effloresces in the air.

Decomp. by H_2O and dil. acids. (Rosenheim, Z. anorg. 1900, **23.** 28.)

Palladonitrous acid.

Potassium palladonitrite, $K_2Pd(NO_2)_4+2H_2O$.

Efflorescent; sol. in H_2O. (Lang, J. pr. **83.** 415.)

Silver palladonitrite, $Ag_2Pd(NO_2)_4$.

Easily sol. in hot H_2O. (Lang.)

Sodium ——, $Na_2Pd(NO_2)_4$.

(Fischer.)

Palladosamine bromide, $Pd(NH_3Br)_2$.

Insol. in cold, sl. sol. in hot H_2O. Easily sol. in $HC_2H_3O_2$, H_2SO_3, KOH, NH_4OH, or alkali carbonates+Aq. (Müller, A. **86.** 341.)

—— carbonate, $Pd(NH_3)_2CO_3$.

Moderately sol. in H_2O.

—— chloride, $Pd(NH_3Cl)_2$.

Insol. in H_2O, but very gradually decomp. by boiling therewith.

Sol. in warm HCl or HNO_3+Aq. Sol. in cold NH_4OH+Aq. Sol. in KOH+Aq without evolution of NH_3.

$+2H_2O$. Efflorescent. Insol. in H_2O. (Baubigny, A. Suppl. **4.** 253.)

—— cyanide, $Pd(NH_3CN)_2$.

Sol. in NH_4OH+Aq.

—— fluoride.

Known only in solution.

—— hydroxide, $Pd(NH_3OH)_2$.

Easily sol. in H_2O. Slowly decomp. by boiling with H_2O. (Müller, A. **86,** 341.)

Palladosamine iodide, $Pd(NH_3I)_2$.

Insol. in H_2O. Sol. in boiling HNO_3 with evolution of I_2. (Fehling, A. **39.** 106.)

—— **nitrate.**

Known only in solution, which decomp. on evaporation.

—— **nitrite,** $Pd(NH_3NO_2)_2$.

Moderately sol. in H_2O. (Lang.)

—— **palladous nitrite,** $Pd(NH_3NO_2)_2$, $Pd(NO_2)_2$.

Slowly sol. in cold, easily in hot H_2O. (Lang.)

—— **sulphate,** $Pd(NH_3)_2SO_4$.

Moderately sol. in H_2O. (Müller.)

—— **sulphite,** $Pd(NH_3)_2SO_3$.

Easily sol. in H_2O. (Müller.)

Pentamine chromium compounds.

See—
Bromopurpureochromium compounds.
Chloropurpureochromium compounds.
Iodopurpureochromium compounds.
Xanthochromium compounds.
Roseochromium compounds.

Pentamine cobaltic compounds.

See—
Bromopurpureocobaltic compounds,
Chloropurpureocobaltic compounds.
Nitratopurpureocobaltic compounds.
Nitritocobaltic compounds,
Purpureocobaltic compounds.
Roseocobaltic compounds.
Sulphatopurpureocobaltic compounds.
Xanthocobaltic compounds.

Pentamine *di*cobaltic sulphite.

See Roseocobaltic cobaltic sulphite.

Pentamine iridium compounds.

See Irido*pent*amine, *and* Iridoaquo*pent*amine compounds.

Pentamine rhodium compounds.

See—
Bromopurpureorhodium compounds.
Chloropurpureorhodium compounds.
Iodopurpureorhodium compounds.
Nitratopurpureorhodium compounds.
Roseorhodium compounds.
Xanthorhodium compounds.

Pentathionic acid, $H_2S_5O_6$.

Known only in aqueous solution.

Conc. solution is decomp. by boiling, but made stable by addition of acids.

Sp. gr. of aqueous solution of pentathionic acid at 22°:

Sp. gr.	1.233	1.320	1.474	1.506
$\%H_2S_5O_6$	32.1	41.7	56	59.7

(Kessler, Pogg. **74.** 279.)

Does not exist. (Spring, Bull. Acad. roy. Belg.)

Existence proven by Smith (Chem. Soc. **43.** 355.)

Barium pentathionate, $BaS_5O_6+2H_2O$.

Easily sol. in H_2O. Aqueous solution is precipitated by alcohol.

Contains $3H_2O$. (Lewes, C. N. **43.** 41.)

Barium pentathionate tetrathionate, BaS_5O_6, $BaS_4O_6+6N_2O$.

Easily sol. in H_2O. Not precipitated from aqueous solution by two vols. alcohol. (Ludwig, Arch. Pharm. (2) **51.** 264.)

Cupric pentathionate, $CuS_5O_6+4H_2O$.

Easily sol. in H_2O. (Debus, Chem. Soc. **53.** 360.)

Lead pentathionate, $PbS_5O_6+4H_2O$.

Pp.

Potassium pentathionate, $K_2S_5O_6$.

Sol. in H_2O. (Rammelsberg, J. B. **1857.** 136.)

Solution decomposes very quickly when neutral, but is more stable in presence of salts or acids.

Sol. in about 2 pts. H_2O.

Insol. in alcohol. (Debus, Chem. Soc. **53.** 295.)

$+H_2O$. (Shaw, Chem. Soc. **43.** 351.)

$+1\frac{1}{2}H_2O$. (Debus, A. **244.** 76.)

$+2H_2O$. (Lewes, C. N. **43.** 41.)

Perarsenic acid.

Sodium perarsenate, $NaAsO_4$.

(Alvarez, C. N. 1906, **94.** 270.)

Perboric acid.

Ammonium perborate, NH_4BO_3.

(Constam and Bennett, Z. anorg. 1900, **25.** 265.)

$+\frac{1}{2}H_2O$. Stable in dry air. 100 pts. H_2O at 17.5° dissolve 1.55 g. anhydrous salt.

Decomp. in aqueous solution at ord. temp.

Decomp. by dil. and conc. H_2SO_4 and by HCl. (Melikoff, B. 1898, **31.** 953.)

$+H_2O$. (Bruhat, C. R. 1905, **140.** 508.)

Much more sol. in H_2O than the Na salt. (Tanatar, Z. phys. Ch. 1898, **26.** 133.)

$+3H_2O$. (Melikoff, B. 1898, **31.** 954.)

NH_4BO_3, $NH_4BO_4+H_2O$. (Petrenko, C. C. **1902,** I. 1192.)

Barium perborate, $Ba(BO_3)_2+7H_2O$.
Difficultly sol. in H_2O. (Melikoff, B. 1898, **31.** 954.)

Cæsium perborate, $CsBO_3+H_2O$.
As NH_4 salt. (Christensen.)

Calcium perborate.
Sl. sol. in H_2O. Decomp. in water much more rapidly than the Ba salt. (Melikoff, B. 1898, **31.** 954.)

Copper perborate.
Very unstable. Insol. in H_2O. (Melikoff, B. 1898, **31.** 954.)

Nickel perborate.
Very unstable. Insol. in H_2O. (Melikoff.)

Potassium perborate, $2KBO_3+H_2O$.
1.25 pts. are sol. in 100 pts. H_2O at 0°; 2.5 pts., at 15°.
Insol. in alcohol and ether. (Girsewald, B. 1909, **42.** 867.)

Potassium perborate hydrogen peroxide, $2KBO_3, H_2O_2$.
0.70 pt. is sol. in 100 pts. H_2O at 15°. (Girsewald, B. 1909, **42.** 868.)

Potassium per*di*borate, $KB_2O_5+2H_2O$.
Ppt. (Bruhat, C. R. 1905, **140.** 508.)

Rubidium perborate, $RbBO_3+H_2O$.
As Na salt. (Christensen.)

Sodium perborate, $Na_2B_4O_8+10H_2O$.
100 g. H_2O dissolve 4.2 g. at 11°; 7.1 g. at 22°; 13.8 g. at 32°. (Jaubert, C. R. 1904, **134.** 796.)
$+4H_2O$. Slowly decomp. in cold solution, rapidly when boiled. (Tanatar, Z. phys. Ch. 1898, **26.** 132.)
Sol. in H_2O. 100 g. H_2O dissolve 1.17 g. Aq. solution decomp. on warming. (Melikoff, B. 1898, **31.** 679.)
100 g. H_2O dissolve 2.55 g. at 15°; 2.69 g. at 21°; 2.85 g. at 26°; 3.78 g. at 32°. (Jaubert and Lion, Rev. gén. Chim. 1905, (7) **8.** 163.)

Uranyl perborate, UBO_4.
(Bruhat, C. R. 1905, **140.** 508.)

Perbromic acid, $HBrO_4$.

Known only in aqueous solution, which can be concentrated to a thick liquid on water bath. Not decomp. by HCl, SO_2, or H_2S. (Kämmerer, J. pr. **85.** 452; **90.** 190.)
Does not exist. (Muir, C. N. **33.** 256; MacIvor, C. N. **33.** 35.)

Barium perbromate, $Ba(BrO_4)_2$.
Very sl. sol. in boiling H_2O. (Kämmerer, J. pr. **90.** 190.)
Does not exist. (Wolfram, A. **198.** 95.)

Potassium perbromate, $KBrO_4$.
Less sol. in H_2O than $KBrO_3$, but more sol. than $KClO_4$. (Kämmerer, J. pr. **90.** 190.)
Does not exist. (Wolfram, A. **198.** 95.)

Silver perbromate, $AgBrO_4$.
Sl. sol. in cold, more abundantly in hot H_2O. (Kämmerer, J. pr. **90.** 190.)
Does not exist. (Wolfram, A. **198.** 95.)

Perbromoplatinocyanhydric acid, $H_2Pt(CN)_4Br_2+xH_2O$.

Deliquescent. Easily sol. in H_2O, alcohol, and ether. (Holst, Bull. Soc. (2) **22.** 347.)

Aluminum perbromoplatinocyanide, $Al_2[Pt(CN)_4Br_2]_3+22H_2O$.
Deliquescent. Very sol. in H_2O.

Ammonium ——, $(NH_4)_2Pt(CN)_4Br_2$.
Sol. in H_2O.

Barium ——, $BaPt(CN)_4Br_2+5H_2O$.
Very sol. in H_2O or alcohol.

Cadmium ——, $CdPt(CN)_4Br_2+xH_2O$.
Very sol. in H_2O.

Calcium ——, $CaPt(CN)_4Br_2+7H_2O$.
Sol. in H_2O.

Cobaltous ——, $CoPt(CN)_4Br_2+5H_2O$.
Sol. in H_2O. Sl. sol. in alcohol.

Glucinum ——, $GlPt(CN)_4Br_2$.
Deliquescent. Sol. in H_2O.

Ferrous ——.
Very sl. sol. in H_2O.

Lead ——, $PbPt(CN)_4Br_2+2H_2O$.
Sl. sol. in H_2O.

Lithium ——, $Li_2Pt(CN)_4Br_2$.
Deliquescent. Sol. in H_2O.

Magnesium ——, $MgPt(CN)_4Br_2+xH_2O$.
Sol. in H_2O.

Nickel ——, $NiPt(CN)_4Br_2+xH_2O$.
Sl. sol. in H_2O. Sol. in NH_4OH+Aq.

Potassium ——, $K_2Pt(CN)_4Br_2$.
Sol. in H_2O.
$+2H_2O$. Efflorescent.

Silver perbromoplatinocyanide, $Ag_2PtBr_2(CN)_4$.

Ppt. (Miolati, Gazz. ch. it. 1900, **30.** 588.)

Sodium ——, $Na_2Pt(CN)_4Br_2$.

Deliquescent. Sol. in H_2O.

Strontium ——, $SrPt(CN)_4Br_2+7H_2O$.

Sol. in H_2O.

Zinc ——, $ZnPt(CN)_4Br_2+5H_2O$.

Not very sol. in H_2O.

Percarbonic acid.

Ammonium percarbonate, $(NH_4)_2CO_4+2H_2O$.

Sol. in H_2O with evolution of NH_3. Insol. in alcohol and ether. (Kasanezky, C. C. **1902,** I. 1263.)

Barium percarbonate, $BaCO_4$.

Insol. in H_2O. (Merck, C. C. **1906,** II. 1743.)

Decomp. slowly in the air. Not rapidly decomp. by H_2O. Rapidly decomp. by acids. (Wolffenstein, B. 1908, **41.** 280.)

Potassium percarbonate, K_2CO_4.

Sol. in H_2O with decomp. Sl. sol. in alcohol. (v. Hansen, Z. Elektrochem. 1897, **3.** 448.)

$K_2C_2O_6$. Sol. in H_2O at 0° with only slight decomp. but is decomp. at ord. temp. Sl. sol. in alcohol. (Treadwell, Ch. Z. 1901, **25.** 1008.)

Rubidium percarbonate, Rb_2CO_4, $2H_2O_2+H_2O$.

Hydroscopic; decomp. by H_2O; pptd. by alcohol.

Rb_2CO_4, $H_2O_2+2H_2O$. Hydroscopic; decomp. by H_2O; pptd. by alcohol.

$Rb_2CO_4+2\frac{1}{2}H_2O$. Hydroscopic; decomp. by H_2O; pptd. by alcohol. (Peltner, B. 1909, **42.** 1782.)

$Rb_2C_2O_6$. Very deliquescent. (Constam and Hansen, Z. Elektrochem. 1897, **3.** 144.)

Sodium percarbonate, $Na_2CO_4+1\frac{1}{2}H_2O$.

Sol. in H_2O with gradual decomp. (Tanatar, B. 1899, **32.** 1544.)

Sodium hydrogen percarbonate, $4Na_2CO_4$, H_2CO_3.

Ppt. (Merck, Chem. Soc. 1908, **94.** (2) 180.)

Perchloric acid, $HClO_4$.

Combines with H_2O with a hissing sound and evolution of much heat.

Solution in H_2O is very stable.

When dil. $HClO_4+Aq$ is distilled, H_2O and $HClO_4$ distil off until a temp. of 203° is reached, when an acid of constant composition containing 71.6–72.2% $HClO_4$ ($=HClO_4+2H_2O$) is obtained. Forms hydrate $HClO_4+H_2O$, which is deliquescent, and dissolves in H_2O with evolution of much heat. $HClO_4$ is very unstable, $HClO_4+H_2O$ more stable, and $HClO_4+2H_2O$ is very stable. (Roscoe, A. **121.** 346.)

Sp. gr. of $HClO_4$+Aq. at 15°/4°.

Sp. gr.	% $HClO_4$	Sp. gr.	% $HClO_4$	Sp. gr.	% $HClO_4$
1.005	1.00	1.235	33.29	1.465	54.50
1.010	1.90	1.240	33.85	1.470	54.89
1.015	2.77	1.245	34.40	1.475	55.18
1.020	3.61	1.250	34.95	1.480	55.56
1.025	4.43	1.255	35.49	1.485	55.95
1.030	5.25	1.260	36.03	1.490	56.32
1.035	6.07	1.265	36.56	1.495	56.69
1.040	6.88	1.270	37.08	1.500	57.06
1.045	9.68	1.275	37.60	1.505	57.44
1.050	8.48	1.280	38.10	1.510	57.81
1.055	9.28	1.285	38.60	1.515	58.17
1.060	10.06	1.290	39.10	1.520	58.54
1.065	10.83	1.295	39.60	1.525	58.91
1.070	11.58	1.300	40.10	1.530	59.28
1.075	12.33	1.305	40.59	1.535	59.66
1.080	13.08	1.310	41.08	1.540	60.04
1.085	13.83	1.315	41.56	1.545	60.41
1.090	14.56	1.320	42.03	1.550	60.78
1.095	15.28	1.325	42.49	1.555	61.15
1.100	16.00	1.330	42.97	1.560	61.52
1.105	16.72	1.335	43.43	1.565	61.89
1.110	17.45	1.340	43.89	1.570	62.26
1.115	18.16	1.345	44.35	1.575	62.63
1.120	18.88	1.350	44.81	1.580	63.00
1.125	19.57	1.355	45.26	1.585	63.37
1.130	20.26	1.360	45.71	1.590	63.74
1.135	20.95	1.365	46.16	1.595	64.12
1.140	21.64	1.370	46.61	1.600	64.50
1.145	22.32	1.375	47.05	1.605	64.88
1.150	22.99	1.380	47.49	1.610	65.26
1.155	23.65	1.385	47.93	1.615	65.63
1.160	24.30	1.390	48.37	1.620	66.01
1.165	24.94	1.395	48.80	1.625	66.39
1.170	25.57	1.400	49.23	1.630	66.76
1.175	26.20	1.405	49.68	1.635	67.13
1.180	26.82	1.410	50.10	1.640	67.51
1.185	27.44	1.415	50.51	1.645	67.89
1.190	28.05	1.420	50.91	1.650	68.26
1.195	28.66	1.425	51.31	1.655	68.64
1.200	29.26	1.430	51.71	1.660	69.02
1.205	29.86	1.435	52.11	1.655	69.40
1.210	30.45	1.440	52.51	1.670	69.77
1.215	31.04	1.445	52.91	1.675	70.15
1.220	31.61	1.450	53.31		
1.225	32.18	1.455	53.71		
1.230	32.74	1.460	54.11		

(Emster, Z. anorg. 1907, **52.** 278.)

Sp. gr. of $HClO_4$+Aq.

% $HClO_4$	Sp. gr. at 15°/4°	Sp. gr. at 30°/4°	Sp. gr. at 50°/4°
11.14	1.0670	......	1.0507
35.63	1.2569	1.2451	1.2292
55.63	1.4807	1.4637	1.4421
69.81	1.6708	......	1.6284

(Emster, Z. anorg. 1907, **52.** 279.)

Sp. gr. of $HClO_4$+Aq.

Sp. gr.				% by wt. $HClO_4$ in the liquid
corrected		uncorrected		
20°	50°	20°	50°	
1.7676	1.7098	1.7716	1.7312	100
1.7817	1.7259	1.7858	1.7475	98.62
1.8059	1.7531	1.8100	1.7751	94.67
...	1.7690	...	1.7912	90.80
...	1.7756	...	1.7979	84.81
...	1.7619	...	1.7840	81.07
1.7386	1.7023	1.7425	1.7237	75.59
1.6471	1.6110	1.6508	1.6311	68.42
1.5353	1.5007	1.5386	1.5194	60.38
1.4078	1.3779	1.4108	1.3949	50.51
1.2901	1.2649	1.2927	1.2804	39.73
1.1778	1.1574	1.1800	1.1715	27.07

(v. Wyk, Z. anorg. 1905, **48.** 45.)

Bpt. of $HClO_4$+Aq. at atmospheric pressure.

% by wt. $HClO_4$ in the liquid	% by wt. $HClO_4$ in the vapor	Initial bpt.
72.4	72.4	203°
70.06	40.11	198.7
65.2	6.06	181.2
61.2	0.9	162.3
56.65	...	148.0
50.67	...	132.4
38.90	...	114.8
24.23	...	105.8
0.0	0.0	100

(v. Wyk, Z. anorg. 1905, **48.** 33.)

Bpt. of $HClO_4$+Aq. at 18 mm. pressure.

% by wt. $HClO_4$ in the liquid	Bpt.
100	16.0°
94.8	24.8
92.0	35
84.8	70
79.8	92
70.5	107

(v. Wyk, Z. anorg. 1905, **48.** 36.)

$+H_2O$. Deliquescent. (Roscoe, A. **121.** 346.)

$+2H_2O$. $HClO_4+2H_2O$ has 1.65 sp. gr. and boils at 200° (Serullas); has 1.72–1.82 sp. gr. and boils at 200° (Nativelle, J. pr. **26.** 405).

Sol. in alcohol with decomp.; often explosive.

$+2\frac{1}{2}H_2O$. (v. Wyck.)
$+3H_2O$. (v. Wyck.)
$+3\frac{1}{2}H_2O$. (v. Wyck.)

Perchlorates.

All perchlorates are sol. in H_2O, $KClO_4$, $RbClO_4$, and $CsClO_4$ somewhat difficultly. They are all deliquescent, and sol in alcohol, excepting NH_4ClO_4, $KClO_4$, $Pb(ClO_4)_2$, and $Hg_2(ClO_4)_2$. (Serullas, A. ch. (2) **46.** 296.)

Aluminum perchlorate, $Al(ClO_4)_3+6H_2O$.

Very deliquescent. (Weinland, Z. anorg. 1913, **84.** 370.)

Aluminum sodium perchlorate, $AlNa(ClO_4)_4+12H_2O$.

Sl. hygroscopic. (Weinland, Z. anorg. 1913, **84.** 370.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium perchlorate, NH_4ClO_4.

Permanent. Sol. in 5 pts. H_2O; somewhat sol. in alcohol. (Mitscherlich, Pogg. **25.** 300.)

Solubility of NH_4ClO_4 in H_2O at t°.

t°	G. per l. solution	Sp. gr.
0	115.63	1.059
20	208.45	1.098
40	305.77	1.128
60	390.50	1.158
80	481.86	1.193
100	570.06	1.216
107	591.15	1.221

(Carlson, Festsk. Stockholm. **1911.** 262.)

100 g. H_2O dissolve 18.5 g. NH_4ClO_4. (Hofmann, Höbald and Quoos, A. 1912, **386.** 304.)

100 g. sat. solution in H_2O contain 1.735 (17.35?) g. NH_4ClO_4 at 14.2°. (Thin and Cumming, Chem. Soc. 1915, **107.** 361.)

Insol. in conc. $HClO_4$+Aq.

100 g. sat. solution in 98.8% ethyl alcohol contain 1.96 g. NH_4ClO_4 at 25.2°. (Thin and Cumming.)

Sol. in acetone. Eidmann, C. C. **1899,** II. 1014.)

Barium perchlorate, $Ba(ClO_4)_2+4H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

$+3H_2O$. Solubility of $Ba(ClO_4)_2+3H_2O$ in H_2O at t°.

t°	G. per 100 g. H_2O	Sp. gr.
0	206	1.782
20	289	1.912
40	358	2.009
60	432	2.070
80	497	2.114
100	564	2.155
120	645	2.195
140	758	2.230

(Carlson, Festsk. Stockholm, **1911**. 262.)

Bismuth perchlorate, $(BiO)ClO_4$.

Insol. in H_2O. Easily sol. in HCl or HNO_3 +Aq, less easily in H_2SO_4+Aq. (Muir, C. N. **33.** 15.)

Cadmium perchlorate, $Cd(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 305.)

$+4H_2O$. (Salvadori, C. C. **1912,** II. 414.)

$+6H_2O$. (S.)

Cadmium perchlorate ammonia, $Cd(ClO_4)_2$, $6NH_3$.

$Cd(ClO_4)_2$, $4NH_3$. (Salvadori, C. C. **1912,** II. 414.)

Cæsium perchlorate, $CsClO_4$.

Very sl. sol. in H_2O. (Retgers, Z. phys. Ch. **8.** 17.)

Solubility in H_2O. 100 g. H_2O dissolve at:

8.5°	14°	33.7°	42°	50°	
0.91	1.19	2.99	4.09	5.47	g. $CsClO_4$,
60°	70°	84°	99°		
7.30	9.79	16.51	28.57	g. $CsClO_4$.	

(Calzolari, Acc. Sc. Med. Ferrara, 1911, **85.** 150.)

Solubility in H_2O at t°.

t°	G. per 100 g. H_2O	Sp. gr.
5	0.97	1.007
25	2.05	1.010
80	17.05	1.084

(Carlson, Festsk. Stockholm, **1911**. 262.)

Calcium perchlorate, $Ca(ClO_4)_2$.

Very deliquescent. Very sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 304.)

Cerous perchlorate, $Ce(ClO_4)_3+8H_2O$.

Very deliquescent. (Jolin.)

Chromic perchlorate, $Cr(ClO_4)_3+6H_2O$.

Very hygroscopic. (Weinland, Z. anorg. 1913, **84.** 371.)

$+9H_2O$. Can be cryst. from H_2O. (Weinland.)

Cobaltous perchlorate, $Co(ClO_4)_2+9H_2O$.

Solubility in H_2O at t°.

t°	G. anhydrous salt in 100 ccm.	Sp. gr. of sat. solution at t°/4°
−30.7	83.[illegible]4	...
−21.3	90.57	...
0	100.13	1.5639
+ 7.5	101.92	1.5658
18	103.80	1.5670
26	11[illegible].45	1.5811
45	115.10	1.5878

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) **11.** 146.)

$+6H_2O$. (Salvadori, Gazz. ch. it. 1912, **42.** (1) 458.)

Cobalt perchlorate ammonia, $Co(ClO_4)_2$ $6NH_3$.

$Co(ClO_4)_2$, $5NH_3$.

$Co(ClO_4)_2$, $4NH_3$, and $+2H_2O$.

$Co(ClO_4)_2$, $3NH_3$, and $+3H_2O$.

$Co(ClO_4)_2$, $3NH_3+2H_2O$.

(Salvadori, Gazz. ch. it. 1912, **42.** (1) 458.)

Cupric perchlorate, basic, $Cu(ClO_4)_2$, $Cu(OH)_2$.

Pp. (Salvadori, C. C. **1912,** II. 414.)

Cupric perchlorate, $Cu(ClO_4)_2$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 306.)

$+4H_2O$. (Salvadori, C. C. **1912,** II. 414.)

Cupric perchlorate ammonia, $Cu(ClO_4)_2$, $4NH_3+2H_2O$.

Not deliquescent. Sol. in NH_4OH+Aq. (Roscoe, A. **121.** 346.)

$Cu(ClO_4)_2$, NH_3+H_2O.

$Cu(ClO_4)_2$, $2CuO+2H_2O$, NH_3.

$Cu(ClO_4)_2$, $2CuO+2H_2O$, $2NH_3$.

$Cu(ClO_4)_2$, $Cu(OH)_2+2H_2O$, $6NH_3$.

$Cu(ClO_4)_2$, $Cu(OH)_2+2H_2O$, $4NH_3$.

(Salvadori, C. C. **1912,** II. 414.)

Didymium perchlorate, $Di(ClO_4)_3+9H_2O$.

Very deliquescent. Very sol. in H_2O and alcohol. (Cleve.)

Erbium perchlorate, $Er(ClO_4)_3+8H_2O$.

Very deliquescent.

Glucinum perchlorate, $Gl(ClO_4)_2+4H_2O$.

Very deliquescent, and sol. in H_2O. (Atterberg.)

Hydrazine perchlorate, $(N_2H_4)(HClO_4)_2+3H_2O$.

1 l. of sat. solution in H_2O contains 417.2 g. at 18°, sp. gr. = 1.264; 669 g. at 35°, sp. gr. = 1.391. (Carlson, Festsk. Stockholm, **1911.** 262.)

Indium perchlorate, $In(ClO_4)_3+8H_2O$.

Deliquescent. H_2O solution decomp. at 40° with separation of basic salt. Sol. in H_2O and easily forms sat. solutions. Sol. in abs. alcohol, but much less sol. in ether. (Mathers, J. Am. Chem. Soc. 1908, **30.** 212.)

Iodine perchlorate, $I(ClO_4)_3+2H_2O$.

Decomp. by H_2O. Indifferent toward organic solvents. (Fichter, Z. anorg. 1915, **91.** 135.)

Iron (ferrous) perchlorate, $Fe(ClO_4)_2$.

Tolerably permanent; sol. in H_2O. (Serullas, A. ch. **46.** 335.)

Iron (ferric) perchlorate, $Fe(ClO_4)_3$.

Sol. in H_2O. (Serullas.)

Iron (ferric) sodium perchlorate, $[Fe(ClO_4)_4]Na+6H_2O$.

Hydroscopic. Can be cryst. from H_2O. (Weinland, Z. anorg. 1913, **84.** 366.)

Lanthanum perchlorate, $La(ClO_4)_3+9H_2O$.

Extremely deliquescent. Sol. in H_2O and absolute alcohol. (Cleve.)

Lead perchlorate, basic, $2PbO$, $Cl_2O_7+2H_2O$.

Decomp. by H_2O into an insol. more basic salt, and sol. $Pb(ClO_4)_2$. (Marignac.)

Lead perchlorate, $Pb(ClO_4)_2+3H_2O$.

Permanent; extremely easily sol. in H_2O. (Roscoe, A. **121.** 356.)

Sol. in about 1 pt. H_2O. (Serullas.)

Lithium perchlorate, $LiClO_4$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas.)

$+3H_2O$. (Wyrouboff, Zeit. Kryst. **10.** 626.)

Magnesium perchlorate, $Mg(ClO_4)_2$.

Deliquescent, and sol. in H_2O and alcohol. (Serullas.)

$+6H_2O$. (Weinland, Z. anorg. 1913, **84.** 372.)

Manganous perchlorate, $Mn(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 335.)

$+6H_2O$. Sol. in 0.342 pts. H_2O. (Salvadori, C. C. **1912,** II. 414.)

Manganous perchlorate ammonia, $Mn(ClO_4)_2$, $5NH_3+H_2O$.

Sol. in HCl; insol. in HNO_3. (Salvadori, C. C. **1912,** II. 414.)

Mercurous perchlorate, $(HgClO_4)_2+4H_2O$.

Very sol. in H_2O. Gradually decomp. by H_2O. Decomp. by alcohol. (Chikashigé, Chem. Soc. 1895, **67.** 1016.)

$+6H_2O$. Very deliquescent. (Roscoe, A. **121.** 356.)

Permanent. (Serullas.)

Mercuric perchlorate, basic, HgO, $2Hg(ClO_4)_2$.

Anhydrous. Ppt. Insol. in either HCl or HNO_3. Decomp. and dissolved by a mixture of the two. (Chikashigé, Chem. Soc. 1905, **87.** 824.)

$+12H_2O$. Very sol. in H_2O. (Chikashigé.)

$2HgO$, $Hg(ClO_4)_2$.

α-salt. Decomp. by H_2O. Sol. in acids. (Chikashigé, Chem. Soc. 1895, **67.** 1015.)

β-salt. Insol. in H_2O; insol. in HCl or HNO_3. (Chikashigé, Chem. Soc. 1905, **87.** 825.)

Mercuric perchlorate, $Hg(ClO_4)_2$.

Very deliquescent. Sol. in H_2O; sl. sol. with decomp. in alcohol. (Serullas, A. ch. **34.** 243.)

$+6H_2O$. Very hygroscopic. Very sol. in H_2O. Slowly decomp. by H_2O, more easily by alcohol. (Chikashigé, Chem. Soc. 1895, **67.** 1014.)

Mercuric perchlorate bromide, $HgClO_4Br$.

Decomp. by H_2O. (Borelli, Gazz. ch. it. 1908, **38.** (2) 421.)

Mercuric perchlorate cyanide, $Hg(ClO_4)_2$, $Hg(CN)_2$.

Very sol. in H_2O. Sol. in alcohol. (Borelli.)

Mercuric perchlorate iodide, $Hg(ClO_4)I$.

Deliquescent. Decomp. by H_2O. Sol. in much alcohol. Decomp. by HNO_3. Completely sol. in KI or KCN+Aq. (Borelli.)

Mercuric perchlorate sulphocyanide, $Hg(ClO_4)_2$, $Hg(SCN)_2$.

Insol. in H_2O and conc. acids. Sol. in aqua regia. (Borelli.)

$+6H_2O$. (Salvadori, C. C. **1912,** II. 414.)

Nickel perchlorate, $Ni(ClO_4)_2$.

Deliquescent; easily sol. in alcohol and H_2O. (Groth, Pogg. **133.** 226.)

Solubility in H_2O at t°.

t°	G. anhydrous salt in 100 ccm.	Sp. gr. of the sat. solution
—30.7	89.98	...
—21.3	92.48	...
0	104.55	1.5726
+7.5	106.76	1.5755
18	110.05	1.5760
26	112.15	1.5841
45	118.60	1.5936

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) **11.** 147.)

$+5H_2O$. (Golblum and Terlikowsky.)
$+6H_2O$. (Salvadori, C. C. **1912**, II. 414.)
$+9H_2O$. (Golblum and Terlikowsky.)

Nickel perchlorate, ammonia, $Ni(ClO_4)_2$, $6NH_3$.

Ppt. (Salvadori.)

Nitrosyl perchlorate, $NO.O.ClO_3+H_2O$.

Ppt.; sl. hydroscopic; decomp. by H_2O. (Hofmann, B. 1909, **42.** 2032.)

Platinum perchlorate, $Pt_6ClO_9+15H_2O$.

Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Potassium perchlorate, $KClO_4$.

Sol. in 57.9 pts. H_2O at 21.3° (Longuinine, A **121.** 123); in 65 pts. H_2O at 15° (Serullas, A. ch. (2) **46.** 297); in 88 pts. H_2O at 10°; in 55 pts. H_2O at 100° (Hutstein, J. B. **1851.** 331.)

Solubility in H_2O.

1 pt. $KClO_4$ dissolves in 142.9 pts. H_2O at 6°, and solution has sp. gr. = 1.0005; in 52.5 pts. H_2O at 25°, and solution has sp. gr. = 1.0123; in 15.5 pts. H_2O at 50°, and solution has sp. gr. = 1.0181; in 5.04 pts. H_2O at 100°, and solution has sp. gr. = 1.0660. (Muir, C. N. **33.** 15.)

1 l. H_2O dissolves 78.07 millimols. $KClO_4$ at 10°; 120.4 millimols. at 20°; 179.9 millimols. at 30°. (Noyes and Sammet, Z. phys. Ch. 1903, **43.** 538.)

1 l. H_2O dissolves 0.1475 mol. $KClO_4$ at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Solubility in H_2O at t°.

t°	G. $KClO_4$ in 100 g. H_2O	t°	G. $KClO_4$ in 100 g. H_2O
0	0.70	50	6.45
10	1.14	70	12.3
15	1.54	99	22.2
20.5	1.90	..	...

(Calzolari, Acc. Sci. Med. Ferrara, 1911, **85.** 150.)

t°	G. per 100 g. H_2O	Sp. gr.
0	0.79	1.007
20	1.80	1.011
40	4.81	1.022
60	8.71	1.033
80	14.78	1.053
100	20.98	1.067

(Carlson, Festsk. Stockholm, **1911.** 262.)

1 l. H_2O dissolves 0.1481 equivalents $KClO_4$ at 25°. (Noyes and Boggs, J. Am. Chem. Soc. 1911, **33.** 1652.)

100 cc. of sat. solution of $KClO_4$ in H_2O contains 2.085 g. $KClO_4$ at 25.2°. (Thin and Cumming, Chem. Soc. 1915, **107.** 361.)

$KClO_4$ is sol. in 22.0 pts. H_2O at ord. temp., and 4.00 pts. at 100°; in 29.6 pts. NH_4OH+Aq (conc.) at ord. temp.; in 30.4 pts. NH_4OH+Aq (1 vol. conc.+3 vols. H_2O) at ord. temp.; in 22.4 pts. HNO_3+Aq (1 vol. conc.+5 vols. H_2O) at ord. temp., and 5.00 pts. at 100°; in 30.4 pts. HCl+Aq. (1 vol. conc.+4 vols. H_2O) at ord. temp.; 45.2 pts. $HC_2H_3O_2$+Aq (1 vol. commercial acid+1 vol. H_2O) at ord. temp.; in 24.4 pts. $NH_4C_2H_3O_2$+Aq. (dil. $HC_2H_3O_2$+dil. NH_4OH+Aq) at ord temp., and 6.00 pts. at 100°; in 25.6 pts. NH_4Cl+Aq (1 pt. NH_4Cl+ 10 pts. H_2O) at ord. temp, and 6.00 pts. at 100°; in 16.0 pts. NH_4NO_3+Aq (1 pt. NH_4NO_3+10 pts. H_2O) at ord. temp., and 4.00 pts. at 100°; in 25.6 pts. $NaC_2H_3O_2$+Aq (conc. $HC_2H_3O_2$+Na_2CO_3+4 vols. H_2O) at ord. temp., and 7.00 pts. at 100°; in 29.2 pts. $Cu(C_2H_3O_2)_2$+Aq (Stolba, Z. anal. **2.** 390) at ord. temp., and 7.00 pts. at 100°; in 27.2 pts. cane sugar (1 pt.+10 pts. H_2O) at ord. temp.; in 36.8 pts. grape sugar (1 pt.+10 pts. H_2O) at ord. temp. (Approximate.) (Pearson, Zeit. Chem. **1869.** 662.)

Solubility of $KClO_4$ in $HClO_4$ at 25.2°.

Normality of $HClO_4$	% $KClO_4$
0.01	1.999
0.10	1.485
1.00	0.527

(Thin and Cumming, Chem. Soc. 1915, **107.** 361.)

Solubility in KCl+Aq at 25°.

Concentration of KCl Equivalents per litre	Solubility of $KClO_4$ Equivalents per litre
0.04973	0.1282
0.09933	0.1123

(Noyes and Boggs, J. Am. Chem. Soc. 1911, **33.** 1652.)

Solubility in K_2SO_4+Aq at 25°.

Concentration of K_2SO_4 Equivalents per litre	Solubility of $KClO_4$ Equivalents per litre
0.04970	0.1315
0.09922	0.1181

(Noyes and Boggs.)

Very sl. sol. in abs. alcohol, and insol. if alcohol contains trace of an acetate. (Roscoe.) Insol. in alcohol of 0.835 sp. gr. (Schlösing, C. R. **73.** 1269.)

Sol. in 6400 pts. 97.2% alcohol; in 5000 pts. 95.8% alcohol; in 2500–3000 pts. 90% alcohol; in 25,000 pts. alcohol-ether (2 pts. 97% alcohol : 1 pt. ether). Practically insol.

in an alcoholic solution of $HClO_4$. (Wenze' Z. angew. Ch. **1891.** 691.)

Solubility of $KClO_4$ in ethyl alcohol+Aq at 25.2°.

Vol. % alcohol	G. $KClO_4$ sol. in 100 g. alcohol
51.2	0.754
93.5	0.051
98.8	0.019

(Thin and Cumming, Chem. Soc. 1915, **107.** 361.)

Solubility in organic compds.+Aq. at 25°.

Solvent	Mol. $KClO_4$ sol. in 1 litre
0.5–N methyl alcohol	0.1402
" ethyl alcohol	0.1356
" propyl alcohol	0.1343
" tert. amyl alcohol	0.1279
" acetone	0.1451
" ether	0.1336
" glycol	0.1416
" glycerine	0.1404
" urea	0.1510
" ammonia	0.1474
" diethylamine	0.1342
" pyridine	0.1410
" urethane	0.1400
" formamide	0.1539
" acetamide	0.1447
" acetic acid	0.1462
" phenol	0.1362
" methylal	0.1400
" methyl acetate	0.1429

(Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Potassium rubidium perchlorate, $KRb_2(ClO_4)_3$.

15.5 g. are contained in 1 l. solution sat. at 20°; sp. gr. = 1.013. (Carlson.)

Rubidium perchlorate, $RbClO_4$.

Sol. in 92.1 pts. H_2O at 21.3°. (Longuinine, A. **121.** 123.)

1 pt. sol. in 92.1 pts. H_2O at 21° as compared with 1 pt. $KClO_4$ sol. in 57.9 pts. H_2O at 21°. (Erdmann, Arch. Pharm. 1894, **232.** 23.)

Solubility in H_2O at t°.

t°	G. $RbClO_4$ in 100 g. H_2O	t°	G. $RbClO_4$ in 100 g. H_2O
0	2.46	42.2	14.94
8	3.50	50	19.40
19.8	6.28	77	41.65
30	9.53	99	76.5

(Calzolari, Acc. Sci. Med. Ferrara, 1911, **85.** 150.)

Solubility in H_2O at t°.

t°	G. in 100 g. H_2O	Sp. gr.
0	1.10	1.007
20	1.56	1.010
40	3.26	1.017
60	6.27	1.028
80	11.04	1.050
100	15.75	1.070

(Carlson, Festsk. Stockholm, **1911.** 262.)

Scandium perchlorate.

(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Silver perchlorate, $AgClO_4$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 307.)

Sodium perchlorate, $NaClO_4$.

Deliquescent, and very sol. in H_2O and alcohol. (Serullas.)

Not deliquescent. (Potilitzin, J. russ. Soc. **1889, 1.** 258.)

Solubility in H_2O at t°.

t°	G. in 1 l. of solution	Sp. gr.
15	1076	1.666
50	1234	1.731
143	1414	1.789

(Carlson, Festsk. Stockholm, **1911.** 262.)

$+H_2O$. Not deliquescent. (Potilitzin.)

Strontium perchlorate, $Sr(ClO_4)_2$.

Very deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 304.)

Terbium perchlorate.

Very sol. in H_2O and in alcohol. (Potratz, C. N. 1905, **92.** 3.)

Thallous perchlorate, $TlClO_4$.

1 pt. salt dissolves in 10 pts. H_2O at 15°, and 0.6 pt. at 100°. (Roscoe, Chem. Soc. (2) **4.** 504.)

Solubility in H_2O at t°.

t°	G. per 100 g. H_2O	Sp. gr.
0	6.00	1.060
10	8.04	1.075
30	19.72	1.146
50	39.62	1.251
70	65.32	1.430
80	81.49	1.520

(Carlson, Festsk. Stockholm, **1911.** **262.**)

Sl. sol. in alcohol. (Roscoe.)

Thallic perchlorate, $Tl(ClO_4)_3+6H_2O$.

Very hydroscopic, sol. in H_2O. Decomp. in moist air. (Gewecke, Z. anorg. 1912, **75.** 274.)

Uranyl perchlorate, $(UO_2)(ClO_4)_2+4H_2O$.

(Salvadori, Ch. Z. 1912, **36.** 513.)

$+6H_2O$. (Salvadori.)

Yttrium perchlorate, $Y(ClO_4)_3+8H_2O$.

Very deliquescent. Sol. in H_2O and alcohol. (Cleve.)

Zinc perchlorate, $Zn(ClO_4)_2$.

Deliquescent. Sol. in H_2O and alcohol. (Serullas, A. ch. **46.** 302.)

$+4H_2O$, and $6H_2O$. (Salvadori, C. C. **1912,** II. 414.)

Zinc perchlorate, ammonia, $Zn(ClO_4)_2, 4NH_3$

Ppt. (Salvadori, C. C. **1912,** II. 414.)

$Zn(ClO_4)_2, 6NH_3$. (Ephraim, B. 1915, **48.** 643.)

Perchromic acid.

Sol. in ethyl acetate and valerate; in amyl chloride, formate, acetate, butyrate, and valerate. (All give blue solutions.)

Insol. in CS_2, C_6H_6, $CHCl_3$, CCl_4, $C_6H_5NH_2$, $C_6H_5NO_2$ and toluene. (Grosvenor, J. Am. Chem. Soc. 1895, **17.** 41–43.)

$H_3CrO_8+2H_2O$. Decomp. above —30°. (Riesenfeld, B. 1914, **47.** 552.)

Ammonium perchromate, $(NH_4)_3CrO_8$.

Very unstable. Sl. sol. in cold H_2O. Decomp. by conc. H_2SO_4. Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50% H_2O. (Wohlers, B. 1905, **38.** 1888.)

CrO_4, $3NH_3$. Sol. in 10% NH_4OH+Aq; sol. in H_2O with decomp., insol. in other solvents. (Wiede, B. 1897, **30.** 2181.)

NH_4CrO_5, H_2O_2. Decomp. in the air. Sol. in ice cold H_2O, decomp. when warmed. Insol. in alcohol, ether, ligroin and $CHCl_3$. (Wiede, B. 1898, **31.** 518.)

Ammonium hydrogen perchromate, $CrO_2(O.O.NH_4)(O.OH)$.

Sol. in H_2O with decomp. Difficultly sol. in cold abs. alcohol. (Hofmann, B. 1904, **37.** 3406.)

Barium perchromate, $BaCr_2O_8$.

(Byers and Reid, Am. Ch. J. 1904, **32.** 513.)

Calcium perchromate, $CaCr_2O_8$.

Very sol. in H_2O. (Mylius, B. 1900, **33.** 3689; Byers and Reid, Am. Ch. J. 1904, **32.** 513.)

Lithium perchromate, $Li_2Cr_2O_8$.

(Byers and Reid, Am. Ch. J. 1904, **32.** 511.)

Magnesium perchromate, $MgCr_2O_8$.

(Byers and Reid.)

Potassium perchromate, K_3CrO_8.

Sl. sol. in cold H_2O. Decomp. by conc. H_2SO_4. Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50% H_2O. (Wohlers, B. 1905, **38.** 1888.)

$+xH_2O$. Sol. in H_2O at 0° without decomp. (Riesenfeld and Kutsch, B. 1908, **41.** 3948.)

$K_2Cr_2O_8$. Sol. in H_2O. Decomp. in the air. (Byers and Reid, Am. Ch. J. 1904, **32.** 505.)

$KCrO_5$, H_2O_2 or KH_2CrO_7. Sol. in ice cold H_2O, decomp. when warmed; explosive. (Wiede, B. 1898, **31.** 520.)

Sodium perchromate, Na_3CrO_8.

Sl. sol. in cold H_2O. Decomp. by conc. H_2SO_4. Insol. in pure alcohol and pure ether. Decomp. by boiling with alc. containing more than 50% H_2O. (Wohlers, B. 1905, **38.** 1888.)

$Na_6Cr_2O_{15}+28H_2O$. Efflorescent. Sl. sol. in cold, easily in hot H_2O, with decomp. Not decomp. by NaOH+Aq. (Häussermann, J. pr. (2) **48.** 70.)

$Na_2Cr_2O_8$. (Byers and Reid, Am. Ch. J. 1904, **32.** 511.)

Perchloroplatinocyanhydric acid, $H_2Pt(CN)_4Cl_2+4H_2O$.

Very sol. in H_2O and alcohol.

Ammonium perchloroplatinocyanide, $(NH_4)_2Pt(CN)_4Cl_2+2H_2O$.

Sol. in H_2O.

Barium ——, $BaPt(CN)_4Cl_2+5H_2O$.

Very sol. in H_2O.

Calcium ——, $CaPt(CN)_4Cl_2$.

Sol. in H_2O.

Magnesium ——, $MgPt(CN)_4Cl_2+xH_2O$.

Sol. in H_2O.

Manganous ——, $MnPt(CN)_4Cl_2+5H_2O$.

Sol. in H_2O and alcohol.

Potassium ——, $K_2Pt(CN)_4Cl_2+2H_2O$.

Very efflorescent, and sol. in H_2O and alcohol.

Percolumbic acid, $HCbO_4+nH_2O$.

Insol. in H_2O. Sol. with decomp. in warm H_2SO_4. (Melikoff, Z. anorg. 1899, **20.** 341.)

Cæsium percolumbate, Cs_3CbO_8.

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1658.)

Cæsium magnesium percolumbate, $MgCsCbO_8+8H_2O$.

Sol. in H_2O without decomp. (E. F. Smith.)

Calcium potassium percolumbate, $CaKCbO_8+4H_2O$.

Difficultly sol. in H_2O. (E. F. Smith.)

Calcium sodium percolumbate, $CaNaCbO_8+4H_2O$.

Difficultly sol. in H_2O. (E. F. Smith.)

Magnesium potassium percolumbate, $MgKCbO_8+7H_2O$.

Sol. in H_2O without decomp. (E. F. Smith.)

Magnesium rubidium percolumbate, $MgRbCbO_8+7\frac{1}{2}H_2O$.

Sol. in H_2O without decomp. (E. F. Smith.)

Magnesium sodium percolumbate, $MgNaCbO_8+8H_2O$.

Sol. in H_2O without decomp. (E. F. Smith.)

Potassium percolumbate, K_3CbO_8.

Sol. in H_2O. Ppt. from aq. solution by alcohol. (E. F. Smith.)

$K_4Cb_2O_{11}+3H_2O$. Sol. with decomp. in H_2O. Ppt. by alcohol. Sol. in $KOH+H_2O_2+Aq$. (Melikoff, Z. anorg. 1899, **20.** 342.)

Rubidium percolumbate, Rb_3CbO_8.

Sol. in H_2O. Insol. in alcohol. (E. F. Smith.)

Sodium percolumbate, Na_3CbO_8.

Sol. in H_2O. Insol. in alcohol. (E. F. Smith.)

Perferricyanhydric acid.

Potassium perferricyanide, $K_2Fe(CN)_6+H_2O$ (?).

Very hygroscopic, and sol. in H_2O. Nearly insol. in absolute alcohol. Decomp. by hot H_2O. (Skraup, A. **189.** 368.)

Periodic acid, H_5IO_6.

Deliquescent in moist air; very sol. in H_2O. (Bengieser, A. **17.** 254.)

Rather easily sol. in alcohol and ether. (Bengieser.)

Rather easily sol. in alcohol, less in ether. (Langtoch.)

Sl. sol. in alcohol, still less in ether. (Langlois, J. pr. **56.** 36.)

Sp. gr. of H_5IO_6+Aq.

$H_5IO_6+20H_2O=1.4008$.
$H_5IO_6+40H_2O=1.2165$.
$H_5IO_6+80H_2O=1.1121$.
$H_5IO_6+160H_2O=1.0570$.
$H_5IO_6+320H_2O=1.0288$.

(Thomsen, B. **7.** 71.)

Periodates.

Most periodates are insol. or sl. sol. in H_2O; all are insol. or very sl. sol. in alcohol, but they all dissolve in dil. HNO_3+Aq. (Bengieser.)

Aluminum ***meta*****periodate,** $Al(IO_4)_3+3H_2O$.

Stable in solution containing HNO_3. (Eakle, C. C. **1896.** II, 649.)

Ammonium ***meta*****periodate,** NH_4IO_4.

Sl. sol. in H_2O. Cryst. with $3H_2O$ (Ihre, B. **3.** 316), $2H_2O$ (Langlois, A. ch. (3) **34.** 257).

Stable in solution containing free ammonia. (Eakle, Zeit. Kryst. 1896, **26.** 258–88.)

100 pts. H_2O dissolve 2.7 pts. NH_4IO_4 at 16°; sp. gr. of sat. solution at 16°/4° = 1.0178. (Barker, Chem. Soc. 1908, **93.** 17.)

Ammonium ***dimeso*****periodate,** $(NH_4)_4I_2O_9+3H_2O$.

Sol. in H_2O. (Rammelsberg, Pogg. **134.** 379.)

Stable in solution containing free ammonia. Two modifications. (Eakle, Zeit. Kryst. 1896, **26.** 558–88; C. C. **1896.** II, 649.).

Ammonium lithium ***dimeso*****periodate,** $(NH_4)_2Li_2I_2O_9+7H_2O$.

Sol. in H_2O. (Ihre.)

Ammonium magnesium ***meso*****periodate,** $NH_4MgIO_5+3H_2O$.

Precipitate. (Rammelsberg, Pogg. **134.** 510.)

Barium ***meta*****periodate,** $Ba(IO_4)_2$.

Known only in solution.

Barium ***dimeso*****periodate,** $Ba_2I_2O_9$.

Sl. sol. in H_2O; easily sol. in dil. HNO_3+Aq. (Rammelsberg, Pogg. **134.** 391.)

Cryst. also with $3H_2O$, $5H_2O$, and $7H_2O$.

Barium ***meso*****periodate,** $Ba_3(IO_5)_2+6H_2O$.

(Ihre.)

Barium ***ortho*****periodate,** $Ba_5(IO_6)_2$.

Insol. in H_2O. Sol. in HNO_3+Aq. (Rammelsberg.)

Barium ***dimesodi*****periodate,** $Ba_5I_4O_{19}+5H_2O$.

Precipitate. Sol. in dil. HNO_3+Aq. (Rammelsberg, Pogg. **134.** 395.)

Barium periodate tungstate.

See **Tungstoperiodate, barium.**

Cæsium ***meta*****periodate,** $CsIO_4$.

Sl. sol. in cold H_2O; readily sol. in hot H_2O. (Wells, Am. Ch. J. 1901, **26.** 279.)

2.15 pts. are sol. in 100 pts. H_2O at 15°. Sp. gr. of the sat. aq. solution at 15°/4° = 1.0166. (Barker, Chem. Soc. 1908, **93.** 17.)

Cæsium periodate hydrogen fluoride, $2CsIO_4$, $3HF+H_2O$.

Sol. in 40–60% HF+Aq. Decomp. by H_2O. Efflorescent. (Weinland, Z. anorg. 1899, **22.** 263.)

Cadmium ***meta*****periodate,** $Cd(IO_4)_2$.

Ppt. (Rammelsberg, Pogg. **134.** 516.)

Cadmium ***dimeso*****periodate,** $Cd_2I_2O_9+9H_2O$.

Insol. in H_2O. (Rammelsberg.)

Cadmium ***meso*****periodate,** $Cd_3(IO_5)_2+5H_2O$

Ppt.

$CdHIO_5$. (Kimmins, Chem. Soc. **55.** 151.)

Cadmium ***di*****periodate,** $Cd_4I_2O_{11}+3H_2O$.

Insol. in H_2O. (Rammelsberg.)

Cadmium periodate, $Cd_{10}I_6O_{31}+15H_2O$.

Insol. in H_2O. (Rammelsberg.)

Calcium ***meta*****periodate,** $Ca(IO_4)_2$.

Sol. in H_5IO_6+Aq and acids. (Rammelsberg, Pogg. **134.** 405.)

Calcium ***dimeso*****periodate,** $Ca_2I_2O_9+7H_2O$, and $9H_2O$.

Sl. sol. in H_2O. (Rammelsberg.)

$+3H_2O$. (Langlois.)

Calcium ***ortho*****periodate,** $Ca_5(IO_6)_2$.

Insol. in H_2O. Sol. in HNO_3+Aq. (Rammelsberg, Pogg. **44.** 577.)

Cobaltous periodate, $7CoO$, $2I_2O_7+18H_2O$.

Attacked by HCl, and sol. on warming. Slowly but completely sol. in NHO_3. (Lautsch, J. pr. **100.** 89.)

Could not be obtained by Rammelsberg.

Cupric ***dimeso*****periodate,** $Cu_2I_2O_9+6H_2O$.

Decomp. by H_2O without dissolving. (Rammelsberg.)

Cupric ***ortho*****periodate,** Cu_2HIO_6.

Very sol. in HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 150.)

Cupric ***di*****periodate,** $Cu_4I_2O_{11}+H_2O$.

Insol. in H_2O; sol. in dil. HNO_3+Aq. (Rammelsberg.)

$+7H_2O$. (R.)

Cupric periodate, $5CuO$, $I_2O_5+5H_2O$.

Wholly insol. in H_2O. (Rammelsberg, B. **1.** 73.)

Didymium peroidate, $Di_2O_2(IO_4)_2$.

Precipitate.

$DiIO_5+4H_2O$. Ppt. (Cleve, Bull. Soc. (2) **43.** 362.)

Erbium periodate.

Sol. in H_2O. (Höglund.)

Glucinum periodate, $Gl_3(IO_5)_2+11H_2O$.

Decomp. by H_2O without dissolving. Easily sol. in HNO_3+Aq.

$+13H_2O$. Nearly insol. in H_2O. (Atterberg, B. **7.** 474.)

Iron (ferrous) ***ortho*****periodate,** $Fe_5(IO_6)_2$.

(Kimmins, Chem. Soc. **55.** 150.)

FeH_3IO_6 (Kimmins.)

Iron (ferric) periodate, $2Fe_2O_3$, $I_2O_7+21H_2O$.

Ppt. (Rammelsberg.)

Iron (ferric) ***dimeso*****periodate,** $FeHI_2O_9$.

Insol. in dil. HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 149.)

Iron (ferric) ***meta*****periodate,** $Fe(IO_4)_3$.

(Kimmins.)

Lanthanum periodate, $La(IO_4)_3+2H_2O$.

Precipitate. (Cleve.)

Lead ***meta*****periodate,** $Pb(IO_4)_2$.

Sol. in HNO_3+Aq. (Kimmins.)

Lead ***ortho*****periodate,** $Pb_3H_4(IO_6)_2$.

Sol. in HNO_3+Aq. (Kimmins, Chem. Soc. **55.** 149.)

Lead ***meso*****periodate,** $Pb_3(IO_5)_2+2H_2O$.

Insol. in H_2O or excess of periodic acid+Aq. Decomp. by dil. H_2SO_4+Aq. (Bengieser, A. **17.** 254.)

Lithium ***meta*****periodate,** $LiIO_4$.

Difficultly sol. in H_2O. (Rammelsberg, B. **1.** 132.)

Somewhat deliquescent.

$+H_2O$; sol. in H_2O. (Barker, Chem. Soc. 1911, **99.** 1326.)

Lithium ***dimeso*****periodate,** $Li_4I_2O_9+3H_2O$.

Very sl. sol. in H_2O. (Rammelsberg, Pogg. **134.** 387.)

Lithium ***ortho*****periodate,** Li_5IO_6.

H_2O dissolves out a slight amount of LiI. Easily sol. in HNO_3+Aq. (Rammelsberg, Pogg. **137.** 313.)

Magnesium ***meta*****periodate,** $Mg(IO_4)_2+10H_2O$.

Easily sol. in H_2O. (Rammelsberg.)

Magnesium ***di*****periodate,** $Mg_4I_2O_{11}+6H_2O$, or $9H_2O$.

Sl. efflorescent. Insol. in H_2O. (Rammelsberg.)

Magnesium *dimeso*periodate, $Mg_2I_2O_9+3H_2O$.

(Rammelsberg, Pogg. **134.** 499.)

$+15H_2O$. *Insol. in* H_2O. *Sol. in periodic* acid+Aq. (Langlois.)

Manganic periodate.

See **Manganiperiodic acid.**

Mercurous *di*periodate, $5Hg_2O$, I_2O_7, or $4Hg_2O$, $I_2O_7=Hg_8I_2O_{11}$.

Insol. in H_2O. Easily sol. in HNO_3+Aq and in HCl+Aq. (Lautsch, J. pr. **100.** 86.)

Mercuric *ortho*periodate, $Hg_5(IO_6)_2$.

Insol. in H_2O. Easily sol. in HCl. Sl. sol. in HNO_3. (Lautsch.)

Mercuric potassium periodate, 10HgO, $5K_2O$, $6I_2O_7$.

Insol. in H_2O. Difficultly sol. in warm HNO_3 without decomp. (Rammelsberg, Pogg. **134.** 526.)

Nickel *dimeso*periodate, $Ni_2I_2O_9$.

(Kimmins, Chem. Soc. **55.** 151.)

Nickel *meso*periodate, $Ni_3(IO_5)_2$.

(Kimmins.)

Nickel periodate, 7NiO, $4I_2O_7+63H_2O$.

Insol. in H_2O. Easily sol. in H_5IO_6+Aq. (Rammelsberg, Pogg. **134.** 514.)

Potassium *meta*periodate, KIO_4.

Sl. sol. in H_2O. Sol. in 290 pts. cold H_2O. (Rammelsberg, Pogg. **134.** 320.)

Almost insol. in KOH+Aq.

0.66 pt. is sol. in 100 pts. H_2O at 13°. Sp. gr. of the sat. sol. at 13°/4° = 1.0051. (Barker, Chem. Soc. 1908, **93.** 16.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Potassium *meso*periodate, $K_3IO_5+4H_2O$.

Deliquescent. Easily sol. in H_2O. (Ihre.)

Potassium *dimeso*periodate, $K_4I_2O_9+9H_2O$.

Sol. in 9.7 pts. cold H_2O. (Rammelsberg, Pogg. **134.** 320.)

Sol. in KOH+Aq.

$+3H_2O$.

Potassium hydrogen *dimeso*periodate, $K_3HI_2O_9$.

Less sol. in H_2O than KIO_4. (Kimmins, Chem. Soc. **51.** 356.)

Potassium manganic periodate.

See **Manganiperiodate, potassium.**

Potassium zinc periodate, K_2O, 4ZnO, $2I_2O_7+4H_2O$.

Ppt. (Rammelsberg, Pogg. **134.** 368.)

Potassium periodate tungstate.

See **Tungstoperiodate, potassium.**

***Rubidium* periodate,** $RbIO_4$.

0.65 pt. is sol. in 100 pts. H_2O *at 13°. Sp. gr. of the sat. aq. solution at 13°/4° = 1.0052.* (Barker, Chem. Soc. 1908, **93.** 16.)

Samarium periodate, $Sm(IO_5)+4H_2O$.

Precipitate. (Cleve.)

Silver *meta*periodate, $AgIO_4$.

Decomp. by cold H_2O into $Ag_4I_2O_9+3H_2O$, and by warm H_2O into $Ag_4I_2O_9+H_2O$. (Ammermüller and Magnus, Pogg. **28.** 516.)

$+H_2O$. Insol. ppt. (Kimmins.)

Silver *meso*periodate, Ag_3IO_5.

(Fernlunds, J. pr. **100.** 99.)

Ag_2HIO_5. Insol. ppt. (Kimmins, Chem. Soc. **51.** 358.)

Ppt. by dil. HNO_3; sol. in HNO_3. (Rosenheim, A. 1899, **308.** 57.)

Silver *dimeso*periodate, $Ag_4I_2O_9+H_2O$, or $3H_2O$.

Insol. ppt. (Kimmins.)

Decomp. by boiling H_2O into Ag_5IO_6. (Rammelsberg.)

Silver *ortho*periodate, Ag_5IO_6.

Sol. in HNO_3 or NH_4OH+Aq. (Rammelsberg, Pogg. **134.** 386.)

Sol. in excess NH_4OH+Aq; pptd. by HNO_3. (Rosenheim, A. 1899, **308.** 56.)

$Ag_3H_2IO_6$. Insol. ppt. (Kimmins, Chem. Soc. **51.** 358.)

$Ag_2H_3IO_6$. As above. (Kimmins.)

Sol. in dil. HNO_3. (Rosenheim, A. 1899, **308.** 53.)

Silver *di*periodate, $Ag_8I_2O_{11}$.

Sl. sol. in HNO_3+Aq; insol. in NH_4OH+Aq. (Lautsch, J. pr. **100.** 75.)

Silver *dimesodi*periodate, $Ag_{10}I_4O_{19}$.

HNO_3+Aq dissolves out Ag_2O. Insol. in NH_4OH+Aq. (Lautsch.)

Sodium *meta*periodate, $NaIO_4$.

Easily sol. in H_2O.

$+2H_2O$. (Langlois.)

$+3H_2O$. Efflorescent; sol. in 12 pts. H_2O at ord. temp. (Rammelsberg, J. pr. **103.** 278.)

Sodium *dimeso*periodate, $Na_4I_2O_9+3H_2O$.

Scarcely sol. in cold, sl. sol. in hot H_2O. (Magnus and Ammermüller, Pogg. **28.** 514.)

Very sol. in dil. HNO_3+Aq. (Langlois.)

Sol. in $HC_2H_3O_2$+Aq with decomp. (Bengieser, A. **17.** 254.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+4H_2O$.

Sodium *meso*periodate, $Na_3IO_5+{}^5/_4H_2O$.
Sol. in H_2O. (Ihre.)
$+H_2O = Na_3H_3IO_6$. Less sol. in H_2O than $Na_4I_2O_9 + 3H_2O (= Na_2H_3IO_6)$. (Kimmins, Chem. Soc. **51.** 357.)

Sodium *ortho*periodate, Na_5IO_6.
$Na_2H_3IO_6$. Correct composition for $Na_4I_2O_9+3H_2O$. (Kimmins.)
$Na_3H_2IO_6$. Correct composition for $Na_3IO_5+H_2O$. (Kimmins.)

Strontium *meta*periodate, $Sr(IO_4)_2+6H_2O$.
Sol. in H_2O.

Strontium *dimeso*periodate, $Sr_2I_2O_9$.
Decomp. by H_2O.
$+3H_2O$.

Strontium *meso*periodate, $Sr_3(IO_5)_2$.
Precipitate.

Strontium *ortho*periodate, $Sr_5(IO_6)_2$.
(Rammelsberg, Pogg. **44.** 577.)

Thallic periodate, $3Tl_2O_3$, $I_2O_7+30H_2O$.
Insol. in H_2O. Decomp. by alkalies. (Rammelsberg, B. **3.** 361.)

Thorium periodate.
Precipitate. Sol. in HNO_3+Aq.

Uranous periodate.
Precipitate, which quickly decomposes.

Ytterbium periodate, $YbIO_5+2H_2O$.
Hydroscopic. (Cleve, Z. anorg. 1902, **32.** 136.)

Yttrium periodate, $Y_2(IO_5)_2+8H_2O$.
Very slightly sol. (Cleve.)
$3Y_2O_3$, $2I_2O_7+6H_2O$. Precipitate. (Cleve.)

Zinc *dimeso*periodate, $Zn_2I_2O_9+6H_2O$.
(Rammelsberg, Pogg. **134.** 513.)

Zinc periodate, $3ZnO$, $2I_2O_7+7H_2O$.
(Langlois.)

Zinc *di*periodate, $Zn_4I_2O_{11}+H_2O$.
Easily sol. in H_2O, sl. acid with HNO_3. (Langlois, A. ch. (3) **34.** 257.)

Zinc *dimesodi*periodate, $Zn_5I_4O_{19}+14H_2O$ (?).
(Rammelsberg.)

Zinc periodate, $9ZnO$, $2I_2O_7+12H_2O$.
(Rammelsberg.)

Periodoplatinocyanhydric acid.

Barium periodoplatinocyanide, $BaPt(CN)_4I_2+xH_2O$.
Easily sol. in H_2O or alcohol. (Holst, Bull. Soc. (2) **22.** 347.)

Potassium periodoplatinocyanide, $K_2Pt(CN)_4I_2$.
Permanent. Easily sol. in H_2O or alcohol.

Permanganic acid, $HMnO_4$.

Known only in solution, which decomposes by evaporation or warming.

Permanganates.
All permanganates are sol. in H_2O, excepting $AgMnO_4$, which is sl. sol.

Ammonium permanganate, NH_4MnO_4.
Sol. in 12.6 pts. H_2O at 15°. (Aschoff.)
Sol. in H_2O with decomp. (Christensen, Z. anorg. 1900, **24.** 206.)

Barium permanganate, $Ba(MnO_4)_2$.
Sol. in H_2O.

Cadmium permanganate, $Cd(MnO_4)_2+8H_2O$.
Stable. (Klobb, Bull. Soc. 1894, (3) **11** 607.)

Cadmium permanganate ammonia, $Cd(MnO_4)_2$, $4NH_3$.
Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 510.)

Cæsium permanganate, $CsMnO_4$.
Sl. sol. in cold, somewhat more easily sol. in hot H_2O. (Muthmann, B. 1893, **26.** 1018.)
Solubility in H_2O.
100 ccm. of the sat. solution contain at:

1°	19°	59°
0.097	0.23	1.25 g. $CsMnO_4$.

(Patterson, J. Am. Chem. Soc. 1906, **28.** 1735.)

Calcium permanganate, $Ca(MnO_4)_2+5H_2O$.
Deliquescent.

Cupric permanganate.
Deliquescent.

Cupric permanganate ammonia, $Cu(MnO_4)_2$, $4NH_3$.

Sol. in H_2O with slow decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Didymium permanganate, $Di(MnO_4)_3+21H_2O$.

Sl. sol. in H_2O. (Frerichs and Smith, A. **191.** 331.)

Has not been prepared. (Cleve, B. **11.** 912.)

Lanthanum permanganate, $La(MnO_4)_3+21H_2O$.

Ppt. (Frerichs and Smith, A. **191.** 331.)

Has not been prepared. (Cleve, B. **11.** 910.)

Lead permanganate.

Sol. in HNO_3+Aq. (Forchhammer.)

Lithium permanganate, $LiMnO_4+3H_2O$.

Sol. in 1.4 pts. H_2O at 16°. (Aschoff.)

Magnesium permanganate, $Mg(MnO_4)_2$.

Insol. in $CHCl_3$, CCl_4, C_6H_6, toluene, nitrobenzene, ligroin, ether and CS_2. Sol. in methyl alcohol, acetone, pyridine, and readily sol. in glacial acetic acid. Only pyridine and glacial acetic acid are sufficiently stable toward the salt to be of any practical use for oxidation purposes. (Michael and Garner, Am. Ch. J. 1906, **35.** 268.)

$+6H_2O$. Easily deliquescent.

Nickel permanganate ammonia, $Ni(MnO_4)_2$, $4NH_3$.

Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Potassium permanganate, $KMnO_4$.

Sol. in 16 pts. H_2O at 15°. (Mitscherlich.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $KMnO_4$
0	2.83
9.8	4.31
19.8	6.34
24.8	7.59
29.8	9.03
34.8	10.67
40.0	12.56
45.0	14.58
50.0	16.89
55.0	19.33
65.0	25.03

(Baxter, J. Am. Chem. Soc. 1906, **28.** 1343.)

Solubility in H_2O at t°.

p = pts. $KMnO_4$ sol. in 100 pts. H_2O at t°.

t°	p	t°	p	t°	p	t°	p
0	2.76	19	6.26	38	11.74	57	20.29
1	2.90	20	6.48	39	12.12	58	20.83
2	3.06	21	6.70	40	12.51	59	21.39
3	3.22	22	6.94	41	12.91	60	21.96
4	3.38	23	7.18	42	13.31	61	22.55
5	3.54	24	7.42	43	13.72	62	23.15
6	3.70	25	7.68	44	14.14	63	23.76
7	3.86	26	7.94	45	14.56	64	24.38
8	4.04	27	8.20	46	15.00	65	25.01
9	4.22	28	8.48	47	15.44	66	25.67
10	4.40	29	8.77	48	15.88	67	26.34
11	4.58	30	9.07	49	16.32	68	27.03
12	4.78	31	9.37	50	16.77	69	27.84
13	4.98	32	9.69	51	17.23	70	28.56
14	5.18	33	10.01	52	17.71	71	29.30
15	5.38	34	10.34	53	18.21	72	30.05
16	5.60	35	10.68	54	18.71	73	30.81
17	5.82	36	11.02	55	19.23	74	31.57
18	6.04	37	11.38	56	19.75	74.5	31.95

(Worden, J. Soc. Chem. Ind. 1907, **26.** 453.)

Solubility in H_2O.

100 ccm. of the sat. solution contain at:

0°	15°	15.3°	30°
2.84	5.22	5.30	8.69 g. $KMnO_4$.

Sp. gr. of sat. solution at 15° = 1.035. (Patterson, J. Am. Chem. Soc. 1906, **28.** 1735.)

1 l. sat. $KMnO_4$+Aq contains at:

0°	10°	20°	30°	40°
0.176	0.278	0.411	0.573	0.792 mol. $KMnO_4$,

53°	63°	70°	75°
1.154	1.429	1.812	2.047 mol. $KMnO_4$.

(Sackur, Z. Elektrochem. 1912, **18.** 723.)

Solubility of $KMnO_4$ in H_2O at t°.

Grams $KMnO_4$ sol. in 100 grams H_2O	t°
0.58	— 0.18
1.01	— 0.27
2.02	— 0.48
2.91	— 0.58
4.22	+10
5.20	+15
7.53	+25
11.61	+40
16.75	+50

(Voerman, C. C. **1906,** I. 125.)

Sol. in conc. H_2SO_4. Deliquesces in liquid HCl, but does not dissolve. (Gore.)

Slowly sol. in H_3PO_4+Aq. (Chevillot and Edwards.)

Solubility in KOH+Aq at t° expressed in mol. per l. of the sat. solution.

t°	H_2O	1-n KOH	2-n KOH	4-n KOH	6-n KOH	8-n KOH	10-n KOH
0	0.176	0.050	0.031	0.027	0.023	0.017	0.012
10	0.278	0.112	0.068	0.048	0.042	0.028	0.016
20	0.411	0.179	0.119	0.079	19° 0.074	0.032	0.029
30	0.573	32° 0.316	32° 0.213	32° 0.149	0.114	32° 0.062	0.040
40	0.792	0.439	0.306	0.211	0.161	0.084	0.052
50	53° 1.154	50° 0.638	0.462	0.304	0.219	0.111	...
63	1.429	61° 0.904	60° 0.659	0.427	0.291	61° 0.143	0.071
70	1.812	1.172	0.869	0.572	0.396	0.188	0.082
75	2.047	....	....	0.651	....	...	0.089
80	....	1.513	1.190	....	0.500	0.231	...
84	....	1.655	1.352	83° 0.803	85° 0.572	....	...
90	....	...	...	.	0.649	0.297	..

(Sackur, Z. Elektrochem. 1912, **18.** 723.)

Solubility in salts+Aq. at t°.

Solvent	t°	Mol. $KMnO_4$ in 1 l. of sat. solution
0.1–n $\frac{K_2CO_3}{2}$	0 25 40	0.1462 0.4375 0.7380
1–n $\frac{K_2CO_3}{2}$	0 25 40	0.0629 0.2589 0.5007
2–n $\frac{K_2CO_3}{2}$	0 40	0.0446 0.3519
4–n $\frac{K_2CO_3}{2}$	0 25	0.0270 0.0930
6–n $\frac{K_2CO_3}{2}$	0	0.0156
0.1–n KCl	0 25 40	0.1395 0.4315 0.7380
0.5–n KCl	0 25 40	0.0760 0.3060 0.5840
1–n KCl	0 25 40	0.0532 0.220 0.444
2–n KCl	0 25 40	0.0379 0.1432 0.288

(Sackur, Z. Elektrochem. 1912, **18.** 723.)

Very sol. in liquid NH_3. (Moissan, A. ch. 1895 (7) **6.** 428; Franklin, Am. Ch. J. 1898, **20.** 829.)

Decomp. immediately by alcohol. Sol. in acetone. (Eidmann, C. C. **1899.** II, 1014; Naumann, B. 1904, **37.** 4328.)

Solubility in acetone+Aq. at 13°.

A = ccm. acetone in 100 ccm. acetone+Aq.
$^1/_5$ $KMnO_4$ = millimols $KMnO_4$ in 100 ccm. of the solution.

A	$^1/_5$ $KMnO_4$
0	148.5
10	162.2
20	177.3
30	208.2
40	257.4
50	289.7
60	316.8
70	328.0
80	312.5
90	227.0
100	67.6

(Herz and Knoch, Z. anorg. 1904, **41.** 317.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3795.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Rubidium permanganate, $RbMnO_4$.

Solubility in H_2O lies between K and Cs salts. (Muthmann, B. 1893, **26.** 1018.)

Solubility in H_2O.

100 ccm. of the sat. solution contain at:

2°	19°	60°
0.46	1.06	4.68 g. $RbMnO_4$.

(Patterson, J. Am. Chem. Soc. 1906, **28.** 1735.)

Silver permanganate, Ag_2MnO_4.

Sol. in 109 pts. cold H_2O and much less hot H_2O. Decomp. by boiling. (Mitscherlich, Pogg. **25.** 301.)

Silver permanganate ammonia.

Sl. sol. in cold, more easily in hot H_2O. (Klobb, C. R. **103.** 384.)

Sodium permanganate, $NaMnO_4+3H_2O$.

Deliquescent. Extremely sol. in H_2O. Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Strontium permanganate, $Sr(MnO_4)_2+4H_2O$.

Deliquescent. Sol. in H_2O. (Fromherz.)

Thallous permanganate, $TlMnO_4$.

Sol. in H_2O with decomp. (R. Meyer, Z. anorg. 1899, **22.** 188.)

Zinc permanganate, $Zn(MnO_4)_2+6H_2O$.

Deliquescent. Very sol. in H_2O. (Martenson, J. B. 1873. 274.)

Zinz permanganate ammonia, $Zn(MnO_4)_2$, $4NH_3$.

Sol. in H_2O with decomp. (Klobb, Bull. Soc. (3) **3.** 509.)

Permanganomolybdic acid, MnO_2, $12MoO_3+10H_2O$.

Sol. in H_2O. Decomp. by alkalis. Sol. in alcohol. (Péchard, C. R. 1897, **125.** 31.)

Ammonium permanganomolybdate, $2(NH_4)_2O$, MnO_2, $7MoO_3+5H_2O$.

(Friedheim and Samelson, Z. anorg. 1900, **24.** 73.)

$3(NH_4)_2O$, MnO_2, $9MoO_3+6H_2O$. (Friedheim and Allemann, Mit. d. Nat. Ges. Bern. **1904.** 23.)

$+7H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 70.)

$4(NH_4)_2O$, MnO_2, $11MoO_3+7H_2O$. (Friedheim and Samelson.)

$3(NH_4)_2O$, MnO_2, $12MoO_3+5H_2O$. Sl. sol. in cold H_2O. Decomp. by alkalis. Insol. in alcohol. (Péchard, C. R. 1897, **125.** 30.)

Ammonium manganous permanganomolybdate, $3[(NH_4)_2, Mn]O$, MnO_2, $9MoO_3+6H_2O$ and $+7H_2O$.

(Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. **1904.** 23.)

$3](NH_4)_2, Mn]O$, MnO_2, $10MoO_3+10H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 94.)

$4[(NH_4)_2, Mn]O$, MnO_2; $10MoO_3+6H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 75.)

$4[(NH_4)_2, Mn]O$, MnO_2, $11MoO_3+8H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 72.)

Ammonium manganous potassium permanganomolybdate, $2(NH_4)_2O$, MnO, K_2O, MnO_2, $10MoO_3+5H_2O$.

Very sl. sol. in cold, easily sol. in H_2O at 70–80°. (Rosenheim, Z. anorg. 1898, **16.** 79.)

$3[(NH_4)_2, K_2, Mn]O$, MnO_2, $9MoO_3+7H_2O$. (Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. **1904.** 23.)

$4[(NH_4)_2, K_2, Mn]O$, MnO_2, $10MoO_3+5H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 97.)

$3[(NH_4)_2, K_2, Mn]O$, MnO_2, $10MoO_3+6H_2O$, and $+10H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 92.)

Ammonium potassium permanganomolybdate, $3[(NH_4)_2, K_2]O$, MnO_2, $8MoO_3+4H_2O$.

(Friedheim and Samelson.)

Barium permanganomolybdate, $3BaO$, MnO_2, $9MoO_3+12H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 700.)

Manganous potassium permanganomolybdate, $2K_2O$, MnO, MnO_2, $9MoO_3+8H_2O$.

True formula for $5K_2O$, Mn_2O_3, $16MoO_3+12H_2O$ of Struve. (Friedheim and Samelson, Z. anorg. 1900, **24.** 86.)

$3[K_2,Mn]O$, MnO_2, $9MoO_3+6H_2O$. (Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. **1904.** 23.)

$2.6\ K_2O$, $0.4\ MnO$, MnO_2, $9MoO_3+7H_2O$. Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 700.)

$4[K_2, Mn]O$, MnO_2, $11MoO_3+7H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 80.)

Manganous potassium sodium permanganomolybdate, $3[K_2, Na_2, Mn]O$, MnO_2, $8MnO_3+4H_2O$.

(Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. **1904.** 48.)

Manganous sodium permanganomolybdate, $3[Na_2, Mn]O$, MnO_2, $9MoO_3+15H_2O$.

(Friedheim and Allemann.)

Potassium permanganomolybdate, $3K_2O$, MnO_2, $8MoO_3+3H_2O$.

Much less sol. in H_2O than NH_4 comp. (Friedheim and Samelson, Z. anorg. 1900, **24.** 78.)

$+5H_2O$. Nearly insol. in cold or hot H_2O. (Rosenheim and Itzig, Z. anorg. 1898, **16.** 81.)

$3K_2O$, MnO_2, $9MoO_3+5H_2O$. (Friedheim and Samelson, Z. anorg. 1900, **24.** 81.)

$+6H_2O$. (Hall, J. Am. Chem. Soc. 1907, **29.** 700.)

$3K_2O$, MnO_2, $12MoO_3+4H_2O$. Nearly insol. in cold H_2O. Decomp. by alkalis. Insol. in alcohol. (Péchard, C. R. 1897, **125.** 31.)

Silver permanganomolybdate, $3Ag_2O$, MnO_2, $9MoO_3+6H_2O$.

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29.** 700.)

Sodium permanganomolybdate, $3Na_2O$, MnO_2, $12MoO_3+13H_2O$.

Efflorescent. Very sol. in H_2O. Decomp. by alkalies. Insol. in alcohol. (Péchard, C. R. **125.** 31.)

Permanganotungstic acid.

Ammonium manganous permanganotungstate, $4(NH_4)_2O$, MnO, MnO_2, $12WO_3+23H_2O$.

Readily sol. in H_2O. Can be cryst. therefrom. (Rogers and Smith, J. Am. Chem. Soc. 1904, **26.** 1475.)

Sodium permanganotungstate, $3Na_2O$, MnO_2, $5WO_3+18H_2O$.

Rather easily sol. in hot H_2O. Solution decomp. on long boiling with separation of manganese peroxide. (Just, B. 1903, **36.** 3621.)

Permolybdic acid, Mo_2O_7, $5H_2O = HMoO_4+2H_2O$.

Very sol. in H_2O, and not decomp. by boiling. (Péchard, A. ch. (6) **28.** 550.)

$H_2MoO_5+1\frac{1}{2}H_2O$. "Ozo-molybdic acid." Only very sl. sol. in H_2O after being dried in the air. Sol. in fairly conc. H_2SO_4. (Muthmann, B. 1898, **31.** 1838.)

$H_2Mo_2O_7$, H_2O_2. Sl. sol. in cold, more easily sol. in hot H_2O, but does not separate on cooling. Sol. in dil. acids, also in H_3PO_4. (Cammerer, Ch. Z. 1891, **15.** 957.)

Ammonium permolybdate, $NH_4MoO_4+2H_2O$.

Very sol. in H_2O; sl. sol. in alcohol, but alcohol extracts it from H_2O, forming a very conc. supersat. solution, which is pptd. by a crystal of NH_4MoO_4, and only a sl amount remains in solution. (Péchard.)

$3(NH_4)_2O$, $5MoO_3$, $2MoO_4+6H_2O$. (Muthmann, B. 1898, **31.** 1837.)

$3(NH_4)_2O$, $7MoO_4+12H_2O$. Ppt. (Muthmann, Z. anorg. 1898, **17.** 76.)

$3(NH_4)_2O$, $5MoO_4+6H_2O$. Ppt. (Muthmann.)

Ammonium nickel permolybdate ammonia, $(NH_4)_2Ni(MoO_4)_2$, $2NH_3$.

Decomp. by H_2O. Sol. in dil. NH_4OH. (Briggs, Chem. Soc. 1904, **85.** 674.)

Barium permolybdate, $Ba(MoO_4)_2+2H_2O$.

(Péchard, A. ch. 1893, (6) **28.** 537.)

$8BaO$, $19MoO_3$, $2H_2O_2+13H_2O$. (Baerwald, Dissert. **1885.**)

Cæsium permolybdate, Cs_2O, $4MoO_4+6H_2O$.

Sol. hot H_2O. (Muthmann, B. 1898, **31.** 1841.)

$3Cs_2O$, $7MoO_3$, $3MoO_4+4H_2O$. Ppt. (Muthmann.)

Copper permolybdate, $Cu(MoO_4)_2+H_2O$.

Insol. in H_2O; easily sol. in acids. Sol. in NH_4OH+Aq with decomp. (Péchard.)

Magnesium permolybdate, $Mg(MoO_4)_2+10H_2O$.

Very sol. in H_2O; sl. sol. in alcohol. (Péchard.)

Mercurous permolybdate.

Insol in H_2O or NH_4NO_3+Aq. (Péchard.)

Potassium permolybdate, $KMoO_4+2H_2O$.

Sl. sol. in cold, more in hot H_2O. Sl. sol. in alcohol. (Péchard.)

K_2O, $2MoO_3$, MoO_4+3H_2O. Ppt. (Muthmann, Z. anorg. 1898, **17.** 77.)

K_2O_2, MoO_4, H_2O_2. Decomp. by H_2O. (Melikoff and Pissarjewsky, B. 1898, **31.** 2449.)

$K_2MoO_5+3H_2O$. Nearly insol. in cold, easily sol. in hot H_2O. (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, **40.** (2) 56.)

Rubidium permolybdates.

"Rubidium ozo-molybdate."

$3Rb_2O$, $10MoO_4+14H_2O$. Ppt.

Rb_2O, $2MoO_3$, MoO_4+3H_2O. May be recryst. from H_2O_2+Aq.

$3Rb_2O$, $5MoO_3$, $2MoO_4+6H_2O$. Ppt.

Rb_2O, $3MoO_3$, MoO_4+4H_2O. Ppt. (Muthmann, B. 1898, **31.** 1839–41.)

Silver permolybdate, $AgMoO_4$.

(Péchard.)

Sodium permolybdate, $NaMoO_4+3H_2O$.

Very sol. in H_2O; insol. in alcohol, but behaves similarly to K salt. (Péchard.)

Thallous permolybdate.

Insol. in H_2O. (Péchard, A. ch. 1893, (6) **28.** 559.)

Pernitric acid, NO_3.

See **Nitrogen** ***hex*oxide.**

Silver pernitrate, basic, $3Ag_2O_2$, $AgNO_5$.

Decomp. H_2O. (Mulder, R. t. c. 1898, **17.** 142.)

Perosmic acid.

Potassium perosmate (?).

Sol. in H_2O, but very easily decomp.

Peroxynitric acid.

Silver peroxynitrate.

Analysis of the black compound formed, under certain circumstances, in a silver voltameter when an aqueous solution of $AgNO_3$

is electrolyzed, points to the composition $3Ag_2O$, 5O, $AgNO_3$, perhaps $2Ag_3O_4$, $AgNO_3$ or $3Ag_2O_2$, $AgNO_5$. (Mulder, Chem. Soc. 1896, **70.** (2) 561.)

Peroxylaminesulphonic acid.

Potassium peroxylaminesulphonate, $N_2O_2(SO_3K)_4$.

Very unstable in H_2O. Very sl. sol. in cold H_2O. More stable in N/10 KOH+Aq.

100 pts. N/10 KOH+Aq dissolve 0.62 pt. of the salt at 3°; 6.6 pts. at 29°. (Haga, Chem. Soc. 1904, **85.** 86.)

Perstannic acid, $H_2Sn_2O_7$.

Known in colloidal state, sol. in H_2O. (Spring, Bull. Soc. (2) **51.** 180.)

Potassium perstannate, $KSnO_4+2H_2O$.

Sol. in H_2O. Insol. in alcohol. (Tanatar, B. 1905, **38.** 1185.)

Sodium perstannate, $NaSnO_4+2H_2O$.

Difficultly sol. in H_2O with decomp. (Tanatar.)

Persulphuric acid, S_2O_7.

See **Sulphur** *hept***oxide.**

$H_2S_2O_8$.

Sp. gr. of $H_2S_2O_8$+Aq.

Sp. gr. 14°/14°	% $H_2S_2O_8$	g. $H_2S_2O_8$ per l.
1.042	7.2	75
1.096	15.4	169
1.154	23.6	272
1.246	35.2	438

(Elbs and Schönherr, Z. Elektrochem. 1896, **2.** 245.)

Ammonium persulphate, $(NH_4)_2S_2O_8$.

Very sol. in H_2O. 100 pts. H_2O at 0° dissolve 58.2 pts. $(NH_4)_2S_2O_8$. (Marshall, Chem. Soc. **59.** 771.)

Solubility in H_2O equals 58% at 8°. (Moreau, C. C. **1901,** II. 56.)

100 pts. H_2O dissolve 65 pts. at ord. temp. (Elbs, J. pr. 1893, (2) **48.** 185.)

Ammonium lead persulphate, $(NH_4)_2Pb(SO_4)_3$.

Decomp. by H_2O. Almost insol. in cold H_2SO_4 of sp. gr.=1.7. Sl. sol. in H_2SO_4 (sp. gr.=1.7) at 50°. Sol. in fuming H_2SO_4 and in cold conc. HCl. Sol. in acetic acid, in Na acetate+Aq acidified with acetic acid and in excess of cold 20%NaOH+Aq. (Elbs, Z. Elektrochem. 1900, **7.** 346.)

Ammonium mercurous persulphate ammonia, $(NH_4)HgS_2O_8$, $2NH_3$.

Decomp. by H_2O. Insol. in dil. or conc., hot or cold H_2SO_4 or HNO_3. Sol. in HCl. (Tarugi, Gazz. ch. it. 1903, **33.** (1) 131.)

Barium persulphate, $BaS_2O_8+4H_2O$.

Very sol. in H_2O. 100 pts. H_2O at 0° dissolve 39.1 pts. BaS_2O_8, or 52.2 pts. $BaS_2O_8+4H_2O$. Sol. in absolute alcohol with pptn. of $BaS_2O_8+H_2O$. Insol. in alcohol. (Marshall.)

Cadmium persulphate ammonia, CdS_2O_8, $6NH_3$.

Sol. in H_2O. (Barbieri, Z. anorg. 1911, **71.** 350.)

Cæsium persulphate, $Cs_2S_2O_8$.

Sol. in H_2O. 8.71-8.98 pts. are sol. in 100 pts. H_2O at 23°. (E. F. Smith, J. Am. Chem. Soc. 1899, **21.** 935.)

Calcium persulphate.

Very sol. in H_2O. (Marshall, J. Soc. Chem. Ind. 1897, **16.** 396.)

Copper persulphate ammonia, CuS_2O_8, $4NH_3$.

Sol. in H_2O. (Barbieri, Z. anorg. 1911, **71.** 351.)

Lead persulphate, PbS_2O_8.

Decomp. by H_2O. Sl. sol. in H_2SO_4, and in pyrosulphuric acid. Sol. in cold conc. HCl. Insol. or sol. with decomp. in all ord. solvents. (Elbs, Z. Elektrochem. 1900, **7.** 345.)

Solubility of $Pb(SO_4)_2$ in H_2SO_4+Aq. at 22°. v=moles of H_2SO_4 per mole of H_2O; c=millimols $Pb(SO_4)_2$ in 1 l.

v	c	v	c
0.304	0.00	0.558	37.2
0.348	1.8	0.699	40.5
0.387	3.0	0.917	23.3
0.407	3.9	1.11	23.7
0.435	5.3	1.54	49.6
0.477	14.4	2.08	83.5
0.515	23.3	2.13	88.2

(Dolezalek and Finckli, Z. anorg. 1906, **51.** 321.)

$+3H_2O$. Deliquescent. Very sol. in H_2O. (Marshall.)

Lead potassium persulphate, $K_2Pb(SO_4)_3$.

Decomp. by H_2O. Almost insol. in cold H_2SO_4 of sp. gr.=1.7. Sl. sol. in H_2SO_4 (sp. gr.=1.7) at 50°. Sol. in fuming H_2SO_4, cold conc. HCl, excess of cold 20% NaOH+Aq, acetic acid, and in Na acetate+Aq acidified with acetic acid. (Elbs, Z. Elektrochem. 1900, **7.** 346.)

Nickel persulphate ammonia, NiS_2O_8, $6NH_3$.
Unstable in the air. Sol. in H_2O with decomp. (Barbieri, Z. anorg. 1911, **71.** 351.)

Potassium persulphate, $K_2S_2O_8$.
100 pts. H_2O at 0° dissolve 1.77 pts. $K_2S_2O_8$; more sol. in hot H_2O with very sl. decomp. Less sol. in H_2O than any other persulphate. (Marshall.)

Rubidium persulphate, $Rb_2S_2O_8$.
Sol. in H_2O. 3.32–3.49 pts. are sol. in 100 pts. H_2O at 22.5°. (E. F. Smith, J. Am. Chem. Soc. 1899, **21.** 934.)

Silver persulphate, basic, $5Ag_2O_2$, $2Ag_2SO_7$.
Decomp. by H_2O and acids. (Mulder, C. C. **1899.** I, 16.)

Sodium persulphate, $Na_2S_2O_8$.
Very sol. in H_2O. (Löwenherz.)

Strontium persulphate.
Very sol. in H_2O. (Marshall, J. Soc. Chem. Ind. 1897, **16.** 396.)

Thallium persulphate, $Tl_2S_2O_8$.
Very sol. in H_2O. (Smith, J. Am. Chem. Soc. 1898, **21.** 936.)

Zinc persulphate ammonia, ZnS_2O_8, $4NH_3$.
Sol. in H_2O. (Barbieri, Z. anorg. 1911, **71.** 350.)

Persulphomolybdic acid.

*See Per*sulphomolybdic acid.

Pertantalic acid, $HTaO_4+nH_2O$.

Ppt. (Melikoff, Z. anorg. 1899, **20.** 345.)

Cæsium pertantalate, Cs_3TaO_8.
Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1667.)

Calcium potassium pertantalate, $CaKTaO_8+4\frac{1}{2}H_2O$.
Insol. in cold H_2O; decomp. by hot H_2O. (Melikoff, Z. anorg. 1899, **20.** 347.)

Calcium sodium pertantalate, $CaNaTaO_8+4\frac{1}{2}H_2O$.
Difficultly sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1668.)

Magnesium potassium pertantalate, $MgKTaO_8+7H_2O$.
Somewhat sol. in H_2O. (E. F. Smith.)

Magnesium rubidium pertantalate, $MgRbTaO_8+9H_2O$.
Somewhat sol. in H_2O. (E. F. Smith.)

Magnesium sodium pertantalate, $MgNaTaO_8+8H_2O$.
Somewhat sol. in H_2O. (E. F. Smith.)

Potassium pertantalate, $K_3TaO_8+\frac{1}{2}H_2O$.
Sol. in H_2O with decomp.; sol. in $KOH+H_2O_2+Aq$; pptd. by alcohol. (Melikoff, Z. anorg. 1899, **20.** 346.)

Rubidium pertantalate, Rb_3TaO_8.
Somewhat sol. in H_2O. (E. F. Smith.)

Sodium pertantalate, $Na_3TaO_8+H_2O$.
Pptd. by alcohol. Sl. sol. in H_2O, decomp. on heating with H_2O. (Melikoff, Z. anorg. 1899, **20.** 348.)
$NaTaO_4+NaOTaO_4+13H_2O$. Sol. in H_2O_2+Aq; pptd. by alcohol. (Melikoff, Z. anorg. 1899, **20.** 349.)

Pertitanic acid.

Ammonium pertitanate, $(NH_4)_2O_2$, $TiO_3+H_2O_2$.
Fairly stable; decomp. rapidly in aq. solution. (Melikoff, B. 1898, **31.** 955.)

Barium pertitanate, BaO_2, TiO_3+5H_2O.
Sl. sol. in H_2O. (Melikoff and Pissarjewsky, Z. anorg. 1898, **18.** 59.)

Potassium pertitanate, K_2O_2, TiO_3, $K_2O_4+10H_2O$.
Stable at zero; deliquesces and decomp. at ordinary temp. (Melikoff, B. 1898, **31.** 680.)

Sodium pertitanate, Na_2O_2, TiO_3+3H_2O.
Sol. in H_2O. Pptd. in alcohol. (Melikoff, B. 1898, **31.** 955.)
$4Na_2O_2$, $Ti_2O_7+10H_2O$. Decomp. by H_2O. (Melikoff.)

Pertungstic acid.

Barium pertungstate, BaO, $2WO_3$, $O+6H_2O$.
Insol. in H_2O. Decomp. by acids. (Kellner, Dissert. **1909.**)

Cæsium pertungstate, $3Cs_2O$, $12WO_3$, $2O+12H_2O$.
Sl. sol. in cold, easily sol. in warm H_2O. (Kellner.)
$5Cs_2O$, $12WO_3$, $24O+11H_2O$.
Sl. sol. in H_2O. (Kellner.)

Calcium pertungstate, $3CaO$, $6WO_3$, $8O+8H_2O$.
Sol. in H_2O. (Kellner.)

Lithium pertungstate, Li_2O, $2WO_3$, $2O+6H_2O$.
Sl. sol. in H_2O. (Kellner.)
$3Li_2O$, $4WO_3$, $O+9H_2O$. Sol. in H_2O. (Kellner.)

Magnesium pertungstate, $2MgO, 4WO_3, 6O+9H_2O$.

Easily sol. in H_2O. (Kellner.)

Potassium pertungstate, K_2O_4, WO_4+H_2O.

Sol. in H_2O with decomp.; explodes in the air at 80°. (Melikoff, B. 1898, **31.** 634.)

$K_2O, 2WO_3, 4O+4H_2O$. Sol. in H_2O from which it is ppt. by alcohol and ether. (Kellner.)

$7K_2O, 10WO_3, 5O+22H_2O$. Very sl. sol. in H_2O. (Kellner.)

Rubidium pertungstate, $2Rb_2O, 4WO_3, O+3H_2O$.

Sol. in H_2O with slow decomp. (Kellner.)

$5Rb_2O, 12WO_3, 3O+12H_2O$. Insol. in H_2O. (Kellner.)

Sodium pertungstate, $NaWO_4+H_2O$.

Very sol. in H_2O. (Péchard, C. R. **112.** 1060.)

$+2H_2O$. Sol. in H_2O but easily decomp. (Kellner.)

$Na_2W_2O_9+6H_2O$. Sol. in H_2O and can be cryst. therefrom. (Pissarjewsky, Z. anorg. 1900, **24.** 113.)

$Na_2O_2, WO_4+H_2O_2, (Na_2O_2)WO_4+7H_2O$. Decomp. in the air. Sol. in H_2O with decomp. (Melikoff, B. 1898, **31.** 633.)

Na_2O_2, WO_4, H_2O_2. Very unstable. Decomp. in the air and by H_2O. (Melikoff.)

Strontium pertungstate, $SrO, 2WO_3, O+6H_2O$.

(Kellner.)

Peruranic acid, UO_6, xH_2O (?).

Known only in its salts.

Ammonium peruranate, $(NH_4)_2O_2, (UO_4)_2+8H_2O$.

Sol. in H_2O; decomp. by acids and by $Al(OH)_3$ in aq. solution. (Melikoff, B. 1897, **30.** 2904.)

Ammonium uranyl peruranate, $(NH_4)_2(UO_2)UO_8+8H_2O$ (?).

Easily sol. in H_2O. (Fairley, Chem. Soc. (2) **31.** 134.)

Barium peruranate, $BaUO_5$.

As K salt. (de Coninck, C. C. **1909,** I. 1970.)

$(BaO_2)_2UO_4+8H_2O$. Decomp. by H_2SO_4 and H_2CO_3. (Melikoff, B. 1897, **30.** 2905.)

$BaO_2(UO_4)_2+9H_2O$. Ppt. (Melikoff.)

Calcium peruranate, $CaUO_5$.

As K salt. (de Coninck.)

Calcium peruranate, $(CaO_2)_2UO_4+10H_2O$.

Ppt. (Melikoff, B. 1897, **30.** 2906.)

Copper peruranate, $(CuO_2)_2UO_4$.

Ppt. (Melikoff.)

Lead peruranate, $(PbO)_2UO_4, PbO, UO_3$.

Ppt. (Melikoff.)

Lithium peruranate, $(Li_2O_2)(UO_4)_2+8H_2O$.

Sol. in H_2O; decomp. by acids and by $Al(OH)_3$ in aq. solution; very unstable. (Melikoff.)

Nickel peruranate, $(NiO)_2UO_4$.

Ppt. (Melikoff.)

Potassium peruranate, $K_4UO_8+10H_2O$ (?).

Unstable. (Fairley.)

K_2UO_5. (de Coninck, C. R. 1909, **148.** 1769.)

$+3H_2O$. Decomp. by H_2O, HCl and dil. HNO_3. (Aloy, Bull. Soc. 1903, (3) **29.** 293.)

Silver peruranate, $Ag_2U_2O_{11}$ (?).

(Guyard, Bull. Soc. (2) **1.** 95.)

Does not exist. (Alibegoff, A. **233.** 117.)

Sodium peruranate, $Na_4UO_8+8H_2O$.

Sol. in H_2O. Sl. sol. in alcohol. (Fairley.)

Na_2UO_5. As K salt. (de Coninck, C. C. **1909,** I. 1970.)

$+5H_2O$. Decomp. by H_2O and HCl. (Aloy, Bull. Soc. 1903, (3) **29.** 293.)

$(Na_2O_2)_2UO_4+8H_2O$. Sol. in H_2O; decomp. by dil. HCl, H_2SO_4, and by $Al(OH)_3$ in aq. solution. (Melikoff, B. 1897, **30.** 2903.)

Sodium uranyl peruranate, $Na_2(UO_2)UO_8+6H_2O$ (?).

Sol. in H_2O. (Fairley.)

Pervanadic acid, HVO_4 (?).

Sol. in H_2O. (Pissarjewsky, C. C. **1902,** II. 565.)

Ammonium pervanadate, NH_4VO_4.

Sol. in H_2O_2+Aq; insol. in alcohol. (Scheuer Z. anorg. 1898, **16.** 294.)

$(NH_4)_3VO_6+2\frac{1}{2}H_2O$. Sol. in H_2O; insol. in alcohol. (Melikoff, B. 1909, **42.** 2292.)

$(NH_4)_4V_2O_{11}$. Sol. in H_2O_2+Aq; ppt. from aq. solution by alcohol. (Melikoff, Z. anorg. 1899, **19.** 406.)

Barium pervanadate, $Ba(VO_4)_2$.

Sl. sol. in H_2O_2+Aq free from H_2SO_4; insol. in alcohol. (Scheuer, Z. anorg. 1898, **16.** 288.)

Cadmium pervanadate, $Cd(VO_4)_2$.

Sl. sol. in H_2O_2+Aq; insol. in alcohol. (Scheuer.)

Calcium pervanadate, $Ca(VO_4)_2$.

Sol. in H_2O_2+Aq; insol. in alcohol. (Scheuer.)

Lead pervanadate, $Pb(VO_4)_2$.

Sl. sol. in H_2O_2+Aq free from H_2SO_4; insol. in alcohol. (Scheuer.)

Lithium pervanadate, $LiVO_4$.

Sol. in H_2O_2+Aq; insol. in alcohol. (Scheuer.)

Potassium pervanadate, KVO_4.

Sol. in H_2O_2+Aq acidified with H_2SO_4; insol. in alcohol. (Scheuer.)

$K_3VO_6+2\frac{1}{2}H_2O$. Sol. in H_2O; insol. in alcohol. (Melikoff, B. 1909, **42.** 2295.)

$3K_2O_2VO_4$, $2KVO_4+2H_2O$. 0.855 g. is sol. in 100 g. H_2O at 19°; sl. sol. in KOH+Aq; very stable in the air. (Melikoff and Pissarjewsky, Z. anorg. 1899, 19. 408.)

$K_4V_2O_{12}+2H_2O$. (Melikoff and Pissarjewsky, Z. anorg. 1899, **19.** 411.)

$K_4V_2O_{13}+3\frac{1}{2}H_2O$. Moderately sol. in H_2O with slow decomp. (Melikoff and Pissarjewsky, Z. anorg. 1899, **19.** 410.)

Silver pervanadate, $AgVO_4$.

Sl. sol. in H_2O_2+Aq free from H_2SO_4; sol. in alcohol. (Scheuer.)

Sodium pervanadate, $NaVO_4$.

Sol. in H_2O_2 acidified with H_2SO_4; insol. in alcohol. (Scheuer.)

Strontium pervanadate, $Sr(VO_4)_2$.

Sl. sol. in H_2O_2+Aq free from H_2SO_4; insol. in alcohol. (Scheuer.)

Philippium, Ph (?).

(Delafontaine, C. R. **87.** 559.)

Consists of terbium and yttrium. (Roscoe, B. **15.** 1274.)

Phosgene, $COCl_2$.

See **Carbonyl chloride.**

Phosphame, PN_2H (?).

Insol. in H_2O. Insol. in dil. HNO_3+Aq; gradually decomp. by conc. HNO_3. (Rose, Pogg. **24.** 308.)

Insol. in conc. HNO_3. (Pauli, A. **123.** 236.)

Sol. in H_2SO_4 with decomp. (Rose.)

Insol. in dil., but decomp. by conc. KOH or NaOH+Aq.

Insol. in alcohol or ether.

Formula is perhaps $P_3N_3H_4$. (Salzmann, B. **6.** 494.)

Phosphamic acid, $PO\begin{cases}NH\\OH.\end{cases}$

(Schiff.)

Does not exist, but was impure *pyro*phospho*di*amic acid. (Gladstone.) Also Mente (A. **248.** 245).

*Pyro*phosphamic acid, $P_2NH_5O_6 = P_2O_3(OH)_3NH_2$.

Deliquescent in moist air; easily sol. in H_2O or alcohol; sl. sol. in ether. (Gladstone, Chem. Soc. **3.** 152.)

Correct composition is imido*di*phosphoric acid, $P_2NH_4O_5 = HO{-}PO{<}{\substack{O\\NH}}{>}PO{-}OH$. (Mente, A. **248.** 232.)

Barium *pyro*phosphamate, $Ba_3(P_2NH_2O_6)_2$.

Sol. in HCl or HNO_3+Aq, not in $HC_2H_3O_2$+Aq. (Gladstone and Holmes, Chem. Soc. (2) **2.** 233.)

Cupric ——, $Cu_3(P_2NH_2O_6)_2+2H_2O$.

Ppt. Decomp. by cold KOH+Aq. (Gladstone, Chem. Soc. **3.** 135.)

Ferric ——, $Fe_2(P_2NH_2O_6)_2+2H_2O$.

Insol. in dil. acids. Sol. in conc. H_2SO_4, and decomp. by warming. Easily sol. in NH_4OH+Aq. Decomp. by KOH+Aq. (Gladstone, Chem. Soc. **3.** 1[illegible].)

Lead ——, $Pb_3(P_2NH_2O_6)_2+4H_2O$.

Insol. in NH_4OH+Aq.

Potassium ——, $K_3P_2NH_2O_6$.

Deliquescent. Sol. in H_2O. Insol. in alcohol. (Gladstone, A. **76.** 85.)

Silver ——, $Ag_3P_2NH_2O_6+5H_2O$.

Ppt.

Zinc ——, $Zn_3(P_2NH_2O_6)_2$.

(Gladstone and Holmes, Chem. Soc. (2) **2.** 225.)

Phosphamide, PON.

See **Phosphoryl nitride.**

PN_2H_3O.

See **Phosphoryl imidoamide.**

***Tri*phosphamide,** PON_2H_6.

See **Phosphoryl *tri*amide.**

*Trimeta*phosphimic acid, $P_3N_3H_6O_6$.

Sol. in H_2O; aq. solution does not coagulate albumen. (Stokes, Am. Ch. J. 1895, **17.** 275.)

Ammonium *trimeta*phosphimate, $(NH_4)_3P_3N_3O_6H_3$.

Sol. in H_2O, insol. in alcohol; unstable. (Stokes, Am. Ch. J. 1896, **18.** 643.)

Barium *trimeta*phosphimate, $Ba_3(P_3N_3O_6H_3)_2+4H_2O$.

$+6H_2O$. Sl. sol. in H_2O. Easily sol. in NH_4Cl+Aq and in NaCl+Aq. (Stokes.)

Barium sodium ***trimeta*****phosphimate,** $P_3N_3O_6H_3NaBa+1\frac{1}{2}H_2O$.

Almost insol. in H_2O; easily sol. in NH_4Cl+Aq and in $NaCl+Aq$. (Stokes.)

Magnesium ***trimeta*****phosphimate,** $(P_3N_3O_6H_3)_2Mg_3$ (?).

Sol. in H_2O; insol. in alcohol; aq. solution decomp. on boiling. (Stokes.)

Potassium ***trimeta*****phosphimate,** $K_3P_3N_3O_6H_3$.

Sol. in H_2O; insol. in alcohol. (Stokes.)

Silver ***trimeta*****phosphimate,** $Ag_3P_3N_3O_6H_3$.

Ppt.; sol. in NH_4OH+Aq; insol. in H_2O; sl. sol. in HNO_3+Aq. (Stokes.)

α **Sodium** ***trimeta*****phosphimate,** $P_3N_3O_6H_3Na_3+4H_2O$.

18.3 pts. are sol. in 100 pts. H_2O at 20°; very sol. in hot H_2O; decomp. by alkali on long boiling. (Stokes.)

β **Sodium** ***trimeta*****phosphimate,** $P_3N_3O_6H_3Na_3+H_2O$.

Sol. in H_2O; insol. in alcohol. (Stokes.)

*Tetrameta*phosphimic acid,

$P_4N_4O_8H_8+2H_2O$.

Very sl. sol. in H_2O; decomposes the sol. salts of HCl, H_2SO_4 and HNO_3. (Stokes, Am. Ch. J. 1895, **17.** 290.)

100 pts. H_2O at 20° dissolve 0.64 pt. crystallized acid. Somewhat more sol. in boiling H_2O. (Stokes.)

100 pts. 10% HNO_3+Aq at 20° dissolve 0.26 pt. of crystallized acid. (Stokes.)

Not decomp. by boiling alkalies+Aq. (Stokes, Am. Ch. J. 1896, **18.** 785.)

Insol. in alcohol. (Stokes, Am. Ch. J. 1896, **18.** 784.)

Ammonium ***tetrameta*****phosphimate,** $P_4N_4O_8H_6(NH_4)_2$.

Only sl. sol. in boiling H_2O; sol. in excess of hot 5% HNO_3. (Stokes.)

$P_4N_4O_8H_4(NH_4)_4+4H_2O$. Readily sol. in H_2O; sl. sol. in NH_4OH+Aq. (Stokes.)

Barium ***tetrameta*****phosphimate,** $P_4N_4O_8H_4Ba_2+2H_2O$.

Ppt.; insol. in H_2O. (Stokes.)

Potassium ***tetrameta*****phosphimate,** $P_4N_4O_8H_6K_2$.

Sl. sol. in boiling H_2O; sol. in cold dil. $KOH+Aq$. (Stokes.)

$P_4N_4O_8H_4K_4$ (?). Very sol. in H_2O. (Stokes.)

Silver ***tetrameta*****phosphimate,** $P_4N_4O_8H_4Ag_4$.

Ppt.; insol. in H_2O; sl. sol. in HNO_3+Aq. (Stokes.)

$P_4N_4O_8Ag_8$. Ppt.; sol. in NH_4NO_3+Aq. (Stokes.)

Sodium ***tetrameta*****phosphimate,** $P_4N_4O_8H_4Na_4+2\frac{1}{2}$ (?) H_2O.

Sl. sol. in cold H_2O. Easily sol. in hot H_2O. Ppt. from aqueous solution by excess of alkali. (Stokes.)

*Pentameta*phosphimic acid,

$$PO.(OH)\begin{matrix}\diagup NH.PO.(OH)NH.PO(OH)\diagdown \\ \diagdown NH.PO.(OH)NH.PO(OH)\diagup\end{matrix}NH$$
$=H_{10}P_5N_5O_{10}$.

Sol. in H_2O; pptd. by alcohol. (Stokes, Am. Ch. J. 1898, **20.** 748.)

Magnesium ***pentameta*****phosphimate,** $(P_5N_5O_{10}Hg)_2Mg$.

Ppt. (Stokes.)

$P_5N_5O_{10}H_6Mg_2+5H_2O$. Ppt., insol. in alcohol; almost insol. in H_2O; sl. sol. in conc. acetic acid. (Stokes.)

Silver ***pentameta*****phosphimate,** $P_5N_5O_{10}H_5Ag_5$.

Ppt., sol. in cold $KOH+Aq$ with decomp. (Stokes.)

Sodium ***pentameta*****phosphimate,** $P_5N_5O_{10}H_5Na_5+2H_2O$.

Sol. in H_2O; insol. in alcohol. (Stokes.)

$P_5N_5O_{10}H_6Na_4+2H_2O$. Sol. in 80% acetic acid; pptd. by alcohol. (Stokes.)

*Hexameta*phosphimic acid.

Silver ***hexameta*****phosphimate,** $P_6N_6O_{12}H_6Ag_6$.

Ppt.; decomp. by cold $KOH+Aq$. (Stokes, Am. Ch. J. 1898, **20.** 757.)

Sodium ***hexameta*****phosphimate,** $P_6N_6O_{12}H_6Na_6+2H_2O$.

Sol. in H_2O; pptd. by alcohol. (Stokes.)

Phosphine.

See **Hydrogen phosphide.**

*Pyro*phospho*di*amic acid,

$P_2N_2H_6O_5=P_2O_3(OH)_2(NH_2)_2$.

Deliquescent. Easily sol. in H_2O, alcohol, or ether. Sol. in cold conc. H_2SO_4 without decomp. (Gladstone, Chem. Soc. **3.** 353.)

Correct composition is *di*imido*di*phosphoric acid, $P_2N_2H_4O_4+H_2O=HO—PO=(NH)_2=PO—OH$. (Mente.)

Aluminum ***pyro*****phospho*****di*****amate.**

Precipitate. Sol. in NH_4OH+Aq. Insol. in acids. (Gladstone, A. **76.** 82.)

Ammonium ——, $P_2O_3\begin{matrix}(ONH_4)_2\\(NH_2)_2\end{matrix}$.

Very deliquescent in moist air. Sol. in H_2O. (Schiff, A. **103.** 168.)

Barium *pyro*phospho*di*amate, $BaP_2O_5(NH_2)_2$.

Precipitate. Sl. sol. in H_2O. Sol. in NH_4OH+Aq. (Gladstone.)

Calcium ——, $CaP_2O_5(NH_2)_2$.

Insol. in NH_4OH+Aq. Sol. in NH_4Cl+Aq and acids. (Gladstone and Holmes.)

Lead ——.

Ppt. Decomp. by H_2O.

Magnesium ——.

Ppt. (Gladstone and Holmes.)

Silver ——, $Ag_2P_2O_5(NH_2)_2$.

Sl. sol. in H_2O. Sol. in HNO_3+Aq. (Gladstone and Holmes.)

Strontium ——.

Sol. in acids and NH_4Cl+Aq. Insol. in NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4.** 295.)

Zinc ——, $ZnP_2O_5(NH_2)_2$.

Ppt. (Gladstone and Holmes.)

***Pyro*phospho*tri*amic acid,** $P_2N_3H_7O_4 = P_2O_3{}^{OH}_{(NH_2)_3}$.

Decomp. by boiling H_2O or HCl. Sol. in conc. H_2SO_4 upon heating. (Gladstone and Holmes.)

Correct formula is $HO—PO<{}^{NH}_{NH}>PO—NH_2$ = *di*imido*di*phospho*mon*amic acid. (Mente, A. **248.** 241.)

Ammonium *pyro*phospho*tri*amate, $P_2O_3{}^{ONH_4}_{(NH_2)_3}$.

Insol. in H_2O. (Gladstone and Holmes.)

Barium ——, $BaP_2N_3H_5O_4$.

$BaH_2(P_2N_3H_5O_4)_2$. Decomp. by $HCl+Aq$. (Gladstone, Chem. Soc. **4.** 6.)

Cobaltous ——, $CoP_2N_3H_5O_4$.

Slowly decomp. by dil. H_2SO_4+Aq, not by $HCl+Aq$. (Gladstone and Holmes, Chem. Soc. (2) **4.** 1.)

Cupric ——, $CuP_2N_3H_5O_4$.

Insol. in H_2O or NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4.** 1.)

Ferrous ——, $FeH_6(P_2N_3H_3O_4)_2$.

Insol. in dil. acids. (Gladstone, Chem. Soc. (2) **4.** 1.)

Lead ——, $H_2Pb_3(P_2N_3H_3O_4)_2$.

Ppt. (Gladstone and Holmes, Chem. Soc. (2) **4.** 1.)

$H_4Pb_2(P_2N_3H_3O_4)_2$. Ppt. (G. and H.)
$H_6Pb(P_2N_3H_3O_4)_2$. (G. and H.)

Mercuric *pyro*phospho*tri*amate, $Hg_2P_2N_3H_3O_4$.

Insol. in H_2O or dil. HCl or HNO_3+Aq. (Gladstone and Holmes, Chem. Soc. (2) **4.** 1.)

Platinum ——, $Pt_2P_2N_3H_3O_4$.

Decomp. by H_2O when freshly pptd. (G. and H.)

Potassium ——, $KP_2N_3H_6O_4$.

Almost insol. in H_2O. (Gladstone, Chem. Soc. **4.** 10.)

Silver ——, $Ag_3P_2N_3H_4O_4$.

Ppt. Sl. attacked by $HC_2H_3O_2$; decomp. by HNO_3 or NH_4OH+Aq into—

$AgH_2P_2N_3H_4O_4$. Insol. in H_2O. Decomp. by HCl. (Gladstone, Chem. Soc. (2) **4.** 1.)

Zinc ——.

Insol. in H_2O. (Gladstone and Holmes.)

***Tetra*phospho*di*amic acid,** $P_4N_2H_8O_{11} = P_4O_7{}^{(OH)_4}_{(NH_2)_2}$.

Known only as NH_4 salt.

Ammonium *tetra*phospho*di*amate, $P_4O_7{}^{O_4H(NH_4)_3}_{(NH_2)_2}$.

Very deliquescent, and sol. in H_2O. (Gladstone.)

Ammonium *di*hydrogen *tetra*phospho*di*amate, $P_4N_4H_{16}O_{12} = P_4O_7{}^{O_4H_2(NH_4)_2}_{(NH_2)_2}$ (?).

Insol. in cold, easily sol. in hot H_2O and dil. acids. (Gladstone.)

***Tetra*phospho*tetra*mic acid,** $P_4N_4H_{10}O_9 = P_4O_7{}^{(OH)_2}_{(NH_2)_4}$.

Sol. in H_2O. Insol. in alcohol. (Gladstone.)

Ammonium *tetra*phospho*tetra*mate, $P_4O_7{}^{(O_2HNH_4)}_{(NH_2)_4}$.

Sol. in H_2O, and precipitated from solution by alcohol. (Gladstone.)

Silver ——, $Ag_6P_4N_4H_4O_9$.

Ppt.

$Ag_2H_4P_4N_4H_4O_9$. Ppt.

Ammonium phosphoarseniovanadicovanadiotungstate.

See **Arseniophosphovanadicovanadiotungstate, ammonium.**

_Tetra_phospho_penta_zotic acid,
$P_4N_5H_9O_7 = P_4O_7{(NH_2)_4 \atop NH.}$

Insol. in H_2O. Decomp. gradually by boiling with H_2O. (Gladstone.)

Ammonio_tetra_phospho_penta_zotic acid (?),
$P_4O_7{(NH_2)_4 \atop NH.NH_3.}$

Decomp. by H_2O. (Gladstone.)

Cupric _tetra_phospho_penta_zotate.
(Gladstone, Chem. Soc. (2) **6.** 261.)

Lead ——.
(Gladstone, Chem. Soc. (2) **6.** 261.)

Potassium ——, $KOP_4N_5H_8O_6$.
Insol. in H_2O. (Gladstone, Chem. Soc. (2) **6.** 268.)

Phosphoboric acid, H_3BO_3, $H_3PO_4 = BPO_4 + 3H_2O$.

Not decomp. by boiling H_2O or conc. acids. Sol. in boiling solution of caustic alkalies. (Vogel, N. Repert. Pharm. **18.** 611.)

Phosphochloroplatinous acid,
$P(OH)_3$, $PtCl_2$.

See **Chloroplatinophosphoric acid.**

Phosphochromic acid.

Ammonium phosphochromate, $3(NH_4)_2O$, P_2O_5, $8CrO_3 + H_2O$.

Sol. in H_2O with decomp. (Friedheim, Z. anorg. 1894, **6.** 284.)

Potassium phosphochromate, $2K_2O$, P_2O_5, $4CrO_3 + H_2O$.

Sol. in H_2O but cannot be cryst. therefrom without decomp. Can be cryst. without decomp. from H_2O containing phosphoric acid. (Friedheim.)

$3K_2O$, P_2O_5, $8CrO_3$. Sol. in H_2O but cannot be cryst. therefrom without decomp. (Blondel, C. R. 1894, **118.** 194.)

Phosphohypophosphotungstic acid.

Potassium sodium phosphohypophosphotungstate, $9K_2O$, Na_2O, $4P_2O_5$, $2PO_2H_3$, $26WO_3 + 23H_2O$.

Precipitate. Easily sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

_Tetra_phospho_tetr_imidic acid,
$P_4N_4H_6O_7 = P_4O_7{(NH_2)_2 \atop (NH)_2.}$

Known only in its salts. (Gladstone.)

Silver _tetra_phospho_tetr_imidate.
Ppt. (Gladstone.)

Phosphoiodic acid, P_2O_5, $18I_2O_5 + 4H_2O$.

Decomp. by H_2O. (Chrétien, A. ch. 1898, (7) **15.** 389.)

Ammonium phosphoiodate, $4(NH_4)_2O$, P_2O_5, $18I_2O_5 + 12H_2O$.

Sol. in H_2O. Sl. sol. in conc. H_3PO_4+Aq. (Chrétien.)

Lithium phosphoiodate, $3Li_2O$, P_2O_5, $18I_2O_5 + 11H_2O$.

Sol. in H_2O. Sl. sol. in conc. H_3PO_4+Aq. (Chrétien.)

Potassium phosphoiodate, $4K_2O$, P_2O_5, $18I_2O_5 + 5H_2O$.

Decomp. by a small amt. of H_2O; sol. in a large amt. Sl. sol. in conc. H_3PO_4+Aq. (Chrétien.)

Sodium phosphoiodate, $6Na_2O$, P_2O_5, $18I_2O_5 + 5H_2O$.

Sol. in H_2O. Sl. sol. in conc. H_3PO_4+Aq. (Chrétien.)

Phosphoiridic acid.

See **Chlorophosphoiridic acid.**

Phospholuteotungstic acid, $H_5PW_8O_{29}$.

See under **Phosphotungstic acid.**

Phosphomolybdic acid, P_2O_5, $18MoO_3 + xH_2O$.

"Phospholuteomolybdic acid."

Deliquescent. Sol. in H_2O in all proportions. (Kehrmann, Z. anorg. 1894, **7.** 418.)

$3H_2O$, P_2O_5, $20MoO_3 + 21H_2O$. Very sol. in H_2O. Sol. in ether. By evaporation of H_2O solution crystals with $44H_2O$, or from a strong solution in conc. HNO_3+Aq, with $19H_2O$, are obtained; also crystals with 38, and $48H_2O$ are known. (Debray, C. R. **66.** 704.)

According to Rammelsberg (B. **10.** 1776) formula is $3H_2O$, P_2O_5, $22MoO_3$.

According to Gibbs (Am. Ch. J. **3.** 317) formula is $3H_2O$, P_2O_5, $24MoO_3 + 59H_2O$.

Finkener (B. **11.** 1638) gives the formula as $3H_2O$, P_2O_5, $24MoO_3 + 58H_2O$, also with $29H_2O$.

P_2O_5, $20MoO_3 + 52H_2O$. Sol. in dry ether with evolution of heat, and subsequent separation into two layers, the upper consisting of pure ether, and lower of a solution of acid in ether. Sp. gr. of lower layer, when sat. at 13°, is 1.3. On warming lower layer, ether separates out and forms an upper layer. This redissolves on cooling and shaking. The lower layer is insol. in H_2O and miscible with alcohol.

100 pts. ether thus dissolve 80.6 pts. acid at 0°; 84.7 pts. at 8.1°; 96.7 pts. at 19.3°; 103.9 pts. at 27.4°; 107.9 pts. at 32.9°. (Parmentier, C. R. **104.** 688.)

P_2O_5, $22MoO_3+57H_2O$, and $+58H_2O$. (Pohl, Dissert. **1906.**)

P_2O_5, $23MoO_3+61H_2O$. (Pohl.)

P_2O_5, $24MoO_3+61H_2O$. (Miolati, C. C. **1903**, II. 789.)

$+64H_2O$. (Pohl.)

*Di*phospho*penta*molybdic acid,

$H_6P_2Mo_5O_{23}=3H_2O$, P_2O_5, $5MoO_3$.

Not known in free state.

Ammonium phosphomolybdate, $(NH_4)_2O$, P_2O_5, $2MoO_3+2H_2O$.

(Meschorier, Dissert. **1894.**)

$2(NH_4)_2O$, P_2O_5, $4MoO_3+5H_2O$. (Friedheim, Z. anorg. 1894, **6.** 33.)

$+6H_2O$. (Perlberger, Dissert. **1904.**)

$(NH_4)_3PO_4$, $11MoO_3+6H_2O$.

Formula is $(NH_4)_3PO_4$, $10MoO_3+1\frac{1}{2}H_2O$, according to the older authorities.

Scarcely sol. in H_2O or aqueous acid solutions. Easily sol. in ammonia, and alkalies+Aq. (Svanberg and Struve, J. pr. **44.** 291.)

It is almost completely insol. in a mixture of $(NH_4)_2MoO_4$+Aq, and dil. HNO_3+Aq. Absolutely insol. in a dil. nitric acid solution of ammonium nitrate. (Richters, Z. anal. **10.** 471.)

Solubility is increased even in presence of ammonium molybdate and free HNO_3 by HCl, ammonium, and other chlorides, tartaric acid, or large quantities of ammonium oxalate or citrate. Not precipitated in presence of excess of H_3PO_4. (Fresenius, Z. anal. **3.** 446.)

Sol. in 10,000 pts. H_2O at 16°; in 6600 pts. H_2O containing 1 vol. % HNO_3; in 550 pts. HCl+Aq of 1.12 sp. gr.; in 620 pts. alcohol of 0.80 sp. gr.; in 190 pts. HNO_3+Aq (sp. gr. = 1.2) at 50°; in 5 pts. conc. H_2SO_4 at 100°; in 3 pts. NH_4OH+Aq of 0.95 sp. gr. (Eggertz, J. pr. **79.** 496.)

Sol. in 21,186 pts. H_2O, 38,117 pts. dil. alcohol, and 13,513 pts. strong alcohol. (Hehner, Analyst, **1879.** 23.)

According to Sonnenschein, the solubility is increased by much H_2O or alcohol, alkaline hydroxides, carbonates, ortho-, pyro-, and metaphosphates; sodium borate, hyposulphate, thiosulphate, acetate, arsenate, and arsenite; potassium sodium tartrate, ammonium oxalate, orthophosphoric acid, and sulphuric acid. It is not increased by ammonium molybdate or sulphate, potassium sulphate, acid tartrate, acid oxalate, nitrate, or chlorate, iodide, chloride, or bromide; sodium bromide or nitrate; nitric, hydrochloric, boric, tartaric, oxalic, and dilute sulphuric acids. (Sonnenschein, J. pr. **53.** 342.)

Sol. in hot H_2O. Sol. in cold caustic alkalies, alkali carbonates, and phosphates, NH_4Cl, and $(NH_4)_2C_2O_4$+Aq; sl. sol. in $(NH_4)_2SO_4$, KNO_3, and KCl+Aq; very sl. sol. in NH_4NO_3+Aq. Sol. in K_2SO_4, Na_2SO_4, NaCl, $MgCl_2$, H_2SO_4, HCl, and conc. or dil. HNO_3+Aq.

Presence of $(NH_4)_2MoO_4$ totally changes the effect of acid liquids; insol. in dil. HNO_3 or H_2SO_4+Aq containing $(NH_4)_2MoO_4$, but somewhat sol. in HCl+Aq even in presence of that salt. Tartaric acid and similar organic substances totally prevent the precipitation of this salt (Eggertz in Fresenius' Quant. anal.)

$5(NH_4)_2O$, $48MoO_3$, $2P_2O_5+17H_2O = 3(NH_4)_2O$, $24MoO_3$, $P_2O_5+2(NH_4)_2O$, H_2O, $24MoO_3$, $P_2O_5+16H_2O$. Formula of above salt according to Gibbs.

$3(NH_4)_2O$, $22MoO_3$, $P_2O_5+9H_2O$, or $12H_2O$.

$8(NH_4)_2O$, H_2O, $60MoO_3$, $3P_2O_5+11H_2O$. Sl. sol. in H_2O.

$3(NH_4)_2O$, $16MoO_3$, $P_2O_5+14H_2O$. Insol. in cold, sol. with decomp. in hot H_2O. Sol. in NH_4OH+Aq. (Gibbs, Am. Ch. J. **3.** 317.)

$5(NH_4)_2O$, P_2O_5, $16MoO_3$. (Meschoirer, Dissert. **1894.**)

$3(NH_4)_2O$, P_2O_5, $18MoO_3+14H_2O$. Sol. in H_2O. The aqueous solution is stable at ordinary temp. for several days, but when warmed ordinary ammonium phosphomolybdate separates. (Kehrmann, Z. anorg. 1894, **7.** 414.)

$3(NH_4)_2O$, P_2O_5, $28MoO_3+8H_2O$. 100 g. H_2O dissolve 0.0238 g. at 15°. 1 pt. is sol. at 15° in 4206 pts. H_2O; 7300 pts. 5% NH_4NO_3+Aq; 4930 pts. 1% HNO_3+Aq. (de Lucchi, Rass. Min. 1910, **32.** 21.)

$9(NH_4)_2O$, $2P_2O_5$, $28MoO_3+8H_2O$. (Meschoirer, Dissert. **1894.**)

Ammonium *di*phospho*penta*molybdate,

$2(NH_4)_3PO_4$, $5MoO_3+7H_2O=3(NH_4)_2O$, $5MoO_3$, $P_2O_5+7H_2O$.

Easily sol. in hot, less in cold H_2O. (Zenkner, J. pr. **58.** 256.)

$5(NH_4)_2O$, H_2O, $10MoO_3$, $2P_2O_5+6H_2O = 3(NH_4)_2O$, $5MoO_3$, $P_2O_5+2(NH_4)_2O$, H_2O, $5MoO_3$, $P_2O_5+6H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 87.)

$+8H_2O$. (Perlberger.)

$+18H_2O$. (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, **40.** (2) 55.)

$5(NH_4)_2O$, P_2O_5, $10MoO_3+13H_2O$, and $+14H_2O$. (Perlberger, Dissert. **1904.**)

Ammonium barium phosphomolybdate,

$3(NH_4)_2O$, $30BaO$, P_2O_5, $30MoO_3$.

Insol. precipitate. (Seligsohn, J. pr. **67.** 478.)

Ammonium cadmium phosphomolybdate,

$5(NH_4)_2O$, CdO, P_2O_5, $6MoO_3+8H_2O$.

(Perlberger, Dissert. **1904.**)

$3(NH_4)_2$, $2CdO$, $2P_2O_5$, $9MoO_3+141H_2O$. (Perlberger.)

Ammonium cobaltous phosphomolybdate, $(NH_4)_2O$, $2CoO$, P_2O_5, $5MoO_3+10H_2O$.

Decomp. by cold H_2O. Sol. in acids and hot H_2O. (Arnfeld, Dissert. **1898.**)

$4(NH_4)_2O$, CoO, $2P_2O_5$, $10MoO_3+12H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Arnfeld.)

Ammonium manganous phosphomolybdate, $(NH_4)_2O$, $2MnO$, P_2O_5, $5MoO_3+20H_2O$.

Decomp. by H_2O, but dissolves clear on heating. (Arnfeld.)

$4(NH_4)_2O$, MnO, $2P_2O_5$, $10MoO_3+13H_2O$. (Arnfeld.)

$5(NH_4)_2O$, $10MnO$, $2P_2O_5$, $20MoO_3+10H_2O$. Very sl. sol. in H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 87.)

Ammonium nickel phosphomolybdate, $(NH_4)_2O$, $2NiO$, P_2O_5, $5MoO_3+10H_2O$.

Decomp. by cold, but sol. in hot H_2O. (Arnfeld.)

$(NH_4)_2O$, NiO, $2P_2O_5$, $10MoO_3+12H_2O$. Very sol. in H_2O. (Arnfeld.)

Ammonium potassium phosphomolybdate, $6(NH_4)_2O$, $15K_2O$, $2P_2O_5$, $60MoO_3+12H_2O$.

Sol. in H_2O. Insol. in alcohol. (Seligsohn, J. pr. **67.** 477.)

Ammonium sodium phosphomolybdate, $6(NH_4)_2O$, $15Na_2O$, $2P_2O_5$, $60MoO_3+18H_2O$.

Sol. in much boiling H_2O. Insol. in alcohol. (Seligsohn, J. pr. **67.** 474.)

Barium phosphomolybdate, $3BaO$, P_2O_5, $24MoO_3+xH_2O$.

Moderately sol. in cold, very easily sol. in hot H_2O. Decomp. in aqueous solution at ordinary temp. on standing. (Kehrmann, Z. anorg. 1894, **7.** 414.)

Cæsium phosphomolybdate, $3Cs_2O$, P_2O_5, $6MoO_3+8H_2O$.

Ppt. (Ephraim, Z. anorg. 1910, **65.** 240.)

$2Cs_2O$, P_2O_5, $14MoO_3+3H_2O$. Difficultly sol. in H_2O. (Ephraim.)

$3Cs_2O$, P_2O_5, $21MoO_3+4H_2O$ (?). (Ephraim.)

Calcium potassium phosphomolybdate, $2CaO$, $3K_2O$, $2P_2O_5$, $10MoO_3+22H_2O$.

(Friedheim, Z. anorg. 1893, **4.** 293.)

Cobaltous phosphomolybdate, $2CoO$, P_2O_5, $4MoO_3+xH_2O$.

(Arnfeld, Dissert. **1898.**)

$3CoO$, P_2O_5, $5MoO_3+16\frac{1}{2}H_2O$, and $+17\frac{1}{2}H_2O$. Extremely sol. in H_2O. (Arnfeld.)

$3CoO$, P_2O_5, $18MoO_3+38H_2O$. Sol. in H_2O. (Arnfeld.)

$3CoO$, P_2O_5, $24MoO_3+58H_2O$, and $+60H_2O$. Sol. in H_2O. (Arnfeld.)

Cobaltous potassium phosphomolybdate, K_2O, $2CoO$, P_2O_5, $5MoO_3+15H_2O$. (Arnfeld.)

$4K_2O$, CoO, $2P_2O_5$, $10MoO_3+12H_2O$. Sl. sol. in cold, easily sol. in hot H_2O. (Arnfeld.)

Croceocobaltic phosphomolybdate, $24MoO_3$, P_2O_5, $[Co(NH_3)_4(NO_2)_2]_2O$, $2H_2O+21H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Gibbs, Am. Ch. J. **3.** 317.)

Gold phosphomolybdate ammonia, $12Au_2O_3$, $7P_2O_5$, $3MoO_3$, $24NH_3+21H_2O$.

Insol. in H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 172.)

Gold sodium phosphomolybdate ammonia, $5Au_2O_3$, Na_2O, P_2O_5, $11MoO_3$, $15NH_3+10H_2O$.

Sol. in dil. HCl. Almost insol. in NH_4OH+Aq. (Gibbs.)

Lead phosphomolybdate, $23PbMoO_4$, P_2O_5, $2PbPO_4+7H_2O$.

Sol. in 500,000 pts. H_2O. Insol. in NH_4OH+Aq. Easily sol. in KOH, NaOH, or HNO_3+Aq; somewhat less sol. in $HC_2H_3O_2$+Aq. (Beuf, Bull. Soc. (3) **3.** 852.)

Lithium phosphomolybdate, $12Li_2O$, $4P_2O_5$, $5MoO_3+18H_2O$.

Partially sol. in H_2O. (Ephraim, Z. anorg. 1909, **64.** 233.)

$3Li_2O$, P_2O_5, $5MoO_3+16H_2O$. Ppt. (Ephraim, Z. anorg. 1910, **65.** 233–6.)

$3Li_2O$, P_2O_5, $5MoO_3+17H_2O$. Ppt. (E.)

$5Li_2O$, $2P_2O_5$, $8MoO_3+28H_2O$. Easily sol. in H_2O. (E.)

$3Li_2O$, P_2O_5, $12MoO_3+18H_2O$. Ppt. (E.)

$3Li_2O$, P_2O_5, $18MoO_3+27H_2O$. Sol. in H_2O. (E.)

Manganous phosphomolybdate, $3MnO$, P_2O_5, $5MoO_3+20H_2O$.

Very sol. in H_2O. Sl. sol. in alcohol. (Arnfeld.)

$3MnO$, P_2O_5, $18MoO_3+38H_2O$. Sol. in H_2O. (Arnfeld.)

$3MnO$, P_2O_5, $24MoO_3+58H_2O$, and $+60H_2O$. Easily sol. in H_2O. (Arnfeld.)

Manganous potassium phosphomolybdate, $2MnO$, $3K_2O$, $2P_2O_5$, $10MoO_3+30H_2O$.

Sol. in hot H_2O. (Arnfeld.)

Manganous sodium phosphomolybdate, $7MnO$, $9Na_2O$, $2P_2O_5$, $22MoO_3+57H_2O$.

Nearly insol. in cold H_2O. Sol. in boiling H_2O but decomp. thereby. (Gibbs, Am. Ch. J. 1895, **17.** 85.)

Nickel phosphomolybdate, $2NiO$, P_2O_5, $4MoO_3+xH_2O$.

Ppt. (Arnfeld.)

$3NiO$, P_2O_5, $5MoO_3+20H_2O$. Decomp. by H_2O. (Arnfeld.)

$3NiO, P_2O_5, 18MoO_3+34H_2O$. Sol. in H_2O. (Arnfeld.)
$3NiO, P_2O_5, 24MoO_3+58H_2O$, and $+60H_2O$. Efflorescent. Sol. in H_2O. (Arnfeld.)

Nickel potassium phosphomolybdate, $K_2O, 2NiO, P_2O_5, 5MoO_3+13H_2O$.

Decomp. by cold H_2O, but goes into solution by boiling. (Arnfeld.)
$4K_2O, NiO, 2P_2O_5, 10MoO_3+12H_2O$. Sol. in H_2O. (Arnfeld.)

Potassium phosphomolybdate, $K_3PO_4, 11MoO_3+1\frac{1}{2}H_2O = 3K_2O, P_2O_5, 22MoO_3 +3H_2O$.

Insol. in H_2O. Easily sol. in alkalies. (Svanberg and Struve.)
100 g. H_2O dissolve 0.007 g. at 30°; 100 g. 10% HNO_3+Aq dissolve 0.204 g. at 30°. (Donk, Bull. 90, Bur. of Chem., U. S. Dept. of Agric. **1905**.)
According to older authorities the formula is $K_3PO_4, 10MoO_3+1\frac{1}{2}H_2O$.
$+6H_2O$. (Rammelsberg.)
$2K_2O, H_2O, 24MoO_3, P_2O_5+3H_2O$. Sl. sol. in cold H_2O.
$5K_2O, H_2O, 44MoO_3, 2P_2O_5+21H_2O$. (Gibbs, Am. Ch. J. **3**. 317.)
$3K_2O, P_2O_5, 18MoO_3+11H_2O$, and $+15H_2O$ (Elias.)
$+14H_2O$. Sl. sol. in cold, very easily sol. in hot H_2O. Can be cryst. from hot H_2O. (Kehrmann, Z. anorg. 1894, **7**. 416.)
$3K_2O, P_2O_5, 17MoO_3+12H_2O$. Moderately sol. in H_2O. (Elias, Dissert. **1906**.)
$5K_2O, P_2O_5, 17MoO_3+xH_2O$. Aqueous solution decomp. rapidly in the cold. (Kehrmann, Z. anorg. 1894, **7**. 423.)
$4K_2O, 2H_2O, 9MoO_3, P_2O_5+18H_2O$. (Zenkner.)
$5K_2O, H_2O, 10MoO_3, P_2O_5+19H_2O$. Easily sol. in H_2O. (Rammelsberg, B. **10**. 1776.)
$6K_2O, 15MoO_3, P_2O_5$. Insol. in H_2O. Sol. in KOH+Aq. (Rammelsberg.)
$K_2O, P_2O_5, 2MoO_3+13H_2O$. Very sol. in H_2O. (Friedheim, Z. anorg. **4**. 287.)
$2K_2O, P_2O_5, 4MoO_3+8H_2O$. Sol. in H_2O. (Friedheim.)

Potassium ***di*****phospho*****penta*****molybdate,** $3K_2O, P_2O_5, 5MoO_3+7H_2O$.

Sol. in H_2O; precipitated by HNO_3 or HCl +Aq. (Zenkner, J. pr. **58**. 261.)
$2K_2O, P_2O_5, 5MoO_3+6H_2O$. (Friedheim.)

Potassium ***di*****phospho*****penta*****molybdate nitrate,** $2K_3PO_4, 5MoO_3, 6KNO_3+9H_2O$.

(Debray, C. R. **66**. 706.)

Rubidium phosphomolybdates:

$7Rb_2O, P_2O_5, 22MoO_3+12H_2O$; $3Rb_2O, P_2O_5, 20MoO_3+12H_2O$; $6Rb_2O, P_2O_5, 18MoO_3 +10H_2O$; $5Rb_2O, 2P_2O_5, 9MoO_3+13H_2O$; $7Rb_2O, 3P_2O_5, 10MoO_3+15H_2O$. (Ephraim, Z. anorg. 1910, **65**. 237–9.)

Silver phosphomolybdate, $7Ag_2O, P_2O_5, 20MoO_3+24H_2O$.

Ppt. Sol. in dil. HNO_3+Aq, forming—
$2Ag_2O, P_2O_5, 20MoO_3+7H_2O$. Sl. sol. in H_2O (Rammelsberg.)
Formula of first salt is—
$7Ag_2O, 22MoO_3, P_2O_5+14H_2O$. Sol. in hot H_2O, but solution is quickly decomp. (Gibbs, Am. Ch. J. **3**. 317.)
$7Ag_2O, P_2O_5, 24MoO_3$. Ppt. (Miolati, J. pr. 1908 (2) **77**. 451.)

Silver ***di*****phospho*****penta*****molybdate,** $Ag_6Mo_5P_2O_{23}+7H_2O$

Easily sol. in H_2O. (Debray, C. R. **66**. 705.)

Sodium phosphomolybdate.

Sol. in H_2O and HNO_3+Aq. (Sonnenschein, A. **104**. 45.)
$Na_2O, 5H_2O, P_2O_5, 18MoO_3+xH_2O$.
$2Na_2O, 4H_2O, P_2O_5, 18MoO_3+xH_2O$.
$3Na_2O, P_2O_5, 18MoO_3+26H_2O$. (Friedheim.)
$3Na_2O, P_2O_5, 24MoO_3+42H_2O$. (Rosenheim and Pinsker, Z. anorg. 1911, **70**. 79.)

Sodium ***di*****phospho*****penta*****molybdate,** $3Na_2O, P_2O_5, 5MoO_3+14H_2O$.

Easily sol. in H_2O. (Debray.)

Sodium auramine phosphomolybdate, $Na_2O, 5Au_2O_3, 2P_2O_5, 11MoO_3, 15NH_3$.

Sol. in hot H_2O. Very sol. in hot HCl. (Gibbs, Am. Ch. J. 1895, **17**. 171.)

*Meta*phosphomolybdic acid.

Ammonium ***monometa*****phosphomolybdate,** $3(NH_4)_2O, 4NH_4PO_3, 10MoO_3+9H_2O$.

Very sol. in H_2O. (Gibbs, Am. Ch. J. **7**. 392.)

Barium ***hexameta*****phosphomolybdate,** $BaO, Ba_3(PO_3)_6, 14MoO_3+55H_2O$.

Sol. in H_2O. (Gibbs.)

*Pyro*phosphonitrylic acid, $P_2HNO_4 = P_2O_3{}^{OH}_{N}$.

Not known in free state.

Ammonium ***pyro*****phosphonitrylate,** $P_2O_3{}^{ONH_4}_{N}$.

Insol. but gradually decomp. by H_2O. (Gladstone.)

Potassium ——, KP_2NO_4.

Insol. in H_2O. (Gladstone.)

Silver ——, AgP_2NO_4.

Ppt.

***Tri*phosphonitrilic chloramide,** $P_3N_3Cl_4(NH_2)_2$.

Sol. in H_2O without decomp.; sol. in ether, alcohol; sl. sol. in benzene. (Stokes, Am. Ch. J. 1895, **17.** 287.)

***Tri*phosphonitrilic *tetra*chlorhydrin,** $P_3N_3Cl_4O_2H_2$.

Sol. in ether, alcohol, and H_2O; insol. in benzene and CS_2. (Stokes, Am. Ch. J. 1895, **17.** 286.)

***Tri*phosphonitrilic chloride,** $P_3N_3Cl_6$.

Sol. in glacial acetic acid and H_2SO_4. 100 pts. ether dissolve 46.5 pts. at 20°. (Liebig.)

Insol. in light petroleum; sol. in benzene. (Stokes, Am. Ch. J. 1897, **19.** 783.)

***Tetra*phosphonitrilic chloride,** $P_4N_4Cl_8$.

Sol. in alcohol, ether, benzene, H_2SO_4. Sl. sol. in H_2O with decomp. 100 pts. ether dissolve 12.3 pts. at 20°. (Stokes, Am. Ch. J. 1895, **17.** 281.)

***Penta*phosphonitrilic chloride,** $(PNCl_2)_5 = P_5N_5Cl_{10}$.

Sol. in benzene, light petroleum, acetic acid, ether, CS_2; insol. in H_2O. (Stokes, Am. Ch. J. 1897, **19.** 790.)

***Hexa*phosphonitrilic chloride,** $(PNCl_2)_6 = P_6N_6Cl_{12}$.

Sol. in benzene, light petroleum, ether, CS_2; insol. in H_2O. (Stokes.)

***Hepta*phosphonitrilic chloride,** $(PNCl_2)_7 = P_7N_7Cl_{14}$.

Sol. in benzene, light petroleum, ether, CS_2; insol. in H_2O; sol. in alcohol with decomp. (Stokes.)

***Poly*phosphonitrilic chloride,** $(PNCl_2)x$.

Depolymerizes on distillation; insol. in benzene and light petroleum and all neutral solvents; sol. in H_2O with decomp. (Stokes.)

Phosphonitrilochloramide, $P_2N_2Cl_3(NH_2)$.

Slowly sol. in H_2O with decomp. Insol. in ether and CS_2. Sl. sol. in boiling CCl_4. (Besson and Rosset, C. R. 1908, **146.** 1149.)

Phosphonium bromide, PH_4Br.

Decomp. violently by H_2O.

Phosphonium chloride, PH_4Cl.

(Ogier, Bull. Soc. (2) **32.** 483.)

Phosphonium titanium chloride, $2PH_4Cl$, $3TiCl_4$.

Decomp. by H_2O, HCl, or alkalies +Aq. R ose.)

Phosphonium iodide, PH_4I.

Decomp. by H_2O, alkalies, alcohol, etc. (Rose, Pogg. **46.** 636.)

Decomp. by PCl_3. (Wilde, B. **16.** 217.)

Phosphonium sulphate (?).

Deliquescent; very unstable. (Besson, C. R. **109.** 644.)

Phosphoramide, $P(NH_2)_3$.

Insol. in $NH_4Br, 3NH_3$; sol. in $NH_4I, 3NH_3$. (Hugot, C. R. 1905, **141.** 1235.)

Phosphor*tri*amide, PON_3H_6.

See **Phosphoryl *tri*amide.**

Phosphoric acid, *anhydrous*, P_2O_5.

See **Phosphorus *pent*oxide.**

***Meta*phosphoric acid,** HPO_3.

Sol. in H_2O. Not isolated. (Fleitmann, Pogg. **78.** 362.)

Deliquescent. Sol. in H_2O, but aqueous solution decomp. into H_3PO_4, slowly in the cold, but more rapidly on heating. Conc. solutions decomp. more rapidly than when dil. (Giran, A. ch. 1903, (7) **30.** 203.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

***Dimeta*phosphoric acid,** $H_2P_2O_6$.

Not isolated. (Fleitmann.)

***Trimeta*phosphoric acid,** $H_3P_3O_9$.

Sol. in H_2O; the solution is permanent in the cold, but on evaporation it is quickly decomp. to H_3PO_4.

***Tetrameta*phosphoric acid,** $H_4P_4O_{12}$.

Not isolated.

***Hexameta*phosphoric acid,** $H_6P_6O_{18}$. **(Glacial phosphoric acid.)**

Deliquescent; easily sol. in H_2O with evolution of heat and conversion into H_3PO_4. Not easily sol. in presence of slight impurities.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

***Ortho*phosphoric acid,** H_3PO_4.

Very sol. in H_2O.

100 pts. of the solution contain at:

26.23°	27.02°	29.42°	29.77°	
95.9	95.98	96.15	96.11	pts. H_3PO_4,
37.65°	39.35°	42.30° (mpt.)		
97.8	98.48	100 pts. H_3PO_4.		

(Smith and Menzies, J. Am. Chem. Soc. 1909, **31.** 1186.)

See also $10H_3PO_4+H_2O$, and $2H_3PO_4+H_2O$.

Sp. gr. of H_3PO_4+Aq containing:

10	20	30	40	50	$\%P_2O_5$.
1.1	1.23	1.39	1.6	1.85	

(Dalton.)

Sp. gr. of H_3PO_4 +Aq.

Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5
1.508	49.60	1.328	36.15	1.114	17.89
1.492	48.41	1.315	34.82	1.136	16.95
1.476	47.10	1.302	33.49	1.124	15.64
1.464	45.63	1.293	32.71	1.113	14.33
1.453	45.38	1.285	31.94	1.109	13.25
1.442	44.13	1.276	31.03	1.095	12.18
1.434	43.95	1.268	30.13	1.081	10.44
1.426	43.28	1.257	29.16	1.073	9.53
1.418	42.61	1.247	28.24	1.066	8.62
1.401	41.60	1.236	27.30	1.056	7.39
1.392	40.86	1.226	26.36	1.047	6.17
1.384	40.12	1.211	24.79	1.031	4.15
1.376	39.66	1.197	23.23	1.022	3.03
1.369	39.21	1.185	22.07	1.014	1.91
1.356	38.00	1.173	20.91	1.006	0.79
1.347	37.37	1.162	19.73	...	...
1.339	36.74	1.153	18.81	...	...

(Watts, C. N. **12.** 160.)

Specific gravity of H_3PO_4+Aq containing:

6	12	18	% H_3PO_4,
1.0333	1.0688	1.1065	
24	36	54	% H_3PO_4.
1.1463	1.2338	1.3840	

(Schiff, A. **113.** 183.)

Sp. gr. of H_3PO_4+Aq at 15°. a=sp. gr. if % is P_2O_5; b=sp. gr. if % is H_3PO_4.

%	a	b	%	a	b
1	1.009	1.0054	31	1.288	1.1962
2	1.017	1.0109	32	1.299	1.2036
3	1.025	1.0164	33	1.310	1.2111
4	1.032	1.0220	34	1.321	1.2186
5	1.039	1.0276	35	1.333	1.2262
6	1.047	1.0333	36	1.345	1.2338
7	1.055	1.0390	37	1.357	1.2415
8	1.063	1.0449	38	1.369	1.2493
9	1.071	1.0508	39	1.381	1.2572
10	1.080	1.0567	40	1.393	1.2651
11	1.089	1.0627	41	1.407	1.2731
12	1.098	1.0688	42	1.420	1.2812
13	1.106	1.0749	43	1.432	1.2894
14	1.115	1.0811	44	1.445	1.2976
15	1.124	1.0874	45	...	1.3059
16	1.133	1.0937	46	...	1.3143
17	1.142	1.1001	47	...	1.3227
18	1.151	1.1065	48	...	1.3313
19	1.161	1.1130	49	...	1.3399
20	1.171	1.1196	50	...	1.3486
21	1.182	1.1262	51	...	1.3573
22	1.192	1.1329	52	...	1.3661
23	1.202	1.1397	53	...	1.3750
24	1.212	1.1465	54	...	1.3840
25	1.223	1.1534	55	...	1.3931
26	1.233	1.1604	56	...	1.4022
27	1.244	1.1674	57	...	1.4114
28	1.254	1.1745	58	...	1.4207
29	1.265	1.1817	59	...	1.4301
30	1.277	1.1889	60	...	1.4395

(Schiff, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of H_3PO_4+Aq at 17.5°.

% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.	% P_2O_5	Sp. gr.
1	1.007	24	1.208	47	1.476
2	1.014	25	1.219	48	1.491
3	1.021	26	1.229	49	1.505
4	1.028	27	1.240	50	1.521
5	1.036	28	1.250	51	1.536
6	1.044	29	1.261	52	1.551
7	1.053	30	1.272	53	1.566
8	1.061	31	1.282	54	1.581
9	1.070	32	1.293	55	1.597
10	1.078	33	1.304	56	1.613
11	1.086	34	1.315	57	1.629
12	1.095	35	1.326	58	1.645
13	1.103	36	1.338	59	1.661
14	1.112	37	1.350	60	1.677
15	1.120	38	1.362	61	1.693
16	1.129	39	1.374	62	1.709
17	1.139	40	1.386	63	1.725
18	1.148	41	1.398	64	1.741
19	1.158	42	1.410	65	1.758
20	1.168	43	1.423	66	1.775
21	1.178	44	1.436	67	1.792
22	1.188	45	1.448	68	1.809
23	1.198	46	1.462	..	...

(Hager, Adjumenta varia, Leipzig, **1876.**)

Table for correction to be added or subtracted for 1° change in temperature.

% P_2O_5	Corr.	% P_2O_5	Corr.
10–14	0.00035	36–45	0.00068
15–25	0.0004	46–55	0.00082
26–35	0.00052	56–68	0.001

(Hager.)

Sp. gr. of H_3PO_4+Aq.

G.-equivalents H_3PO_4 per litre	t°	Sp. gr. t°/t°
0.002572	17.714	1.001552
0.005142	17.706	1.0003051
0.01025	17.685	1.000595
0.02042	17.683	1.001158
0.03056	17.687	1.001708
0.04065	17.704	1.002252
0.0507	17.663	1.002790
0.10046	17.696	1.005412
0.19951	17.749	1.010560
0.29716	17.701	1.015584
0.49057	17.719	1.025469
0.5070	17.58	1.02627
5.0700	17.84	1.25162

(Kohlrausch, W. Ann. 1894, **53.** 29.)

Miscible with conc. $HC_2H_3O_2$+Aq. Sol. in 30 pts. warm creosote.

1 cc. of a sat. solution of ether in H_2O dissolves 0.0886 grams H_3PO_4.

1 cc. of a sat. solution of H_2O in ether dissolves 0.000033 grams H_3PO_4.

Solutions of H_3PO_4 in H_2O containing less than 0.434 grams acid per 1 cc. lose an insignificant amount of acid to ether when agitated therewith. (Berthelot, C. R. 1896, **123.** 345.)

The composition of the hydrates formed by H_3PO_4 at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by H_3PO_4 and of the conductivity and sp. gr. of H_3PO_4+Aq. (Jones, Am. Ch. J. 1905, **34.** 331.)

$10H_3PO_4+H_2O$. Solubility in H_2O.

100 pts. of the solution contain at:

24.11°	24.38°	24.40°
94.78	94.80	94.84 pts. H_3PO_4,
24.81°	25.41°	25.85°
94.95	95.26	95.54 pts. H_3PO_4.

(Smith and Menzies, J. Am. Chem. Soc. 1909, **31.** 1186.)

$2H_3PO_4+H_2O$. Solubility in H_2O.

100 pts. of the solution contain at:

—16.3°	0.5°	14.95°	24.03°	27.0°
76.7	78.7	81.7	85.7	87.7 pts. H_3PO_4,

29.15°	29.35° (mpt.)
90.5	91.6 pts. H_3PO_4,

28.5°	27.0°	25.41°
92.5	93.4	94.1 pts. H_3PO_4.

Retroflex part of curve.

(Smith and Menzies, J. Am. Chem. Soc. 1909, **31.** 1186.)

*Pyro*phosphoric acid (*Di*phosphoric acid), $H_4P_2O_7$.

Very sol. in H_2O. The solution may be kept without change, but on heating it is converted into H_3PO_4.

The acid in solution gradually changes to H_3PO_4; the conversion being more rapid with more concentrated solutions. (Montemartini and Egidi, Gazz. ch. it. 1902, **32.** (1) 381.)

Phosphoric acid, $H_8P_2O_9$ (?).

Sol. in H_2O. (Joly, C. R. **100.** 447.)

Phosphates.

The phosphates of NH_4, K, Na, Li, Cs, and Rb are sol. in H_2O, with the exception of certain metaphosphates; the other phosphates excepting neutral Tl salts, are nearly insol. in H_2O, excepting when an excess of H_3PO_4 is present. The latter are all sol. in HNO_3+Aq.

(*a*) **Metaphosphates.**

*Mono***metaphosphates.** Only alkali monometaphosphates are known, and they are all insol. in H_2O.

*Di***metaphosphates.** Alkali dimetaphosphates and some double salts containing an alkali as one of the bases are sol. in H_2O, the rest are sl. sol. or insol. in H_2O.

*Tri***metaphosphates.** All salts are sol. in H_2O.

*Tetra***metaphosphates.** The alkali salts are sol. in H_2O, the others are insol.

*Hexa***metaphosphates.** The alkali salts are sol., the others insol., in H_2O, but are mostly sol. in Na hexametaphosphate+Aq.

(*b*) **Orthophosphates.** K, Na, Li, Cs, and Rb orthophosphates are sol. in H_2O. All the others are insol. in H_2O, but sol. in excess of H_3PO_4, and HNO_3+Aq; less easily sol. in $HC_2H_3O_2$+Aq. Pb, Al, and Fe_2 phosphates are insol. in $HC_2H_3O_2$+Aq. Sl. sol. in NH_4 salts+Aq, especially NH_4Cl+Aq, from which solution they are pptd. by NH_4OH+Aq. Orthophosphates insol. in H_2O are also insol. in an excess of alkali orthophosphates+Aq.

All orthophosphates are insol., or very sl. sol. in alcohol.

(*c*) **Pyrophosphates.** Alkali pyrophosphates are sol. in H_2O; the others are insol. in H_2O, but are mostly sol. in an excess of Na pyrophosphate+Aq.

Aluminum *meta*phosphate, $Al_2(PO_3)_6$.

Insol. in H_2O and conc. acids. (Maddrell, A. **61.** 59.)

Aluminum *ortho*phosphate, basic, $3Al_2O_3$, $P_2O_5+18H_2O$.

Min. *Evansite.*

$4Al_2O_3$, $3P_2O_5+18H_2O$. Ppt. Insol. in H_2O. (Rammelsberg.)

$2Al_2O_3$, P_2O_5.

$+3H_2O$. Min. *Angelite.*

$+5H_2O$. Min. *Kalaite* (*Turquoise*). Sol. in HCl+Aq.

$+6H_2O$. Decomp. by H_2O. (Hautefeuille, J. pr. (2) **37.** 111.)

Min. *Peganite.* More or less sol. in HCl, and HNO_3+Aq.

$+8H_2O$. Ppt. (Munroe, A. **159.** 278.)

Min. *Fischerite.* Sl. attacked by HCl or HNO_3+Aq; sol. in H_2SO_4+Aq.

$3Al_2O_3$, $2P_2O_5+8H_2O$, or $12H_2O$. Sol. in acids, even after ignition. (Millot, C. R. **82.** 89.)

$+10H_2O$. Min. *Cæruleolactite.* Sol. in acids.

$+12H_2O$. Min. *Wavellite.*

Aluminum *ortho*phosphate, $Al_2(PO_4)_2$.

Crystalline. Not attacked by conc. HCl or HNO_3+Aq, difficultly by hot conc. H_2SO_4. (de Schulten, C. R. **98.** 1583.)

Ignited $Al_2(PO_4)_2$ is sl. decomp. by H_2O, so that solubility determinations are variable. For an extended discussion, see original paper. (Cameron and Hurst, 1904, **26.** 898.)

$+4H_2O$. Easily sol. in mineral acids, insol. in acetic and other organic acids. Easily sol. in $KOH+Aq$, but is reprecipitated by NH_4Cl+Aq. Sol. in NH_4OH+Aq. Sol. in a large amount of alum+Aq (Rose), in aluminum acetate and other aluminum salts +Aq (Fleischer, Z. anal. **6.** 28). More sol. than ferric phosphate in ammonium oxalate or citrate+Aq. (Millot.)

Acid NH_4 citrate+Aq dissolves 3% of the P_2O_5; neutral NH_4 citrate+Aq dissolves 6.6 % of the P_2O_5; ammoniacal NH_4 citrate+Aq dissolves completely in 25 min. (Erlenmeyer, B. **14.** 1869.)

Sol. in NH_4OH+Aq, especially in presence of alkali phosphates. (de Koninck, Z. anal. **23.** 90.)

Not pptd. in presence of alkali tartrates or citrates, sugar, glycerine, etc.

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Min. *Variscite.* Very quickly sol. in warm conc. $HCl+Aq$.

$+5H_2O$. Min. *Zepharovitchite.*

$+8H_2O$. Min. *Gibbsite.*

Aluminum *ortho*phosphate, acid, $2Al_2O_3$, $3P_2O_5+16H_2O$.

Insol. in acids after being ignited. (Millot, Bull. Soc. (2) **22.** 244.)

$+4H_2O$, and $6H_2O$. Insol. in H_2O or alcohol. (Hautefeuille and Margottet, J. pr. (2) **37.** 111.)

Al_2O_3, $2P_2O_5+8H_2O$. Insol. in acids or aqua regia after being ignited. (Millot.)

$2Al_2O_3$, $5P_2O_5+14H_2O$. Decomp. by cold H_2O into—

$4Al_2O_3$, $7P_2O_5+9H_2O$. Decomp. by hot H_2O. (Erlenmeyer, A. **194.** 200.)

Al_2O_3, $3P_2O_5+3H_2O=Al_2(H_2PO_4)_6$. Deliquescent; completely sol. in a little cold H_2O, and conc. solution can be boiled without decomp., but dil. solution (1 : 20) separates $Al_2(PO_4)_2$ on boiling, which redissolves on cooling, the more quickly the more dilute the original solution. (Erlenmeyer, A. **194.** 198.)

Aluminum *pyro*phosphate, $Al_4(P_2O_7)_3+10H_2O$.

Precipitate. Sol. in mineral acids, and $Na_4P_2O_7+Aq$; insol. in acetic acid. Sol. in $KOH+Aq$; sol. in NH_4OH+Aq, but when dissolved in $HCl+Aq$ is reprecipitated by NH_4OH+Aq, and is not redissolved in an excess thereof. (Schwarzenberg, A. **65.** 147.)

Sol. in alum+Aq. (Rose, Pogg. **76.** 19.)

Aluminum *pyrometa*phosphate, Al_2O_3, $2P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 849.)

Aluminum ammonium *di*hydrogen *ortho*phosphate, $NH_4H_2PO_4$, $AlPO_4$.

Partially decomp. by H_2O. Sol. in acids and alkalies. Nearly insol. in 50% acetic acid. (Cohen, J. Am. Chem. Soc. 1907, **29.** 720.)

Aluminum calcium phosphate, Al_2O_3, $3CaO$, $P_2O_5+3H_2O$.

Min. *Tavistockite.*

$2Al_2O_3$, $6CaO$, $3P_2O_5+3H_2O$. Min. *Kirrolite.*

Aluminum calcium phosphate sulphate, $3Al_2O_3$, SO_3, $Ca_2(PO_4)_2+6H_2O$.

Min. *Svanbergite.* Scarcely attacked by $HCl+Aq$, and only sl. by H_2SO_4+Aq.

Aluminum ferrous magnesium phosphate, $(Mg, Fe)_2Al_2P_2O_{10}+4H_2O$.

Min. *Childrenite.* Slowly sol. in $HCl+Aq$.

Min. *Eosphorite.* Sol. in HNO_3 or $HCl+Aq$.

$(Mg, Fe)Al_2P_2O_9+H_2O$. Min. *Lazulite.* Only sl. attacked by acids, when not previously ignited.

Aluminum lithium phosphate, $Al_2(PO_4)_2$, $4Li_3PO_4+30H_2O$.

Precipitate. (Berzelius.)

Insol. in H_2O; easily sol. in acids.

Aluminum magnesium phosphate.

Min. *Lazulite.*

See **Phosphate, aluminum ferrous magnesium.**

Aluminum potassium phosphate, Al_2O_3, K_2O, $2P_2O_5$.

Insol. in acids. (Ouvrard, A. ch. (6) **16.** 289.)

$2Al_2O_3$, $2K_2O$, $3P_2O_5$. (Ouvrard.)

Aluminum silver *meta*phosphate, $2Al_2O_3$, Ag_2O, $4P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 849, 1142.)

Aluminum sodium *pyro*phosphate, $Al_2Na_2(P_2O_7)_2$.

Insol. in H_2O and acids. (Wallroth.)

Nearly insol. in acids. (Ouvrard, A. ch. (6) **16.** 338.)

$2Al_2O_3$, $3Na_2O$, $3P_2O_5$. Sol. in HNO_3+Aq. (Ouvrard.)

$Al_4(P_2O_7)_3$, $2Na_4P_2O_7+30H_2O$.

Very difficultly sol. in H_2O. (Pahl, Bull. Soc. (2) **22.** 122.)

Aluminum phosphate lithium fluoride, $2Al_2(PO_4)_2$, $3LiF$.

Min. *Amblygonite.* Sl. attacked by $HCl+Aq$, more easily by H_2SO_4+Aq.

Ammonium *meta*phosphate, NH_4PO_3.

Insol. in H_2O. (Fleitmann, Pogg. **78.** 345.)

Ammonium *dimeta*phosphate, $(NH_4)_2(PO_3)_2$.

Sol. in 1.15 pts. cold or hot H_2O. (Fleitmann, Pogg. **78.** 245.) More sol. in dil. alcohol than Na or K salt.

Sol. in 0.9 pts. H_2O; easily sol. in acids especially by boiling with conc. H_2SO_4. (Glatzel, Dissert. **1880.**)

Ammonium ***trimeta*****phosphate,** $(NH_4)_3P_3O_9$.

Very sol. in H_2O. (Lindbom, Acta Lund. **1873.** 15.)

Ammonium ***tetrameta*****phosphate,** $(NH_4)_4P_4O_{12}$.

Sol. in H_2O. (Warschauer, Z. anorg. 1903, **36.** 177.)

$+4H_2O$. Much more sol. in H_2O than the K or Na salt. 1 pt. is sol. in 8 pts. H_2O. (Glatzel, Dissert. **1880.**)

Ammonium ***pentameta*****phosphate,** $(NH_4)_5P_5O_{15}$.

Sol. in H_2O. (Tammann, J. pr. 1892, (2) **45.** 455.)

Ammonium ***dekameta*****phosphate,** $(NH_4)_{10}P_{10}O_{30}$.

Very sl. sol. in H_2O; 100 g. H_2O dissolved 1.20-1.54 g. in 2 months. Easily sol. in hot H_2O with decomp. (Tammann, J. pr. 1892, (2) **45.** 448.)

$+12H_2O$. (Tammann, J. pr. 1892, (2) **45.** 465.)

Ammonium ***ortho*****phosphate,** $(NH_4)_3PO_4+3H_2O$.

Difficultly sol. in H_2O.

Less sol. in H_2O than $(NH_4)_2HPO_4$. (Berzelius.)

Insol. in alkalies+Aq. (Berzelius.)

Sl. sol. in H_2O. Decomp. in the air. (Schottländer, Z. anorg. 1894, **7.** 344.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.

NH_4	PO_4
7.42	0.084
5.02	0.20
2.95	0.46
3.04	1.02
3.32	1.32
4.78	2.32

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 105.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

$+5H_2O$. (Sestini, Gazz. ch. it. **9.** 298.)

Ammonium hydrogen ***ortho*****phosphate,** $(NH_4)_2HPO_4$.

Easily sol. in H_2O. Effloresces to form $NH_4H_2PO_4$. (Schiff, A. **112.** 88.)

Sol. in 4 pts. cold, and less hot H_2O. Solution loses NH_3 by boiling. Insol. in alcohol. 100 g. H_2O dissolve 131 g. at 15°; sp. gr. of sat. solution=1.343. (Greenish and Smith, Pharm. J. 1901, **66.** 774.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.

NH_4	PO_4
6.42	3.23
6.46	3.74
6.56	4.01
6.78	4.34
7.26	4.83
7.16	4.82

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 105.)

Insol. in acetone. (Eidmann, C. C. **1899.** II, 1014; Naumann, B. 1904, **37.** 4329.)

Ammonium ***di*****hydrogen** ***ortho*****phosphate,** $NH_4H_2PO_4$.

Does not effloresce.

Less easily sol. in H_2O than $(NH_4)_2HPO_4$. (Mitscherlich, A. ch. **19.** 385.)

Sol. in 5 pts. cold, and less hot H_2O.

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.

NH_4	PO_4
6.72	4.54
5.62	3.88
4.62	3.36
2.72	2.59
2.50	2.54
2.58	4.29
2.76	6.21
3.06	7.70
3.10	7.86

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 106.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Ammonium ***ortho*****phosphate, acid.**

Decomp. into $NH_4H_2PO_4$ at 77-78°. (Parravano and Mieli, Gazz. ch. it. 1908, **38,** II. 536.)

Ammonium ***pyro*****phosphate,** $(NH_4)_4P_2O_7$.

Easily sol. in H_2O. Alcohol precipitates it from the aqueous solution. (Schwarzenberg, A. **65.** 141.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Ammonium hydrogen ***pyro*****phosphate** $(NH_4)_2H_2P_2O_7$.

Very sol. in H_2O. Insol. in alcohol. (Schwarzenberg, A. **65.** 141.)

Ammonium barium *trimeta*phosphate, $(NH_4)BaP_3O_9+H_2O$.

Easily sol. in H_2O. (Lindbom.)

Ammonium cadmium *dimeta*phosphate, $(NH_4)_2O$, CdO, $2P_2O_5+3H_2O = (NH_4)_2Cd(P_2O_6)_2$.

Efflorescent. (Fleitmann, Pogg. **78.** 347.)

Ammonium cadmium *ortho*phosphate, $NH_4CdPO_4+1\frac{1}{4}H_2O$.

Easily sol. in NH_4OH+Aq and acids. (Drewson, Gm. K. Handb. 6te Aufl. III. 74.)

Ammonium calcium *dimeta*phosphate, $(NH_4)_2Ca(P_2O_6)_2+2H_2O$.

Very sl. sol. in H_2O. Not decomp. by acids. (Fleitmann, Pogg. **78.** 344.)

Ammonium calcium phosphate, $NH_4CaPO_4+xH_2O$.

Ppt. (Herzfeld and Feuerlein, Z. anal. **20.** 191.)

$+7H_2O$. Not completely decomp. by cold H_2O in ¾ hour; rapidly by hot H_2O. (Lasne, Bull. Soc. 1902, (3) **27.** 131.)

Ammonium chromium *ortho*phosphate, basic, $5(NH_4)H_2PO_4$, $2CrPO_4$, $4Cr(OH)_3$.

(Cohen, J. Am. Chem. Soc. 1907, **29.** 1196.)

$(NH_4)_2HPO_4$, $2CrPO_4+3H_2O$. Ppt. (Cohen.)

Ammonium chromic *pyro*phosphate, $NH_4(CrP_2O_7)+6H_2O$.

Sl. sol. in cold H_2O. Decomp. by boiling H_2O. (Rosenheim, B. 1915, **48.** 586.)

Ammonium cobaltous *meta*phosphate.

Extremely sol. in H_2O and in NH_4OH+Aq. (Persoz, J. pr. **3.** 215.)

Ammonium cobaltous *ortho*phosphate, $NH_4CoPO_4+H_2O$.

Not decomp. by boiling H_2O. (Debray, J. Pharm. (3) **46.** 121.)

$+12H_2O$. Ppt. (Chancel, **1862.**)

$Co(NH_4)_2H_2(PO_4)_2+4H_2O$. Insol. in H_2O. (Debray.)

Ammonium copper *dimeta*phosphate, $(NH_4)_2P_2O_6$, $CuP_2O_6+2H_2O$.

Very sl. sol. in H_2O; insol. in alcohol. (Fleitmann, Pogg. **78.** 345.)

$+4H_2O$. Efflorescent. Very sl. sol. in H_2O; insol. in alcohol. (F.)

Sol. in 50 pts. H_2O. Slowly attacked by acids. Only boiling H_2SO_4 attacks easily. (Glatzel, Dissert. **1880.**)

Ammonium glucinum *ortho*phosphate, NH_4GlPO_4.

Insol. in cold, sl. sol. in hot H_2O. (Rössler, Z. anal. **17.** 148.)

Ammonium glucinum sodium *ortho*phosphate, $(NH_4)_2GlNa_2(PO_4)_2+7H_2O$.

(Scheffer, A. **109.** 146.)

Ammonium iron (ferrous) *ortho*phosphate, $NH_4FePO_4+H_2O$.

Insol. even in boiling H_2O. When still moist, easily sol. in dil. acids, but sparingly and slowly sol. after drying, even in conc. acids. Decomp. by NH_4OH, KOH, and NaOH+Aq. Insol. in alcohol. (Otto, J. pr. **2.** 409.)

$(NH_4)_2FeH_2(PO_4)_2+4H_2O$. (Debray.)

Ammonium iron (ferric) hydrogen *ortho*phosphate, basic, $2(NH_4)_2HPO_4$, $3FePO_4$, $3Fe(OH)_3$.

Ppt. Insol. in 95% alcohol. (Cohen, J. Am. Chem. Soc. 1907, **29.** 719.)

Ammonium iron (ferric) hydrogen *ortho*phosphate, $NH_4H_2Fe(PO_4)_2$.

Ppt. Same properties as Na salt. (Weinland, Z. anorg. 1913, **84.** 356.)

Partially hydrolyzed by H_2O. Readily sol. in HCl, HNO_3, H_2SO_4 and H_3PO_4. Partially hydrolyzed by cold NH_4OH+Aq. Sol. in excess of hot NH_4OH+Aq. Completely hydrolyzed by caustic alkalies. Practically insol. in 50% acetic acid. (Cohen, J. Am. Chem. Soc. 1907, **29.** 718.)

Ammonium lead *dimeta*phosphate, $(NH_4)_2Pb(P_2O_6)_2$.

Very difficultly sol. in H_2O and acids. (Fleitmann, Pogg. **78.** 343.)

Ammonium lithium *meta*phosphate, Li_2O, $2(NH_4)_2O$, $3P_2O_5+8H_2O$.

Not appreciably sol. in cold H_2O but rapidly and abundantly sol. in H_2O at 70°. (Tammann, J. pr. 1892, (2) **45.** 442.)

Ammonium lithium phosphate, $(NH_4)_2LiPO_4$.

Sl. sol. in H_2O. (Berzelius.)

Ammonium magnesium *meta*phosphate, $(NH_4)_2O$, $2MgO$, $2P_2O_5+9H_2O$ (?).

Sol. with difficulty in H_2O or acids when heated. Easily sol. in H_2O before heating. (Wach, Schw. J. **59.** 29.)

Precipitated from aqueous solution by alcohol.

Ammonium magnesium *dimeta*phosphate, $(NH_4)_2Mg(P_2O_6)_2+6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78.** 346.)

Ammonium magnesium phosphate, NH_4MgPO_4, and $+6H_2O$.

1 l. H_2O dissolves 66 mg. anhydrous NH_4MgPO_4 at 15°. (Fresenius, A. **55.** 109.)

1 l. H_2O dissolves 74.1 mg. anhydrous NH_4MgPO_4 at 20.5–22.5°. (Ebermayer.)

1 l. H_2O dissolves 106 mg. anhydrous NH_4MgPO_4. (Liebig.)

Insol. in H_2O, but when boiled with H_2O it loses NH_3 and H_2O. (Struve, Z. anal. 1898, **37.** 485.)

Solubility of $NH_4MgPO_4+6H_2O$ in H_2O at t°.

t°	G. salt in 100 g. H_2O
0	0.0231
20	0.0516
40	0.0359
50	0.0303
60	0.0401
70	0.0163
80	0.0195

(Wenger, Dissert. Geneva, **1911.**)

Aqueous solution is precipitated by NH_4OH, but not by Na_2HPO_4+Aq. (Fresenius.)

Sol. in 44,600 pts. H_2O containing ammonia. More sol. in H_2O containing NH_4Cl, and is sol. in 7548 pts. of a solution containing 1 pt. NH_4Cl to 5 pts. H_2O and ammonia, and in 15,627 pts. of a solution containing 1 pt. of NH_4Cl to 7 pts. H_2O and ammonia. (Fresenius.)

According to Kremers (J. pr. **55.** 190), a solution of 3 pts. H_2O to 1 pt. NH_4OH+Aq of 0.96 sp. gr. is best suited for washing the precipitated NH_4MgPO_4.

According to Ebermayer (J. pr. **60.** 41), 1 pt. anhydrous salt is sol. in 13,497 pts. H_2O at 23°; in 31,098 pts. NH_4OH+Aq (4 pts. H_2O: 1 pt. NH_4OH+Aq of 0.961 sp. gr.) at 21.25°; in 36,764 pts. NH_4OH+Aq (3 pts. H_2O: 1 pt. NH_4OH+Aq) at 20.6°; in 43,089 pts. NH_4OH+Aq (1 pt. H_2O: 1 pt. NH_4OH+Aq) at 22.5°; in 45,206 pts. NH_4OH+Aq (1 pt. H_2O: 2 pts. NH_4OH+Aq) at 22.5°; in 52,412 pts. NH_4OH+Aq (1 pt. H_2O: 3 pts. NH_4OH+Aq) at 22.5°; in 60,883 pts. pure NH_4OH+Aq (sp. gr. 0.961) at 22.5°.

Almost absolutely insol. in H_2O containing ¼ vol. NH_4OH+Aq (sp. gr. 0.96) and NH_4Cl, *i. e.*, much more insol. than given by Fresenius. (Kubel, Z. anal. **8.** 125.)

According to Kissel (Z. anal. **8.** 173), 1 l. NH_4OH+Aq (3 pts. H_2O: 1 pt. NH_4OH+Aq of 0.96 sp. gr.) dissolves 4.98 mg. in 24 hours, while 13.9 mg. are dissolved if 18 g. NH_4Cl to a litre of H_2O are also present.

$(NH_4)_2SO_4$+Aq containing 2.2 g. per litre dissolves 71.7 mg.; 3.0 g., 113 mg.; 10 g., 147 mg.; NaCl+Aq containing 2 g. NaCl per l. dissolves 123.4 mg.; $NaNO_3$+Aq containing 3 g. $NaNO_3$ per l. dissolves 93.1 mg. (Liebig, A. **106.** 196.)

Completely insol. in water containing ammonium phosphate or ammonium sodium phosphate. (Berzelius.)

800 ccm. H_2O, sat. with CO_2, dissolve 1.425 g. (Liebig.)

Easily sol. in H_2SO_3+Aq, acetic and other acids, also in boiling solution of ammonium citrate. (Millot, Bull. Soc. (2) **18.** **20.**)

When in presence of Fe or Al salts it is sol. to a considerable extent in $H_2C_4H_4O_6$+Aq.

6 g. NH_4Cl in 100 ccm. H_2O containing 10 ccm. 6.34% NH_4OH+Aq dissolve pptd. salt $=0.0029$ g. $Mg_2P_2O_7$. 1 g. $(NH_4)_2C_2O_4$ in 100 ccm. H_2O, and NH_4OH+Aq dissolve= 0.0061 g. $Mg_2P_2O_7$. 2 g. citric acid in excess of NH_4OH+Aq dissolve=0.0147 g. $Mg_2P_2O_7$. Solubility prevented by excess of magnesia mixture. (Lindo, C. N. **48.** 217.)

Solubility of $NH_4MgPO_4+6H_2O$ in salts+Aq at t°.

(G. salt dissolved in 100 g. solvent.)

t°	5% NH_4NO_3 +Aq.	5% NH_4Cl+Aq.	1 pt. NH_4OH (D=0.96) +4 pts. H_2O
0	0.1100	0.0597	0.0087
20	0.0463	0.1055	0.0098
30	0.0546	0.1133	. . .
40	0.0645	0.0713	0.0135
50	0.0723	0.0931	0.0153
60	0.0846	0.1728	0.0174
70	0.0834	0.1239	0.0178
80	0.1009	0.1913	0.0145

t°	4% NH_4OH+Aq and 5% NH_4Cl+Aq.	4% NH_4OH+Aq and 10% NH_4Cl+Aq.
20	0.0165	0.0541
60	0.0274	0.0731

(Wenger, Dissert. Geneva, **1911.**)

About 3 times as sol. in $Ca(C_2H_3O_2)_2$+Aq as in $NaC_2H_3O_2$+Aq, but solubility is prevented by excess of $MgCl_2$. (Ville, Bull. Soc. (2) **18.** 316.

Sl. sol. in ammonium citrate+Aq containing 400 g. ammonium citrate in a litre. Solubility=0.457% at ord. temp. and 0.58% at 50°. (Bolis, Ch. Z. 1903, **27.** 1151.)

Min. *Struvite.*

$+H_2O$. Insol. in H_2O or citric acid+Aq. (Millot and Maquenne, Bull. Soc. (2) **23.** 238.)

Ammonium magnesium hydrogen *ortho*phosphate, $(NH_4)_2MgH_2(PO_4)_2+3H_2O$ (?).

(Graham.)

Ammonium magnesium phosphate, $5MgO, (NH_4)_2O, 2P_2O_5+24H_2O$.

(Gawalovsky, C. C. **1885.** 721.)

Ammonium magnesium sodium *pyro*phosphate, $(NH_4)_3Mg_6Na(P_2O_7)_4$.

Insol. in H_2O and not decomp. thereby. (Berthelot and André, A. ch. 1897, (7) **11.** 186.)

Ammonium manganous *dimeta*phosphate, $(NH_4)_2Mn(PO_3)_4+4H_2O$.

Relatively easily attacked by acids. (Glatzel, Dissert. **1880.**)

$+6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78**. 346.)

Ammonium manganous *ortho*phosphate, $NH_4MnPO_4+H_2O$.

Sol. in 32,092 pts. cold, and 20,122 pts. boiling H_2O, and in 17,755 pts. NH_4Cl+Aq (1.4% NH_4Cl). (Fresenius.)

$+7H_2O$. Insol. in H_2O below 70°; at 70° 100 g. H_2O dissolve 0.0052 g. salt; at 80°, 0.0067. (Wenger, Dissert. Geneva, **1911.**)

Easily sol. in dil. acids. Decomp. by KOH+Aq, but not by NH_4OH+Aq or K_2CO_3+Aq. Insol. in NH_4OH or NH_4 salts +Aq. (Gibbs.)

Solubility in salts+Aq at t°.

(G. in 100 g. solvent.)

t°	5% NH_4NO_3 +Aq.	5% NH_4Cl+Aq.	1 pt. NH_4OH D = 0.96 +4 pts. H_2O.
0	0.0206	0.0020	0.0116
20	0.0200	0.0255	0.0122
30	0.0226	0.0345	...
40	0.0209	0.0386	0.0118
50	0.0226	0.0355	0.0132
60	0.0270	0.0384	0.0193
70	0.0281	0.0414	0.0191
80	0.0326	0.0451	0.0197

(Wenger, *l. c.*)

Insol. in alcohol.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Ammonium manganic *pyro*phosphate, $NH_4MnP_2O_7+3H_2O$.

Decomp. by cold H_2O with separation of Mn_2O_3. (Rosenheim, B. 1915, **48.** 584.)

Ammonium manganous sodium *pyro*phosphate, $NH_4NaMnP_2O_7+3H_2O$.

Insol. in H_2O or alcohol. Easily sol. in very dil. acids. (Otto, J. pr. **2.** 418.)

Formula is $Na_4(NH_4)_4Mn_2(P_2O_7)_3+12H_2O$, according to Berzelius.

Ammonium mercuric *meta*phosphate.

Sol. in H_2O, or at least in NH_4OH+Aq. (Persoz, J. pr. **3.** 216.)

Ammonium nickel *meta*phosphate.

Insol. in H_2O. Sol. in NH_4OH+Aq, from which it is repptd. on evaporation of the NH_3. (Persoz, J. pr. **3.** 215.)

Ammonium nickel *dimeta*phosphate, $(NH_4)_2NiP_4O_{12}+4H_2O$.

Sol. in 12.5 pts. H_2O. (Glatzel, Dissert. **1880.**)

Ammonium nickel *ortho*phosphate, $NH_4NiPO_4+2H_2O$.

Ppt. (Debray, C. R. **59.** 40.)

$+6H_2O$. Decomp. by boiling H_2O. (Debray.)

Ammonium potassium *dimeta*phosphate, $(NH_4)_{10}K_4(P_2O_6)_7$.

More sol in H_2O than following salt. (Fleitmann, Pogg. **78.** 341.)

$NH_4K_3P_4O_{12}+2H_2O$. Difficultly sol. in H_2O. (Fleitmann.)

Ammonium potassium *pyro*phosphate, $NH_4K_2HP_2O_7+\frac{1}{2}H_2O$.

Deliquescent. Sol. in H_2O. Decomp. on boiling. (Schwarzenberg.)

Ammonium sodium *dimeta*phosphate, $NH_4NaP_2O_6+H_2O$.

More sol. in H_2O than $Na_2P_2O_6$, but less than $(NH_4)_2P_2O_6$. Less sol. in alcohol than in H_2O. (Fleitmann, Pogg. **78.** 340.)

Ammonium sodium *ortho*phosphate, $(NH_4)_2NaPO_4+4H_2O$.

Decomp. by H_2O. Cryst. from NH_4OH+Aq of 0.96 sp. gr. From H_2O solution, $NaNH_4HPO_4+4H_2O$ separates out. (Uelsmann, Arch. Pharm. (2) **99.** 138.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+5H_2O$.

$NH_4Na_2PO_4+12H_2O$. (Herzfeld, Z. anal. **20.** 191.)

$(NH_4)_5Na(PO_4)_2+6H_2O$. Sol. in H_2O with decomp. Cryst. from hot conc. NH_4OH+Aq. (Uelsmann, Arch. Pharm. (2) **99.** 138.)

Ammonium sodium hydrogen phosphate (Microcosmic salt), $NH_4NaHPO_4+4H_2O$.

Efflorescent. Easily sol. in H_2O. Sol. in 6 pts. cold, and 1 pt. boiling H_2O. Insol. in alcohol.

Aqueous solution gives off NH_3, especially if hot.

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Min. *Stercorite.*

$+5H_2O$. (Uelsmann.)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, **34.** 319.)

$(NH_4)_3Na_3H_6(PO_4)_4+3H_2O$. Decomp. by H_2O. (Filhol and Senderens, C. R. **93.** 388.)

Ammonium sodium *pyro*phosphate, $(NH_4)_2Na_2P_2O_7+5H_2O$.

Easily sol. in H_2O. Aqueous solution decomp. by boiling. (Schwarzenberg, A. **65.** 142.)

$+6H_2O$. (Rammelsberg.)

Ammonium sodium glucinum *ortho*phosphate, $(NH_4)_2Na_2Gl(PO_4)_2+7H_2O$.

Precipitate. (Scheffer.)

Ammonium thallous *ortho*phosphate, $(NH_4)_3PO_4$, $(NH_4)_2TlPO_4$, or $H_2NH_4PO_4$, HTl_2PO_4.

Sol. in H_2O. (Lamy; Rammelsberg.)

Ammonium uranyl phosphate, $NH_4(UO_2)PO_4+xH_2O$.

Insol. in H_2O and $HC_2H_3O_2$+Aq. Sol. in mineral acids, from which it is precipitated by $NH_4C_2H_3O_2$+Aq, in which it is insol. (Knop.)

$+3H_2O$. Insol. in H_2O and acetic acid. Sol. in all mineral acids, oxalic acid and M_2CO_3+Aq. (Lienau, Dissert. **1898.**)

Ammonium vanadium phosphate.

See **Phosphovanadate, ammonium.**

Ammonium zinc *dimeta*phosphate, $(NH_4)_2Zn(P_2O_6)_2+6H_2O$.

Efflorescent. (Fleitmann, Pogg. **78.** 347.)

$+4H_2O$. Sol. in 70 pts. H_2O. Decomp. by H_2SO_4. (Glatzel, Dissert. **1880.**)

Ammonium zinc *ortho*phosphate, basic, $3NH_3$, $2ZnO$, $P_2O_5+8H_2O$.

(Rother, A. 1867, **143.** 356.)

$4(NH_4)_2O$, $6ZnO$, $3P_2O_5+4H_2O$. (Schweikert, A. 1868, **145.** 57.)

Ammonium zinc *ortho*phosphate, $NH_4ZnPO_4+H_2O$.

Insol. in H_2O. Sol. in acids, and caustic alkalies. (Bette, A. **15.** 129.)

Ammonium zinc hydrogen phosphate, $NH_4H_2PO_4$, $ZnHPO_4+H_2O$.

Insol. in H_2O. (Debray.)

$4(NH_4)_2O$, $6ZnO$, $3P_2O_5$. (Schweikert, A. **145.** 57.)

$3(NH_4)_2O$, $4ZnO$, $2P_2O_5+13H_2O$. (Rother, A. **143.** 356.)

Ammonium phosphate selenate.

See **Selenophosphate, ammonium.**

Barium *tri*phosphate, $5BaO$, $3P_2O_5$.

Insol. in H_2O; insol. in acids after heating to a high temp. (Schwarz, Z. anorg. 1895, **9.** 264.)

Barium *meta*phosphate, $Ba(PO_3)_2$.

Insol. in H_2O or dil. acids. (Maddrell, A. **61.** 61.)

Not decomp. by boiling with acids or alkali carbonates+Aq. (Fleitmann, Pogg. **78.** 352.)

Barium *dimeta*phosphate, $BaP_2O_6+2H_2O$.

More difficultly sol. in H_2O than $Ba_3(P_3O_9)_2$. Slightly attacked by boiling conc. HCl+Aq or HNO_3+Aq. Easily decomp. by H_2SO_4. (Fleitmann, Pogg. **78.** 254.)

Barium *trimeta*phosphate, $Ba_3(P_3O_9)_2+2H_2O$.

Somewhat sol. in H_2O. (Fleitmann, A. **65.** 313.)

$+6H_2O$. Easily sol. in HCl+Aq. (Lindbom.)

1 l. H_2O dissolves 2.589 g. at ord. temp. (Wiesler, Z. anorg. 1901, **28.** 198.)

Barium *hexameta*phosphate, $Ba_3P_6O_{18}$ (?).

Sol. in H_2O only after boiling several hours. Nearly insol. in H_2O. (Lüdert, Z. anorg. **5.** 15.)

Insol. in NH_4Cl+Aq. (Wackenroder.)

Sol. in $Na_6P_6O_{18}$+Aq. Sol. in HNO_3+Aq. After ignition it is nearly insol. in HNO_3+Aq.

Barium *ortho*phosphate, $Ba_3(PO_4)_2$.

Precipitate. Very sl. sol. or insol. in H_2O. (Graham, Pogg. **32.** 49.)

Sol. in HCl+Aq. Decomp. by SO_2+Aq.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Barium hydrogen phosphate, $BaHPO_4$.

Sol. in 10,000 pts. H_2O. (Malaguti, A. ch. (3) **51.** 346.)

Sol. in 20,570 pts. H_2O at 20°. (Bischof, **1833.**)

Not completely soluble in water containing CO_2, but $BaCl_2$ causes no ppt. in Na_2HPO_4+Aq containing 7.16 g. or less Na_2HPO_4 in a litre after it has been saturated with CO_2. (Setschenow, C. C. **1875.** 97.)

Easily sol. in H_3PO_4+Aq, and dil. HCl+Aq. HNO_3+Aq of 1.275 sp. gr. if not diluted has scarcely any solvent action, but more dissolves on dilution until a maximum is reached, when 10 vols. of H_2O have been added. (Bischof, Schw. J. **67.** 39.)

Sol. in 367-403 pts. acetic acid (1.032 sp. gr.) at 22.5°. (Bischof, *l. c.*)

Easily sol. in H_2O containing NH_4Cl, NH_4NO_3, or NH_4 succinate, from which solutions it is completely pptd. by NH_4OH+Aq. (Rose.)

Insol. in Na_2HPO_4 or $BaCl_2$+Aq. (Rose, Pogg. **76.** 23.)

More sol. in $BaCl_2$ or NaCl+Aq than in H_2O, 1 pt. $BaHPO_4$ being sol. in 4362 pts. H_2O containing 1.2% NaCl and 0.8% $BaCl_2$. (Ludwig, Arch. Pharm. (2) **56.** 265.)

Sol. in Na citrate+Aq. (Spiller.)

Barium *tetra*hydrogen phosphate, $BaH_4(PO_4)_2$.

Sol. in H_2O. (Mitscherlich, **1821.**)

Decomp. by much H_2O into $BaHPO_4$. Sol. in phosphoric, and certain other acids. (Berzelius, A. ch. **2.** 153.)

Barium *pyro*phosphate, $Ba_2P_2O_7+xH_2O$.

Somewhat sol. in H_2O, in much $H_4P_2O_7$+Aq, also in HCl+Aq or HNO_3+Aq. Insol. in $HC_2H_3O_2$+Aq or $Na_4P_2O_7$+Aq. (Schwarzenberg.)

Insol. in NH_4Cl+Aq. (Wackenroder.)

Barium hydrogen *pyro*phosphate, $BaH_2P_2O_7$, $Ba_2P_2O_7+3H_2O$.

Ppt. (Knorre and Oppelt, B. **21.** 773.)

Barium *tetra*phosphate, $Ba_3P_4O_{13}$.

Insol. in H_2O or acids when strongly heated. (Fleitmann and Henneberg, A. **65.** 331.)

Barium manganic *pyro*phosphate, $Ba(MnP_2O_7)_2+5H_2O$.

Almost insol. in H_2O. (Rosenheim, B. 1915, **48.** 585.)

Barium potassium *trimeta*phosphate, $BaKP_3O_9+H_2O$.

Much less sol. in H_2O than $NH_4BaP_3O_9$ or $NaBaP_3O_9$. (Lindbom.)

Sol. in HCl+Aq after ignition.

Barium potassium *ortho*phosphate, $BaKPO_4$.

Insol. in H_2O. (Ouvrard, A. ch. (6) **16.** 297.)

$+10H_2O$. (de Schulten, C. R. **96.** 706.)

Barium sodium *dimeta*phosphate, $BaNa_2(P_2O_6)_2+4H_2O$.

(Glatzel, Dissert. **1880.**)

Barium sodium *trimeta*phosphate, $BaNaP_3O_9+4H_2O$.

More easily sol. in H_2O than $Ba_3(P_3O_9)_2$. Sol. in acids, unless ignited. (Fleitmann and Henneberg, A. **65.** 314.)

Efflorescent. Sol. in HCl+Aq after ignition only by long boiling. When fused it is easily sol. in HCl+Aq. (Lindbom, Acta Lund. **1873.** 21.)

Barium sodium *ortho*phosphate, $BaNaPO_4+10H_2O$.

(de Schulten, C. R. **96.** 706.)

Not attacked by cold, but decomp. by hot H_2O. (Villiers, C. R. **104.** 1103.)

Sl. sol. in H_2O. (Quartaroli, C. A. **1911.** 2375.)

Barium sodium *pyro*phosphate, $Ba_4Na_4(P_2O_7)_3$.

Sol. in hot HCl and HNO_3. (Tammann, J. pr. 1892, (2) **45.** 469.)

$6Ba_2P_2O_7$, $Na_4P_2O_7+6H_2O$. Completely insol. in $Na_4P_2O_7$+Aq, but not insol. in H_2O or NH_4OH+Aq. Easily sol. in HNO_3 or HCl +Aq. Insol. in alcohol. (Baer, Pogg. **75.** 164.)

Barium uranous *meta*phosphate, UO_2, BaO, P_2O_5.

(Colani, A. ch. 1907, (8) **12.** 142.)

Barium uranyl *ortho*phosphate, $Ba(UO_2)_2(PO_4)_2+8H_2O$.

Min. *Uranocircite.*

Barium phosphate chloride, $3Ba_3(PO_4)_2$, $BaCl_2$.

Min. *Barytapatite.* (Deville and Caron, A. ch. (3) **67.** 451.)

$4BaH_4(PO_4)_2$, $BaCl_2$. (Erlenmeyer, J. B. **1857.** 145.)

$15BaO$, $6P_2O_5$, $BaCl_2+6H_2O$ (?). Sol. in 18,000 pts. cold H_2O. Much more sol. in H_2O containing $BaCl_2$, NH_4Cl, and NH_4OH. (Ludwig, Arch. Pharm. (2) **56.** 271.)

Bismuth *ortho*phosphate, basic, $2BiPO_4$, $3Bi_2O_3$.

Insol. in H_2O. Sol. in HCl+Aq. (Cavazzi, Gazz. ch. it. **14.** 289.)

Bismuth *ortho*phosphate, $BiPO_4$.

Insol. in H_2O or HNO_3+Aq. Sl. sol. in NH_4 salts+Aq. (Chancel, C. R. **50.** 416.)

Not decomp. by H_2O. Other phosphates of Bi are decomp. by H_2O. (Montmartini, C. C. **1900,** II. 1256.)

Not hydrolyzed by hot H_2O; sl. sol. in $BiCl_3$ +Aq; decomp. by boiling alkali. (Caven, J. Soc. Chem. Ind. 1897, **16.** 30.)

More sol. in HCl+Aq than in HNO_3+Aq. (Rose.)

Sol. in $UO_2(NO_3)_2$+Aq. (M'Curdy, Am. J. Sci. (2) **31.** 282.)

Insol. in MNO_3+Aq.

Insol. in Bi salts+Aq. (Rose, Pogg. **76.** 26.)

Sol. in NH_4Cl+Aq, but insol. in NH_4NO_3+Aq. (Brett, **1837.**)

$+1\frac{1}{2}H_2O$. (Kühn.)

$+3H_2O$. Ppt. Decomp. by H_2S or KOH +Aq. (Vanino, J. pr. 1906, (2) **74.** 151.)

Bismuth *pyro*phosphate, basic, $2Bi_2O_3$, P_2O_5.

Insol. in H_2O and $HC_2H_3O_2$+Aq; sol. in hot HCl and HNO_3+Aq. Insol. in $Na_4P_2O_7$ +Aq, and NH_4 citrate+Aq. (Passerini, Cim. **9.** 84.)

Bismuth *pyro*phosphate, $Bi_4(P_2O_7)_3$.

Insol. in H_2O or HNO_3+Aq. (Chancel, C. R. **50.** 416.)

Decomp. by H_2O. (Wallroth, Bull. Soc. (2) **39.** 316.)

Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Bismuth sodium *pyro*phosphate, $NaBiP_2O_7+3H_2O$.

Insol. in H_2O. (Rosenheim, B. 1915, **48.** 588.

Boron phosphate, BPO_4.

Insol. in H_2O. Not attacked by boiling alkalies. (Meyer, B. **22.** 2919.)

Bromomolybdenum phosphate.
See under **Bromomolybdenum comps.**

Cadmium *tri*phosphate, $Cd_5(P_3O_{10})_2$.
Insol. in H_2O and acids. (Glühmann, Dissert. **1899.**)

Cadmium *tetra*phosphate, $6CdO$, $4P_2O_5+18H_2O$.
Insol. in acids. (Glühmann.)

Cadmium *meta*phosphate.
Very sol. in NH_4OH+Aq. (Persoz, A. ch. **56.** 334.)

Cadmium *dimeta*phosphate, $Cd(PO_3)_2+2H_2O$.
Sol. in 32 pts. H_2O. Scarcely attacked by acids, especially conc. H_2SO_4. (Glatzel, Dissert. **1880.**)

Cadmium *tetrameta*phosphate.
Insol. in H_2O. Easily decomp. by Na_2S+Aq. (Fleitmann, Pogg. **78.** 358.)
$Cd_2(PO_3)_4+10H_2O$. Not so very difficultly attacked by acids but insol. after ignition. (Glatzel, Dissert. **1880.**)

Cadmium *ortho*phosphate, $Cd_3(PO_4)_2$.
Ppt. Insol. in H_2O. Sol. in Cd salts+Aq. (Stromeyer.)
Easily sol. in NH_4 sulphate, chloride, nitrate, or succinate+Aq. (Wittstein, Repert. **57.** 32.)
$H_2Cd_5(PO_4)_4+4H_2O$. Sol. in dil. H_3PO_4+Aq. (de Schulten, Bull. Soc. (3) **1.** 473.)

Cadmium *tetra*hydrogen phosphate, $CdH_4(PO_4)_2+2H_2O$.
Decomp. by great excess of H_2O. (de Schulten.)

Cadmium *pyro*phosphate, $Cd_2P_2O_7+2H_2O$.
Insol. in H_2O. Sol. in NH_4OH, $Na_4P_2O_7+Aq$, or acids. Insol. in $KOH+Aq$. Sol. in SO_2+Aq. (Schwarzenberg, A. **65.** 183.)

Cadmium hydrogen *ortho*phosphate hydrazine, $CdHPO_4$, $2N_2H_4$.
Decomp. by light. (Franzen, Z. anorg. 1908, **60.** 283.)

Cadmium potassium *tetrameta*phosphate, $CdK_2(PO_3)_4+3H_2O$.
Sol. in 135 pts. H_2O. Difficultly decomp. by acids. (Glatzel, Dissert. **1880.**)

Cadmium potassium *ortho*phosphate, $CdKPO_4$.
Insol. in H_2O; sol. in dil. $HCl+Aq$. (Ouvrard, A. ch. (6) **16.** 321.)

Cadmium potassium *pyro*phosphate, $CdK_2P_2O_7$.
Insol. in H_2O; sol. in dil. $HCl+Aq$. (Ouvrard.)
$5Cd_2P_2O_7$, $4K_4P_2O_7+30H_2O$. Much more easily sol. in H_2O than the CdNa salt. (Pahl, Sv. V. A. F. **30, 7.** 39.)

Cadmium sodium *tri*phosphate, $Na_3CdP_3O_{10}+12H_2O$.
Sol. in acids even after ignition. (Glühmann, Dissert. **1899.**)

Cadmium sodium *trimeta*phosphate, $Na_4Cd(PO_3)_6+4H_2O$.
Sl. sol. in H_2O. Insol. in alcohol. (Wiesler, Z. anorg. 1901, **28.** 204.)

Cadmium sodium *tetrameta*phosphate, $Na_2Cd(PO_3)_4+3H_2O$.
Completely insol. in H_2O. (Glatzel, Dissert. **1880.**)

Cadmium sodium *ortho*phosphate, $CdNa_4(PO_4)_2$.
Insol. in H_2O; very sol. in dil. acids.
$CdNaPO_4$. As above. (Ouvrard.)

Cadmium sodium *pyro*phosphate, $CdNa_2P_2O_7$.
Sol. in dil. acids, even acetic acid. (Wallroth.)
$+4H_2O$. Insol. in H_2O. (Pahl, Sv. V. A. F. **30, 7.** 39.)

Cadmium phosphate bromide, $3Cd_3(PO_4)_2$, $CdBr_2$.
Sol. in cold very dil. HNO_3+Aq. (de Schulten, Bull. Soc. (3) **1.** 472.)

Cadmium phosphate chloride, $3Cd_3(PO_4)_2$, $CdCl_2$.
Sol. in dil. HNO_3+Aq. (de Schulten.)

Cæsium *meta*phosphate, $CsPO_3$.
Sol. in H_2O. (von Berg, B. 1901, **34.** 4185.)

Cæsium *ortho*phosphate, $Cs_3PO_4+5H_2O$.
Deliquescent; very sol. in H_2O. (von Berg.)

Cæsium hydrogen *ortho*phosphate, $Cs_2HPO_4+H_2O$.
Very sol. in H_2O. (von Berg.)

Cæsium *di*hydrogen *ortho*phosphate, CsH_2PO_4.
Sol. in H_2O; insol. in alcohol. (von Berg.)

Cæsium *pyro*phosphate, $Cs_4P_2O_7$.
Very sol. in H_2O; very hydroscopic. (von Berg.)

Calcium *tri*phosphate, $5CaO, 3P_2O_5$.

Insol. in H_2O. (Schwarz, Z. anorg. 1895, **9.** 264.)

Calcium *monometa*phosphate, $Ca(PO_3)_2$.

Insol. in H_2O and dil. acids. (Maddrell, A. **61.** 61.)

Not decomp. by digestion with alkali carbonates+Aq. (Fleitmann.)

Calcium *dimeta*phosphate, $Ca_2(P_2O_6)_2+4H_2O$.

Insol. in H_2O. Decomp. by warm H_2SO_4, but not appreciably by conc. HCl or HNO_3+Aq. (Fleitmann, Pogg. **78.** 255.)

Calcium *hexameta*phosphate (?).

Insol. in H_2O. Sol. in $Na_6P_6O_{18}$+Aq and in HCl+Aq. (Rose, Pogg. **76.** 3.)

$Ca_3P_6O_{18}$. Nearly insol. in H_2O; sol. in dil. acids. (Lüdert, Z. anorg. **5.** 15.)

Calcium *ortho*phosphate, basic, $3Ca_3(PO_4)_2+CaO_2H_2$.

(Warington, J. B. **1873.** 253.)

$4CaO, P_2O_5$. (Hilgenstock.)

Calcium *ortho*phosphates,

Equilibrium in system $CaO+P_2O_5+H_2O$.

Solubility of CaO in P_2O_5+Aq at 25°.

g. CaO per l. of solution	g. P_2O_5 per l. of solution	Solid phase
1.71	4.69	$CaHPO_4, 2H_2O$
7.48	22.39	
8.10	23.37	
11.57	36.14	
12.88	41.24	
18.77	59.35	
19.25	63.03	
23.31	75.95	
23.69	79.10	
32.41	109.8	
35.90	129.8	
39.81	139.6	
40.89	142.7	
43.82	154.6	
49.76	191.0	
55.52	216.5	
59.40	234.6	
70.31	279.7	
72.30	351.9	$CaH_4(PO_4)_2, H_2O$
69.33	361.1	
65.46	380.3	
63.53	395.1	
59.98	419.7	
59.25	424.6	
57.74	428.0	
53.59	451.7	
48.78	475.3	
44.52	505.8	
41.86	528.9	
39.89	538.3	

(Cameron and Seidell, J. Am. Chem. Soc. 1905, **27.** 1508.)

Solubility of CaO in P_2O_5+Aq at 25°.

g. CaO per l. of solution	g. P_2O_5 per l. of solution	Solid phase
7.61	19.96	$CaHPO_4$
6.51	16.52	
5.01	12.82	
3.42	8.16	
2.42	5.75	
1.58	3.66	
0.544	1.516	Solid phases are evidently solid solutions
0.400	1.108	
0.291	0.773	
0.232	0.662	
0.145	0.381	
0.062	0.109	
0.049	0.088	
0.034	0.015	$Ca_3(PO_4)_2$
0.587	0.013	Solid phase is probably a solid solution
0.789	0.012	

(Cameron and Seidell, J. Am. Chem. Soc. 1905, **27.** 1513.)

Solubility of CaO in P_2O_5+Aq at 50.7°.

100 g. of the solution contain		Solid phase
g. P_2O_5	g. CaO	
62.01	0.336	$CaH_4P_2O_8+CaH_4P_2O_8, H_2O$
58.08	0.635	$CaH_4P_2O_8, H_2O$
54.67	0.939	"
50.25	1.428	"
46.15	2.100	"
41.92	2.974	"
37.33	3.898	"
33.18	4.880	"
29.61	5.725	$CaH_4P_2O_8, H_2O+CaHPO_4$
15.48	3.507	$CaHPO_4$
9.465	2.328	"
6.157	1.563	"
2.946	0.852	"
2.281	0.692	"
0.1521	0.0588	"
0.1527	0.0596	$CaHPO_4, 2H_2O$
0.1331	0.0514	$Ca_3P_2O_8, H_2O$
0.0942	0.0351	"
0.0309	0.0106	"
0.00068	0.00071	"

(Bassett, Z. anorg. 1908, **59.** 15.)

Solubility of CaO in P_2O_5+Aq at 40°.

100 g. of the solution contain		Solid phase
g. P_2O_5	g. CaO	
45.42	1.768	$CaH_4P_2O_8, H_2O$
41.33	2.588	"
36.79	3.584	"
32.46	4.505	"
28.27	5.501	"
21.67	4.813	$CaHPO_4$
17.78	4.100	"
16.35	3.810	"
9.905	2.536	"
6.979	1.847	"
4.397	1.267	"
1.819	0.57[illegible]	"
0.423	0.156	"
0.294	0.110	"
0.158	0.0592	"
0.146	0.0519	"
0.128	0.0508	$Ca_3P_2O_8, H_2O$
0.0262	0.0098	"
trace	0.0709	$Ca_4P_2O_9, 4H_2O$
"	0.0814	"
"	0.0829	"
"	0.0840	"

(Bassett, Z. anorg. 1908, **59.** 18.)

Solubility of CaO in P_2O_5+Aq at 25°.

100 g. the solution contain		Solid phase
g. P_2O_5	g. CaO	
36.11	3.088	$CaH_4P_2O_8, H_2O$
31.97	4.128	"
28.34	4.908	"
27.99	4.930	"
25.45	5.489	"
22.90	5.523	$CaHPO_4$
17.55	4.499	"
15.34	4.027	"
9.10	2.638	"
6.049	1.878	"
3.613	1.181	"
2.387	0.826	"
0.417	0.165	$CaHPO_4+CaHPO_4, 2H_2O$
0.178	0.0696	"
0.0332	0.0126	"
0.0948	0.0352	Probably $Ca_3P_2O_8, H_2O$
0.0571	0.0211	"
0.0525	0.0175	"
0.0468	0.0186	"
trace	0.1131	$Ca_4P_2O_9, 4H_2O+Ca(OH)_2$
	0.118	$Ca(OH)_2$

(Bassett, Z. anorg. 1908, **59.** 20.)

Calcium *ortho*phosphate, $Ca_3(PO_4)_2$.

Decomp. by long boiling with H_2O into basic salt, $3Ca_3(PO_4)_2, CaO_2H_2$. This decomp. begins with cold H_2O, so that the solubility at 6–8° varies from 9.9 to 28.6 mg. in a litre. (Warington, Chem. Soc. (2) **11.** 983.)

1 l. cold H_2O dissolves in 7 days 31 mg. ignited, and 79 mg. freshly precipitated $Ca_3(PO_4)_2$. (Völcker, J. B. **1862.** 131.)

100,000 pts. H_2O dissolve 2.36 pts. gelatinous Ca phosphate; 2.56 pts. ignited Ca phosphate; 3.00 pts. Ca phosphate from bone dust. (Maly and Donath, J. pr. (2) **7.** 416.)

Solubility of bones in various solvents is given by Maly and Donath, *l. c.*

0.009 g. $Ca_3(PO_4)_2$ is sol. in 1 l. H_2O.
0.153 " " " " " " " sat. with CO_2. (Joffre, Bull. Soc. 1898, (3) **19.** 372.)

Determinations of solubility in H_2O as stated in the literature vary because $Ca_3(PO_4)_2$ is apparently a solid solution of $CaHPO_4$ and CaO. When placed in contact with H_2O more PO_4 ions dissolve than Ca ions, the resulting solution is acid and solid phase richer in Ca than before addition of H_2O. For material of the approximate composition, $Ca_3(PO_4)_2$, the amt. dissolved by CO_2 free H_2O at ord. temp. is 0.01–0.10 g. per l. depending on conditions of experiment. H_2O sat with CO_2 dissolves 0.15–0.30 g. per l. (Cameron and Hurst, J. Am. Chem. Soc. 1904, **26.** 903.)

The decomposition of $Ca_3(PO_4)_2$ in H_2O is increased by presence of $CaSO_4$; decreased by presence of $CaCO_3$ or of $CaSO_4$ and CO_2. CO_2 increases the amount of PO_4 dissolved in the solution of water alone and the sat. $CaSO_4$ solutions, but has no other effect than to increase the amount of Ca in the solutions in contact with $CaCO_3$. (Cameron and Seidell, J. Am. Chem. Soc. 1904, **26.** 1458.)

Sol. in CO_2+Aq.

1 l. H_2O containing 1 vol. CO_2 dissolves in 12 hours at 10°, 0.75 g. precipitated $Ca_3(PO_4)_2$; 0.166 g. $Ca_3(PO_4)_2$ from bone ash; 0.300 g. $Ca_3(PO_4)_2$ from bones which had been buried 20 years. (Lassaigne, J. ch. méd. (3) **3.** 11.)

1 l. H_2O containing 0.8 vol. CO_2 dissolves 0.61 g. $Ca_3(PO_4)_2$. (Liebig, A. **106.** 196.)

H_2O sat. with CO_2 at 5–10° and 760 mm. pressure dissolves 0.527–0.60 g. $Ca_3(PO_4)_2$, or, if containing 1% NH_4Cl, 0.739 g. $Ca_3(PO_4)_2$. (Warington, Chem. Soc. (2) **9.** 80.)

Solubility varies according to form of $Ca_3(PO_4)_2$.

In apatite, 1 pt. $Ca_3(PO_4)_2$ dissolves in 222,222 pts. H_2O sat. with CO_2; in raw bones, in 5698 pts.; in bone ash, in 8029 pts.; in So. Carolina phosphate, in 6983 pts.; in phosphatic guano from Orchilla Id., in 8009 pts. (Williams, C. N. **24.** 306.)

$Al_2O_6H_6$ and $Fe_2O_6H_6$ prevent the solubility of $Ca_3(PO_4)_2$ in H_2O containing CO_2. (Warington, *l. c.*)

1 l. H_2O dissolves 0.22848 g. $Ca_3(PO_4)_2$. under a CO_2-pressure of 2 atmos. at 14°. (Ehlert, Z. Elektrochem. 1912, **18.** 728.)

Sol. in SO_2+Aq, forming a liquid of 1.3 sp. gr. at 9° from freshly precipitated $Ca_3(PO_4)_2$, and of 1.188 sp. gr. from bone ash.

Sol. in H_2S+Aq. 1 l. H_2O sat. with H_2S

dissolves 190–240 mg. $Ca_3(PO_4)_2$. (Béchamp, A. ch. (4) **16.** 241.)

Easily sol. in HNO_3 or HCl+Aq.

100 pts. very dil. HCl+Aq dissolve 198–225 pts. $Ca_3(PO_4)_2$. (Crum, A. **63.** 291.)

100 pts. HCl of 1.153 sp. gr. (containing 31% HCl) dissolve at 17° when diluted with:

0	1	4	7 pts. H_2O,
25.3	45.0	62.3	64.7 pts. $Ca_3(PO_4)_2$,
10	13	16	19 pts. H_2O.
68.0	71.9	69.5	69.7 pts. $Ca_3(PO_4)_2$.

(Bischof, Schw. J. **67.** 39.)

Decomp. by H_2SO_4.

Completely decomp. to $CaSO_4$ and H_3PO_4 by a mixture of H_2SO_4 and alcohol.

Solubility in HNO_3+Aq.

1 pt. of $Ca_3(PO_4)_2$ dissolves at 16.25–17.5° in pts. HNO_3+Aq which contain pts. H_2O to 1 pt. HNO_3 (sp. gr. = 1.23).

Pts. HNO_3+Aq	Pts. H_2O	Pts. HNO_3+Aq	Pts. H_2O
2.72	0	30.64	10.754
4.23	0.827	26.48	13
10.25	3.309	32.14	13.236
15.45	5.791	36.06	15.718
20.34	8.273	127.81	40
20.82	10	...	...

(Bischof, **1833.**)

More sol. in acetic, lactic, malic, and tartaric acids than in HCl or HNO_3+Aq. (Crum.)

Solubility in H_3PO_4+Aq.

G. H_3PO_4 in 100 cc. of H_3PO_4+Aq	G. $Ca_3(PO_4)_2$ dissolved by 100 cc. of solvent
5	3.85
10	7.28
15	9.45
20	12.50
25	13.79
30	15.10

(Causse, C. R. 1892, **114.** 414.)

Very small quantities of the salts of the alkali metals increase the solubility in H_2O. (Lassaigne, J. chim. méd. (3) **3.** 11.)

1 litre cold H_2O with 2 g. NaCl dissolves 45.7 mg. $Ca_3(PO_4)_2$; with 3 g. $NaNO_3$, 33 mg. $Ca_3(PO_4)_2$. (Liebig.)

1 litre H_2O containing 8.75% NaCl dissolves 317.5 mg. $Ca(PO_4)_2$. (Lassaigne.)

NH_4 salts have even more effect, especially NH_4Cl+Aq, which dissolves $Ca_3(PO_4)_2$ in the cold; also ammonium nitrate and succinate. (Wittstein.)

$(NH_4)_2SO_4$+Aq dissolves $Ca_3(PO_4)_2$ as easily as $CaSO_4$. (Liebig, A. **61.** 128.)

1 litre H_2O containing 2 g. NaCl dissolves at 7–12.3° 45.7 mg. $Ca_3(PO_4)_2$; 3 g. $NaNO_3$ at 17.3°, 33 mg. $Ca_3(PO_4)_2$; 2.2 g. $(NH_4)_2SO_4$, 76.7 mg. $Ca_3(PO_4)_2$. (Liebig, A. **106.** 185.)

Dry $Ca_3(PO_4)_2$ also dissolves by long boiling with solutions of ammonium chloride, nitrate, succinate (Wittstein), or sulphate (Delkeskamp).

Sol. in 89,448 pts. H_2O (boiled) at 7°; 19,028 pts. H_2O (boiled) containing 1% NH_4Cl at 10°; 4324 pts. H_2O (boiled) containing 10% NH_4Cl at 17°; 1788 pts. H_2O sat. with CO_2 and containing 10% NH_4Cl at 10° and 751 mm. pressure; 1351 pts. H_2O sat. with CO_2 and containing 1% NH_4Cl at 12° and 745 mm. pressure; 42,313 pts. H_2O sat. with CO_2 and containing $CaCO_3$ at 21° and 756.3 mm. pressure; 18,551 pts. H_2O sat. with CO_2 and containing $CaCO_3$ and 1% NH_4Cl at 16° and 746.1 mm. pressure. (Warington, Chem. Soc. (2) **4.** 296.)

Aqueous solutions of the following NH_4 salts dissolve the given amts. of $Ca_3(PO_4)_2$, calculated for 100 pts. of the corresponding acid: NH_4Cl, 0.655 pt.; NH_4NO_3, 0.306 pt.; $(NH_4)_2SO_4$, 1.050 pts.; $NH_4C_2H_3O_2$, 0.255 pt.; NH_4 tartrate, 4.56 pts.; NH_4 citrate, 7.015 pts.; NH_4 malate, 1.125 pts. $Ca_3(PO_4)_2$. (Terreil, Bull. Soc. (2) **35.** 578.)

Solubility in various salts+Aq under a CO_2 pressure of 2 atmospheres, at 14°.

Salt	G. salt per 100 g. H_2O	G. $Ca_3(PO_4)_2$ sol. in 1 l. of the solvent.
H_2O		0.22848
NaCl	50	1.3208
	conc.	0.64089
$MgCl_2+6H_2O$	86.9	1.2873
	conc.	2.8923
$KMgCl_3+6H_2O$	79.2	1.5771
	conc.	1.1536
K_2SO_4, $MgSO_4$, $MgCl_2+6H_2O$	70.95	1.7777
	conc.	2.4911
$NaNO_3$	72.7	1.5827
	conc.	0.8638
K_2SO_4	74.5	4.9041
	conc.	4.7649
$(NH_4)_2SO_4$	56.5	2.4131
	conc.	5.8849
$Na_2SO_4+10H_2O$	137.7	2.4911
	conc.	3.2267
$MgSO_4+7H_2O$	105.3	1.9728
	conc.	3.6001
NH_4Cl	45.74	1.3710
	conc.	1.2929

(Ehlert and Hempel, Z. Elektrochem. **1912**, **18.** 728.)

$Ca_3(PO_4)_2$ is sol. in $K_2C_2O_4$+Aq. 100 ccm. $K_2C_2O_4$+Aq (1½% $K_2C_2O_4$) dissolves 57.1% of the P_2O_5 from phosphorite, 71% from guano by boiling 25 min. At ord. temp. bone meal gives up 50–80% of its P_2O_5 to $K_2C_2O_4$+Aq in 36 hours. (Liebig, Landw. J. B. **1881.** 603.)

Sol. in Ca sucrate+Aq. (Bobierre, C. R. **32.** 859.)

More sol. in H_2O containing starch, glue, or other animal substances than in pure H_2O. (Vauquelin, Pogg. **85.** 126.)

Sol. in H_2O containing organic matter, therefore when bones decay under H_2O, $Ca_3(PO_4)_2$ is dissolved in considerable quantity. (Hayes, Edin. Phil. J. **5.** 378.)

Sol. in sodium citrate+Aq. (Spiller.)

Solubility in NH_4 citrates+Aq.

Ammonium citrate solution of 1.09 sp. gr. at 30–35° dissolves precipitated $Ca_3(PO_4)_2$ completely, but not phosphorite. (Fresenius.)

Dried on the air, with $2^1/_5H_2O$. Sol. in 40 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 55.3% of the P_2O_5; citric acid +Aq (¼%) dissolves 83.8% of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Dried at 50°, *with* $1^7/_8H_2O$. Sol. in 45 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq dissolves 52.3% of the P_2O_5. (Erlenmeyer.)

Ignited. Diammonium citrate+Aq (sp. gr. 1.09) dissolves 93% of the P_2O_5; triammonium citrate+Aq (sp. gr. 1.09) dissolves 32% of the P_2O_5; citric acid (¼%) dissolves 53.4% of the P_2O_5. (Erlenmeyer.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in alcohol and ether.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Min. *Apatite.*

0.002 g. is sol. in 1 l. H_2O.

0.014 " " " " 1 l. H_2O sat. with CO_2. (Joffre, Bull. Soc. 1898, (3) **19.** 374.)

$+H_2O$. Solubility in H_2O, in H_2O sat. with CO_2, and in H_2O containing $CO_2+CaH_2(CO_3)_2$. Temp. 16°–20°.

Solvent				In 1 l. of the filtrate P_2O_5 mg.	CaO mg.
(1)	Boiled distilled H_2O.			0.74	
(2)	1200 cc. distilled H_2O+50 cc. H_2O sat. with CO_2.			6.9	
(3)	1000 cc. " " +250 cc. " " " "			48.5	
(4)	1250 cc. H_2O sat. with CO_2.			91.9	
	Solutions of $CO_2+CaH_2(CO_3)_2$. 1 l. (filtered) contains:				
(5)	Calcium carbonate		13 mg.	0.38	100.0
	Bicarbonate	Carbonate	166 "		
		Carbonic acid	73 "		
	Free carbonic acid		9 "		
(6)	Calcium carbonate		13 "	1.1	162.3
	Bicarbonate	Carbonate	277 "		
		Carbonic acid	122 "		
	Free carbonic acid		49 "		
(7)	Calcium carbonate		13 "	0.80	218.8
	Bicarbonate	Carbonate	376 "		
		Carbonic acid	165 "		
	Free carbonic acid		105 "		
(8)	Calcium carbonate		13 "	1.77	273.3
	Bicarbonate	Carbonate	475 "		
		Carbonic acid	209 "		
	Free carbonic acid		206 "		
(9)	Calcium carbonate		13 "	1.30	312.7
	Bicarbonate	Carbonate	545 "		
		Carbonic acid	240 "		
	Free carbonic acid		301 "		

(Schloesing, C. R. 1900, **131.** 151.)

Calcium hydrogen phosphate, $CaHPO_4$, and $+2H_2O$.

Insol. or nearly so in H_2O. Gradually decomp. by cold, more quickly by hot H_2O.

1000 pts. H_2O dissolve 0.135–0.152 pt. $CaHPO_4+2H_2O$. Solution clouds up on boiling. (Birnbaum.)

1000 pts. H_2O dissolve 0.28 pt., and if sat. with CO_2, 0.66 pt. $CaHPO_4+2H_2O$. (Dusart and Pelouze.)

When this salt dissolves in H_2O, decomp. takes place and a very considerable time is necessary to establish equilibrium. (Rindell, C. R. 1902, **134.** 112.)

Much less decomp. by H_2O than $Ca_3(PO_4)_2$ or $CaH_4(PO_4)_2$, and the decomposition of this salt in water depends only slightly upon the relative amounts of solid and solvent which are present.. The decomposition is increased by the addition of CO_2. The presence of $CaSO_4$ or of $CaCO_3$ decreased the amount of phosphoric acid which dissolved See original paper. (Cameron and Seidell, J. Am. Chem. Soc. 1904, **26.** 1460.)

When the ratio of P_2O_5 : CaO is above 1.0 or below 1.27, H_2O dissolves 0.40–0.54 g. CaO and 1.11–1.52 g. P_2O_5 (see original paper). (Cameron and Bell, J. Am. Chem. Soc. 1905, **27.** 1512.)

Solubility in H_3PO_4+Aq.

G. H_3PO_4 in 100 cc. H_3PO_4+Aq	G. $CaHPO_4$ dissolved by 100 cc. of solvent
5	4.30
10	7.15
15	9.30
20	11.86
25	13.40
30	15.10

(Causse, C. R. 1892, **114.** 415.)

1 l. H_2O containing 2.2 g. $(NH_4)_2SO_4$, 2 g. NaCl, or 3 g. $NaNO_3$ dissolves 79.2, 66.3, or 78.9 mg. CaP_2O_7, which is present in form of $CaHPO_4$. (Liebig, A. **106.** 185.) Slowly but completely sol. in boiling NH_4Cl+Aq. (Kraut, Arch. Pharm. (2) **111.** 102.) Easily sol. in H_2SO_3+Aq. (Gerland, J. pr. (2) **4.** 123.) Very sol. in HCl or HNO_3+Aq. Less sol. in $HC_2H_3O_2$. (Berzelius.) More sol. in dil. than conc. $HC_2H_3O_2$+Aq, but 60 pts. $HC_2H_3O_2$ (1 mol.) dissolve at most 23.1 pts. P_2O_5 (1 mol. = 142 pts.) from this compound. Aqueous solution of sodium acetate dissolves more easily than H_2O, and becomes turbid on boiling. (Birnbaum.)

Completely sol. in $K_2C_2O_4$+Aq. (Liebig, Landw. J. B. **1881.** 603.)

1 l. of sat. solution in N/200 acid K tartrate +Aq at 25° contains 0.235 g. $CaHPO_4$.

Insol. in alcohol. Sol. in many organic substances, as starch or gelatine+Aq.

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

$+{}^1/_3H_2O$. (Vorbringer, Z. anal. **9.** 457.)
$+H_2O$. (Gerlach, J. pr. (2) **4.** 104.)
$+2H_2O$. Min. *Brushite.*
$+3H_2O$. Min. *Metabrushite.*
$+5H_2O$. (Dusart, C. R. **66.** 327.)

Calcium *tetra***hydrogen** *ortho***phosphate,** $CaH_4(PO_4)_2+H_2O$.

Very deliquescent. Crystals take up 97.7 pts. H_2O in 16 days, and 226 pts. H_2O in 28 days from air saturated with moisture. (Birnbaum, Zeit. Ch. (2) **7.** 131.)

Not hygroscopic when pure. (Stocklasa, B. **23.** 626 R.)

Completely sol. in 100 pts. H_2O, but decomp. by 10–40 pts. H_2O with separation of $CaHPO_4$, which slowly dissolves. (Erlenmeyer, J. B. **1873.** 254.)

Later (B. **9.** 1839) Erlenmeyer says $CaH_4(PO_4)_2+H_2O$ is sol. in 700 pts. H_2O and decomp. into $CaHPO_4$ by a less amount of H_2O. Wattenberg (Z. anal. **19.** 243) says that the decomposition by small amts. of H_2O down to 144 pts. H_2O to 1 pt. salt is inappreciable.

Completely sol. in 200 pts. H_2O if pure, and in less H_2O in presence of H_3PO_4. (Stocklasa.)

Sol. in 25 pts. H_2O at 15°. Solution begins to decompose when warmed to 50°. (Otto, C. C. **1887.** 1563.)

Greatly decomp. by H_2O and the resulting solution is to be regarded as a solution of the decomposition products rather than of the substance itself. The presence of an excess of $CaSO_4$ does not materially affect the amount of phosphoric acid entering the solution. (Cameron, J. Am. Chem. Soc. 1904, **26.** 1462.)

Violently decomp. by H_2O in conc. solution; only sl. decomp. when dissolved in 200 pts. H_2O. (Stocklasa, Z. anorg. 1892, **1.** 310.)

Solubility of $CaH_4P_2O_8$ in H_3PO_4+Aq at pressure of 745 mm. at high temp.

B.-pt.	100 g. of the solution contain		Solid phase
	G. P_2O_5	G. CaO	
115°	43.60	5.623	$CaH_4P_2O_8$, $H_2O+CaHPO_4$
132°	53.43	4.327	$CaH_4P_2O_8+CaH_4P_2O_8$, H_2O
169°	63.95	4.489	$CaH_4P_2O_8$

(Bassett, Z. anorg. 1908, 59. 26.)

Glacial $HC_2H_3O_2$ ppts. it completely from aqueous solution even in presence of HNO_3. (Persoz.)

Decomp. by 50 pts. absolute alcohol at b.-pt. in 1 hour; by 30 pts. in 2 hours. Sol. in absolute ether. (Erlenmeyer, *l. c.*)

Calcium *pyro*phosphate, $Ca_2P_2O_7+4H_2O$.

Somewhat sol. in H_2O; completely sol. in mineral acids; less sol. in acetic acid, and insol. in $Na_4P_2O_7$+Aq. (Schwarzenberg, A. **65.** 145.) Less sol. in warm than in cold acetic acid. (Baer, Pogg. **75.** 155.)

Insol. in NH_4Cl+Aq. (Wackenroder, A. **41.** 316.)

Insol. in $CaCl_2$+Aq.

Min. *Pyrophosphorite.*

Calcium hydrogen *pyro*phosphate, $CaH_2P_2O_7+2H_2O$.

Sol. in H_2O. (Pahl, B. **7.** 478.)

$2CaH_2P_2O_7, Ca_2P_2O_7+6H_2O$. Decomp. by boiling with H_2O into—

$CaH_2P_2O_7, Ca_2P_2O_7+3H_2O$. Insol. in hot H_2O. (Knorre and Oppelt, B. **21.** 771.)

***Tetra*calcium hydrogen phosphate,** $Ca_4H(PO_4)_3+H_2O$.

Ppt. Insol. in H_2O, but decomp. by boiling therewith. Sol. in acids. (Warington, Chem. Soc. (2) **4.** 296.)

$+2H_2O$.

Calcium *tetra*phosphate, $Ca_3P_4O_{13}$.

Insol. in acids when ignited. (Fleitmann and Henneberg, A. **65.** 331.)

Calcium lithium phosphate, $CaLiPO_4$.

Insol. in H_2O. (Rose, Pogg. **77.** 298.)

Calcium potassium *dimeta*phosphate, $CaK_2(P_2O_6)_2+4H_2O$.

As BaK comp. (Glatzel, Dissert. **1880.**)

Calcium potassium *ortho*phosphate, $CaKPO_4$.

Insol. in H_2O. (Rose, Pogg. **77.** 291.)

Easily sol. in acids. (Ouvrard, A. ch. (6) **16.** 308.)

Calcium potassium *pyro*phosphate, $CaK_2P_2O_7$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106.** 1599.)

Calcium sodium *dimeta*phosphate, $CaNa_2(P_2O_6)_2+4H_2O$.

As BaNa comp. (Glatzel.)

Calcium sodium *trimeta*phosphate, $CaNaP_3O_9+3H_2O$.

Sl. sol. in H_2O. (Fleitmann, A. **65.** 315.)

Easily sol. in H_2O. Difficultly sol. in HCl+Aq when heated to redness. Easily sol. in boiling HCl+Aq after being fused. (Lindbom.)

Calcium sodium *ortho*phosphate, $CaNaPO_4$.

Insol. in H_2O. (Rose, Pogg. **77.** 292.)

Easily sol. in dil. acids. (Ouvrard, A. ch. (6) **16.** 308.)

$3CaO, 3Na_2O, 2P_2O_5$. Sol. in dil. acids. (Ouvrard, C. R. 1888, **106.** 1599.)

Calcium sodium *pyro*phosphate, $CaNa_2P_2O_7+4H_2O$.

Insol. in $Na_4P_2O_7$+Aq. Easily sol. in HCl+Aq, HNO_3+Aq, and also in $HC_2H_3O_2$+Aq. (Baer, Pogg. **75.** 159.)

$Ca_{10}Na_{16}(P_2O_7)_9$. Sol. in acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

$3CaO, 3Na_2O, 2P_2O_5$. Easily sol. in acids. (Ouvrard, A. ch. (6) **16.** 307.)

Calcium thorium *meta*phosphate, ThO_2, CaO, P_2O_5.

(Colani, C. R. 1909, **149.** 209.)

Calcium uranous *meta*phosphate, UO_2, CaO, P_2O_5.

Insol. in acids. (Colani, A. ch. 1907, (8) **12.** 140.)

Calcium uranyl phosphate, $Ca(UO_2)H_2(PO_4)_2$ +2, 3, or $4H_2O$.

Sol. in HNO_3+Aq. (Debray.)

$Ca(UO_2)_2(PO_4)_2+8H_2O$. Min. *Uranite.* Sol. in HNO_3+Aq.

$3CaO, 5UO_3, 2P_2O_5+16H_2O$. (Blinkoff, Dissert. **1900.**)

Calcium phosphate chloride, $Ca_3(PO_4)_2, CaCl_2$.

(Deville and Caron, A. ch. (3) **67.** 458.)

$3Ca_3(PO_4)_2, CaCl_2$. *Chlorapatite.* Insol. in H_2O. (Daubrée, Ann. Min. (4) **19.** 684.)

$7CaH_4(PO_4)_2, CaCl_2+14H_2O$. Sol. in HCl+Aq.

$4CaH_4(PO_4)_2, CaCl_2+8H_2O$.

$CaH_4(PO_4)_2, CaCl_2+2H_2O$. Partly sol. in H_2O with decomp. Also with $8H_2O$. (Erlenmeyer, J. B. **1857.** 145.)

Calcium phosphate chloride fluoride, $3Ca_3(PO_4)_2$, CaClF.

Min. *Apatite.* Boiling H_2O dissolves out $CaCl_2$; dil. mineral acids dissolve easily, acetic acid with more difficulty. Easily soluble in molten NaCl, crystallizing on cooling. (Forchhammer.)

Calcium phosphate silicate, $Ca_3(PO_4)_2, Ca_2SiO_4$.

Insol. in H_2O; decomp. by HCl+Aq. (Carnot and Richard, C. R. **97.** 316.)

$4Ca_3(PO_4)_2, Ca_3SiO_5$. (Bücking and Linck, C. C. **1887.** 562.)

$4Ca_3(PO_4)_2, 3Ca_3SiO_5$. (B. and L.)

$Ca(PO_3)_2, CaSiO_3$. (Stead and Ridsdate, Chem. Soc. **51.** 601.)

Calcium *di*hydrogen phosphate sulphite, $CaH_2(PO_4)_2, CaSO_3+H_2O$.

Not decomp. by cold, slowly by boiling H_2O. Slightly sol. in NH_4OH+Aq. Sol. in mineral acids. Insol. in cold, slowly sol. in boiling acetic acid. More sol. in a solution of oxalic acid. (Gerland, C. N. **20.** 268.)

Cerous *meta*phosphate, $Ce(PO_3)_3$. (Rammelsberg.)

Ce_2O_3, $5P_2O_5$. Insol. in H_2O or acids. (Johnsson, B. **22.** 976.)

Cerous *ortho*phosphate, $CePO_4$.

Insol. in H_2O. Easily sol. in acids. (Grandeau, A. ch. (6) **8.** 193.)

Insol. in acids. (Hartley, Proc. Roy. Soc. **41.** 202.)

$+2H_2O$. Insol. in H_2O. Sol. in acids. (Jolin.)

Insol. in H_3PO_4+Aq; sl. sol. in HCl or HNO_3+Aq. (Hisinger.)

Insol. in HNO_3+Aq. (Boussingault, A. ch. (5) **5.** 178.)

Min. *Cryptolite.* Completely decomp. by H_2SO_4 when finely powdered. Insol. in dil. HNO_3+Aq.

Ceric *ortho*phosphate, $4CeO_2$, $6P_2O_5+26H_2O$.

Ppt. (Hartley, Proc. Roy. Soc. **41.** 202.)

Cerous *pyro*phosphate, $Ce_2H_2(P_2O_7)_6+6H_2O$.

Sol. in cerous nitrate+Aq.

$Ce_4(P_2O_7)_3+12H_2O$. Sol. in excess of sodium pyrophosphate+Aq. Easily sol. in HCl. (Rosenheim, B. 1915, **48.** 592.)

Cerous lanthanum thorium phosphate, $(Ce, La, Th)_2(PO_4)_2$.

Min. *Monazite.* Sol. in HCl+Aq with white residue.

Cerous potassium *ortho*phosphate, $2Ce_2O_3$, $3K_2O$, $3P_2O_5=2CePO_4$, K_3PO_4.

Insol. in H_2O; sol. in acids. (Ouvrard, C. R. **107.** 37.)

Cerous sodium *ortho*phosphate, Ce_2O_3, $3Na_2O$, $2P_2O_5=CePO_4$, Na_3PO_4.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Cerous sodium *pyro*phosphate, $CeNaP_2O_7$.

Insol. in acetic, and cold dil. mineral acids. Sol. in warm acids. (Wallroth.)

Chromous phosphate, $Cr_3(PO_4)_2$.

Insol. in H_2O. Easily sol. in citric, tartaric and acetic acids. Sl. sol. in H_2CO_3+Aq. (Moissan, A. ch. 1882, (5) **25.** 415.)

$+H_2O$. Precipitate. Easily sol. in acids. (Moberg; Moissan, A. ch. (5) **21.** 199.)

Chromic *meta*phosphate, $Cr_2(PO_3)_6$.

Insol. in H_2O or conc. acids. (Maddrell, A. **61.** 53.)

Chromic *ortho*phosphate, $CrPO_4$.

Hydrolyzed by hot H_2O. Somewhat sol. in NH_4OH+Aq and in $Cr_2(SO_4)_3$+Aq. (Caven, J. Soc. Chem. Ind. 1897, **16.** 29.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Chromic phosphate, $Cr_2(PO_4)_2+12H_2O$.

Violet modification. Precipitate. (Rammelsberg, Pogg. **68.** 383.)

$+6H_2O$. *Green modification.* Very sl. sol. in H_2O and still less in NH_4NO_3 or $NH_4C_2H_3O_2$+Aq. (Carnot, C. R. **94.** 1313.)

Insol. in acetic, but easily sol. in mineral acids. Easily sol. in cold KOH or NaOH+Aq, from which it is separated on boiling. (Dowling and Plunkett, Chem. Gaz. **1858.** 220.)

Chromic hydrogen phosphate, $Cr_2H_6(PO_4)_4+16H_2O$.

Sol. in H_2O. (Haushofer.)

Chromic *pyro*phosphate, $Cr_4(P_2O_7)_3$.

Anhydrous. Insol. in H_2O or acids. (Ouvrard, A. ch. (6) **16.** 344.)

$+7H_2O$. Precipitate. Sol. in strong mineral acids, SO_2+Aq, KOH+Aq, and $Na_4P_2O_7$+Aq. (Schwarzenberg, A. **65.** 149.)

Insol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Chromic potassium phosphate, Cr_2O_3, K_2O, $2P_2O_5$.

Insol. in H_2O and in acids. (Ouvrard, A. ch. (6) **16.** 289.)

Chromic potassium *pyro*phosphate, $K(CrP_2O_7)+5H_2O$.

Sl. sol. in cold H_2O. Decomp. by boiling H_2O. (Rosenheim, B. 1915, **48.** 586.)

$Cr_2K_2H_4(P_2O_7)_3$. Insol. in H_2O, acids, or alkalies. Sl. decomp. by boiling conc. H_2SO_4. (Schjerning, J. pr. (2) **45.** 515.)

Chromic silver phosphate, $2Cr_2O_3$, $2Ag_2O$, $5P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 1142.)

Chromic sodium *ortho*phosphate, Na_2HPO_4, $2CrPO_4+5H_2O$.

Decomp. by H_2O. (Cohen, J. Am. Chem. Soc. 1907, **29.** 1197.)

Chromic sodium *pyro*phosphate, $Cr_2Na_2(P_2O_7)_2$.

Insol. in acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

$+10H_2O$, and $16H_2O$. Sl. sol. in cold H_2O. Decomp. by boiling H_2O. (Rosenheim, B. 1915, **48.** 586.)

Cobaltous *monometa*phosphate, $Co(PO_3)_2(?)$.

Insol. in H_2O and dil. acids. Sol. in conc. HCl+Aq. (Maddrell, A. **58.** 61.)

Cobaltous *dimeta***phosphate,** $Co_2(P_2O_6)_2$.

Insol. in cold conc. H_2SO_4; sl. sol. on warming, but sol. in H_2O after treating with H_2SO_4. Sol. in conc. NH_4OH+Aq. Scarcely attacked by boiling Na_2S+Aq. (Fleitmann.)

Cobaltous *hexameta***phosphate** (?).

Ppt. Sol. in sodium hexametaphosphate+Aq. (Rose, Pogg. **76.** 4.)

Cobaltous *ortho***phosphate,** $Co_3(PO_4)_2+xH_2O$.

Sol. in H_3PO_4+Aq or NH_4OH+Aq; sl. sol. in NH_4Cl or NH_4NO_3+Aq. (Salvetat, C. R. **48.** 295.) Sol. in Co salts+Aq.

$+2H_2O$. (Debray, A. ch. (3) **61.** 438.)

$+8H_2O$. (Reynoso, C. R. **34.** 795.)

Cobaltous hydrogen *ortho***phosphate,** $CoHPO_4+1\frac{1}{2}H_2O$.

Ppt. (Debray.)

$+2\frac{1}{2}H_2O$. Ppt. Insol. in H_2O. Sol. in H_3PO_4+Aq. (Bödeker, A. **94.** 357.)

Cobaltous *tetra***hydrogen** *ortho***phosphate,** $CoH_4(PO_4)_2$.

Sol. in H_2O. (Reynoso.)

Cobaltous *pyro***phosphate.**

Ppt. Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.) Sol. in NH_4OH+Aq. (Schwarzenberg.)

Cobaltous *pyrometa***phosphate,** $3CoO, 2P_2O_5$. (Braun.)

$6CoO, 5P_2O_5$. (Braun.)

Cobaltous potassium phosphate, $CoKPO_4$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$3CoO, 3K_2O, 2P_2O_5$. As above.

Cobaltous sodium *tri***phosphate,** $NaCo_2P_3O_{10}$. (Schwarz, Z. anorg. 1895, **9.** 260.)

$Na_3CoP_3O_{10}+12H_2O$. Very sol. in H_2O; decomp. in aq. solution. Sol. in acids. (Schwarz, Z. anorg. 1895, **9.** 258.)

Cobaltous sodium *meta***phosphate,** $Co_3Na_2(PO_3)_8$.

Insol. in H_2O or acids, even conc. H_2SO_4. (Watts' Dict.)

Cobaltous sodium *monometa***phosphate,** $6Co(PO_3)_2, 2NaPO_3$.

Insol. in H_2O and dil. acids. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 57.)

Cobaltous sodium *trimeta***phosphate,** $CoNa_4(PO_3)_3+8H_2O$.

Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 315.)

Cobaltous sodium *ortho***phosphate,** $CoNaPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **106.** 1729.)

$Co_3(PO_4)_2, 2Na_2HPO_4+8H_2O$. (Debray, J. Pharm. (3) **46.** 119.)

Cobaltous sodium *pyro***phosphate,** $Co_{10}Na_{16}(P_2O_7)_9$.

Insol. in H_2O. Sol. in acids. (Wallroth.)

$+xH_2O$. Sol. in H_2O. (Stromeyer.)

Cobaltous zinc phosphate, $Co_3(PO_4)_2, 3Zn_3(PO_4)_2+12H_2O$.

Ppt. Sol. in acids. (Gentele.)

$CoZn_2(PO_4)_2+6H_2O$. Insol. in H_2O.

Columbium phosphate (?)

Insol. in H_2O. (Blomstrand.)

Cupric *dimeta***phosphate,** $Cu_2(P_2O_6)_2$.

Insol. in H_2O. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 62.) Insol. in most conc. acids and in alkalies, except hot NH_4OH+Aq or conc. H_2SO_4, in which it is moderately sol. Not decomp. by H_2S, but by $(NH_4)_2S$+Aq, less easily by Na_2S, and K_2S+Aq. (Fleitmann, Pogg. **78.** 242.)

$+8H_2O$. Completely insol. in H_2O. (Fleitmann.)

Cupric *hexameta***phosphate** (?).

Sol. in $Na_6P_6O_{18}$+Aq or $CuCl_2$+Aq. (Rose, Pogg. **76.** 5.)

$Cu_3P_6O_{18}$. Easily sol. in H_2O or acids, especially when freshly pptd. (Lüdert, Z. anorg. **5.** 15.)

Cupric *ortho***phosphate, basic,** $6CuO, P_2O_5+3H_2O$.

Min. *Phosphocalcite.*

$5CuO, P_2O_5+2H_2O$. Min. *Dihydrite.*

$+3H_2O$. Min. *Ehlite.* Easily sol. in NH_4OH+Aq, and HNO_3+Aq.

$4CuO, P_2O_5+H_2O$. Slowly sol. in NH_4OH or $(NH_4)_2CO_3$+Aq; insol. in cold $Na_2S_2O_3$+Aq. (Steinschneider, C. C. **1891**, II. 51.)

Sl. sol. in $CuCl_2$+Aq and $CaSO_4$+Aq Decomp. by boiling H_2O and boiling Aq potash. (Caven, J. Soc. Chem. Ind. 1897, **16.** 29.)

Min. *Libethenite.* Sol. in acids and NH_4OH+Aq.

$+2H_2O$. Min. *Pseudolibethenite.* Sol. in acids and NH_4OH+Aq.

$+3H_2O$. Min. *Tagilite.* Sol. in acids and NH_4OH+Aq.

Cupric *tri***phosphate,** $5CuO, 3P_2O_5+13H_2O$.

Sol. in H_2O. Sol. in HNO_3. (Schwarz, Z. anorg. 1895, **9.** 262.)

Cupric *dimeta***phosphate,** $CuP_2O_6+4H_2O$.

Sol. in 78 pts. H_2O. Easily decomp. by hot conc. H_2SO_4. (Glatzel, Dissert. **1880.**)

Cupric *trimeta*phosphate, $Cu_3(P_3O_9)_2+9H_2O$.
Very sl. sol. in H_2O (0.04 g. in 1 l. at 20°). (Tammann, J. pr. 1892, (2) **45.** 425.)

Cupric *tetrameta*phosphate, $Cu_2P_4O_{12}$.
Insol. in H_2O and in HCl. Sl. sol. in boiling HNO_3. Very sol. in boiling conc. H_2SO_4. (Glatzel.)
$+8H_2O$. Nearly insol. in H_2O. Slowly attacked by acids except conc. H_2SO_4. (Glatzel.)

Cupric *ortho*phosphate, $Cu_3(PO_4)_2+3H_2O$.
Insol. in H_2O; easily sol. in acids, even H_3PO_4, $HC_2H_3O_2$, or H_2SO_3+Aq. Sol in NH_4OH+Aq. Sl. sol. in NH_4 salts+Aq.
Sl. sol. in Cu salts+Aq. (Rose, Pogg. **76.** 25.)
Sol. in cold $Na_2S_2O_3$+Aq. (Steinschneider, C. C. **1891,** II, 51.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 827.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Cupric hydrogen phosphate, $CuHPO_4+1\frac{1}{2}H_2O$(?).
Insol. in H_2O; sol. in H_3PO_4+Aq, and $HC_2H_3O_2$+Aq. Insol. in NH_4Cl, and NH_4NO_3+Aq. (Brett, Phil. Mag. (3) **10.** 98.)

Cupric *pyro*phosphate, basic, $Cu_2P_2O_7$, $2CuO$, H_2O+3H_2O.
Insol. in H_2O. (Pahl, J. B. **1873.** 229.)

Cupric *pyro*phosphate, $Cu_2P_2O_7$.
Anhydrous. Insol. in H_2O, and very sl. sol. in conc. acids. (Fleitmann, Pogg. **78.** 244.)
As insol. as Cu metaphosphate, but decomp. by H_2S. (Rose, Pogg. **76.** 14.)
$+2H_2O$. Sol. in mineral acids, and NH_4OH+Aq; also in $Na_4P_2O_7$+Aq. (Schwarzenberg, A. **65.** 156.)
Sol. in cold H_2SO_3+Aq without decomp., crystallizing out on boiling.
Decomp. by boiling KOH+Aq.
Sol. in large excess of $CuSO_4$+Aq.
$+2\frac{1}{2}H_2O$. (Pahl, Sv. V. A. F. **30, 7.** 40.)
$+5H_2O$. Very sl. sol. in H_2O.
Sol. in dil. acids. (Wiesler, Z. anorg. 1901, **28.** 202.)

Cupric iron (ferric) *pyro*phosphate, $Cu_3Fe_2(P_2O_7)_3+12H_2O$.
Ppt. (Pascal, C. R. 1908, **146.** 233.)

Cupric potassium phosphate, $4CuO$, K_2O, $3P_2O_5$.
Insol. in H_2O. (Ouvrard, C. R. **111.** 177.)
$CuKPO_4$. As above.

Cupric potassium *tetrameta*phosphate, $K_2CuP_4O_{12}+4H_2O$
Sol. in 58 pts. H_2O. Easily attacked by acids. (Glatzel, Dissert. **1880.**)

Cupric potassium *pyro*phosphate, $CuK_2P_2O_7$.
Extremely easily sol. in H_2O. (Persoz, A. ch. (3) **20.** 315.)
$Cu_2P_2O_7$, $3K_4P_2O_7+4H_2O$. Insol. in H_2O. (Pahl, Sv. V. A. F. **30, 7.** 44.)

Cupric sodium phosphate, $Cu_3Na_6(PO_4)_4$.
Insol. in $HC_2H_3O_2$+Aq. Sol. in conc. acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

Cupric sodium *tri*phosphate, $CuNa_3P_3O_{10}+12H_2O$.
Sl. sol. in H_2O; very unstable.
Easily sol. in acids. (Stange, Z. anorg. 1896, **12.** 458.)

Cupric sodium *tetrameta*phosphate, $CuNa_2P_4O_{12}$.
As insol. in H_2O as Cu dimetaphosphate. Difficultly decomp. by digestion with Na_2S+Aq. (Fleitmann, Pogg. **78.** 355.)
$+4H_2O$. Sol. in 45 pts. H_2O. (Glatzel, Dissert. **1880.**)

Cupric sodium *ortho*phosphate, $3Cu_3(PO_4)_2$, NaH_2PO_4.
Decomp. by H_2O to $4CuO$, P_2O_5. (Steinschneider, C. C. **1891,** II. 52.)
$2Cu_3(PO_4)_2$, Na_2HPO_4. Decomp. by H_2O into—
$3Cu_3(PO_4)_2$, Na_2HPO_4. Decomp. by H_2O. (S.)
$Cu_3(PO_4)_2$, NaH_2PO_4. Decomp. by H_2O. (S.)
$6Cu_3(PO_4)_2$, $2Na_3PO_4$. Decomp. by H_2O. (S.)

Cupric sodium *pyro*phosphate, $CuNa_2P_2O_7$.
Insol. in H_2O. (Fleitmann and Henneberg, A. **65.** 387.)
$+\frac{2}{3}H_2O$. (F. and H.) Much more sol. than the next salt. (Pahl.)
$+6H_2O$. (Persoz, A. ch. (3) **20.** 315.)
$Cu_2P_2O_7$, $CuNa_2P_2O_7+3\frac{1}{2}H_2O$. Very efflorescent; insol. in H_2O. (F. and H.)
$+10\frac{1}{2}H_2O$. (Pahl, Sv. V. A. F. **30, 7.** 42.
$CuNa_2P_2O_7$, $Na_4P_2O_7$. Sol. in H_2O. (F. and H.)
$+2H_2O$. (F. amd H.)
$+12$, and $16H_2O$. Very efflorescent, and sol. in H_2O. (Pahl.)
$Cu_3Na_2P_4O_{14}+10H_2O$. Insol. in H_2O; sol. in HCl and HNO_3 even after heating. (Stange, Z. anorg. 1896, **12.** 456.)

Cupric uranyl phosphate, $(UO_2)_2Cu(PO_4)_2+8H_2O$.
Insol. in H_2O; easily sol. in acids. (Debray.)
Min. *Chalcolite.* Sol. in HNO_3+Aq.

Cupric *ortho*phosphate ammonia, $Cu_3(PO_4)_2$, $4NH_3$.

Sl. sol. in H_2O. Easily sol. in H_2O containing NH_4OH. (Schiff, A. **123.** 41.)

$2CuO$, $3P_2O_5$, $20NH_3+21H_2O$. Easily sol. in cold H_2O, with subsequent decomp. (Metzner, A. **149.** 66.)

$2CuO$, P_2O_5, $6NH_3$. (Maumené.)

Cupric *pyro*phosphate ammonia, $8CuO$, $4P_2O_5$, $4NH_3+4H_2O$.

Sl. sol. in H_2O. (Schwarzenberg, A. **65.** 133.)

$Cu_2P_2O_7$, $4NH_3+H_2O$. Sl. sol. in H_2O. (Schiff, A. **123.** 1.)

Didymium *meta*phosphate, $Di(PO_3)_3$.

Precipitate. (Smith.)

Di_2O_3, $5P_2O_5$. Insol. in H_2O. (Cleve.)

Didymium phosphate, $2Di_2O_3$, $3P_2O_5$.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Didymium *ortho*phosphate, $DiPO_4$.

Insol. in H_2O. Very sl. sol. in dil., easily sol. in conc. acids. (Marignac.) Insol. in H_2O. (Wallroth, Bull. Soc. (2) **39.** 316.)

$+H_2O$. (Frerichs and Smith, A. **191.** 355.)

Didymium *tri*hydrogen phosphate, $Di_2H_3(PO_4)_3$.

Precipitate. (Frerichs and Smith.)

Existence is doubtful. (Cleve, B. **12.** 910.)

Didymium *hexa*hydrogen phosphate, $DiH_3(PO_4)_2+H_2O$.

Precipitate. (Hermann.)

Didymium *pyro*phosphate, $Di_4(P_2O_7)_3+6H_2O$.

Precipitate. (Cleve.)

Didymium hydrogen *pyro*phosphate, $Di_2H_6(P_2O_7)_3$.

Precipitate. Sol. in disodium pyrophosphate+Aq. (Frerichs and Smith, A. **191.** 355.)

Does not exist. (Cleve.)

Didymium potassium phosphate, $2Di_2O_3$, $3K_2O$, $3P_2O_5=2DiPO_4$, K_3PO_4.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Didymium sodium *ortho*phosphate, Di_2O_3, $3Na_2O$, $2P_2O_5=DiPO_4$, Na_3PO_4.

Insol. in H_2O. (Ouvrard.)

Didymium sodium *pyro*phosphate, Di_2O_3, Na_2O, $2P_2O_5=DiNaP_2O_7$.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Dysprosium *ortho*phosphate, $DyPO_4+5H_2O$.

Nearly insol. in H_2O.

Easily sol. in dil. acids or acetic acid. (Jantsch, B. 1911, **44.** 1276.)

Erbium phosphate, $ErPO_4+H_2O$.

Precipitate.

Erbium *pyro*phosphate, $ErHP_2O_7+3\frac{1}{2}H_2O$.

Scarcely sol. in boiling H_2O. Slowly sol. in acids.

Erbium sodium *pyro*phosphate, $ErNaP_2O_7$.

Precipitate. (Wallroth.)

Glucinum *meta*phosphate, $Gl(PO_3)_2$.

Insol. in H_2O and acids. (Bleyer, Z. anorg. 1912, **79.** 274.

Glucinum *ortho*phosphate, basic. $2Gl_3P_2O_8$, $GlO+13H_2O$.

Ppt. (Bleyer, Z. anorg. 1912, **79.** 268.)

Glucinum *ortho*phosphate, $Gl_3(PO_4)_2+6H_2O$.

Precipitate. Insol. in H_2O. Sol. in acids. (Atterberg, Sv. V. A. Handl. **12, 5.** 33.)

1 l. 2% $HC_2H_3O_2$+Aq dissolves 0.55 g. of the anhydrous salt; 1 l. 10% $HC_2H_3O_2$+Aq dissolves 1.725 g. (Sestini, Gazz. ch. it. **20.** 313.)

$+7H_2O$. (Atterberg.)

Glucinum hydrogen *ortho*phosphate, $GlHPO_4+3H_2O$.

$GlH_4(PO_4)_2$ hydroscopic. (Bleyer, Z. anorg. 1912, **79.** 266.)

Precipitated by alcohol. (Atterberg.)

Glucinum phosphate, $5GlO$, $2P_2O_5+8H_2O$.

Ppt. Sol. in H_2O with decomp. (Scheffer.)

$3GlO$, P_2O_5, $3H_2O+H_2O$. (Sestini, Gazz. ch. it. **20.** 313.)

Glucinum *pyro*phosphate, $Gl_2P_2O_7+5H_2O$.

Precipitate. (Scheffer.)

Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Glucinum potassium phosphate, $GlKPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **110.** 1333.)

Glucinum sodium phosphate, $GlNaPO_4$.

Sl. sol. in cold, easily sol. in hot acids. (Wallroth.) Insol. in acetic acid.

Min. *Beryllonite.*

GlO, $2Na_2O$, P_2O_5. Insol. in H_2O. (Ouvrard, C. R. **110.** 1333.)

Gold (Auric) sodium *pyro*phosphate (?), $Au_4(P_2O_7)_3$, $2Na_4P_2O_7+H_2O$.

Sol. in H_2O. (Persoz.)

Gold sodium *pyro*phosphate, ammonia, $14Au_2O_3$, $6P_2O_5$, $3Na_2O$, $14NH_3+24H_2O$.

Insol. in H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 172.)

Iron (ferrous) *trimeta*phosphate, $Fe(P_3O_9)_3+12H_2O$.

Rather sl. sol. in cold, more easily in hot H_2O. After ignition sol. in HCl+Aq only after long boiling. (Lindbom, Acta Lund. **1873.** 17.)

Ferrous *hexameta*phosphate, $Fe_3P_6O_{18}$.

When freshly pptd. is sol. in H_2O, and very sol. in least traces of acids, or $Na_6P_6O_{18}$+Aq. (Lüdert, Z. anorg. **5.** 15.)

Ferrous phosphate, basic, $7FeO$, $2P_2O_5+9H_2O$.

Min. *Ludlamite.* Sol. in dil. H_2SO_4 or HCl+Aq. Decomp. by boiling KOH or NaOH+Aq.

Ferrous *ortho*phosphate, $Fe_3(PO_4)_2$.

Insol. in H_2O; sol. in acids.

Sol. in 1000 pts. H_2O containing more than 1 vol. CO_2. (Pierre.)

Sol. in an excess of ferrous salts+Aq.

Sol. in 560 pts. H_2O containing $^1/_{560}$ pt. $HC_2H_3O_2$. Sol. in 1666 pts. H_2O containing 150 pts. $NH_4C_2H_3O_2$. (Pierre, A. ch. (3) **36.** 78.)

Sol. in NH_4 salts+Aq.

Sol. in NH_4OH+Aq. Not pptd. in presence of Na citrate.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

+H_2O. (Debray, A. ch. (3) **61.** 437.)

+$8H_2O$. Min. *Vivianite.* Easily sol. in HCl or HNO_3+Aq. Boiling KOH+Aq dissolves out phosphoric acid. Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

Insol. in H_2O. Sol. in acids. (Evans, C. C. **1897,** I. 580.)

Ferrous hydrogen *ortho*phosphate, $FeHPO_4+H_2O$.

Ppt. (Debray, A. ch. (3) **61.** 437.)

Is impure $Fe_3(PO_4)_2$. (Erlenmeyer and Heinrichs, A. **194.** 176.)

Ferrous *tetra*hydrogen *ortho*phosphate, $FeH_4(PO_4)_2+H_2O$.

Easily sol. in H_2O. Not changed by alcohol. (Erlenmeyer and Heinrichs, A. **194.** 176.)

Ferrous *pyro*phosphate.

Ppt. Sol. in an excess of $Na_4P_2O_7$ or $FeSO_4$ +Aq. (Schwarzenberg, A. **65.** 153.)

Ferric *meta*phosphate, $Fe_3(PO_3)_6$ or $Fe(PO_3)_3$.

Insol. in H_2O or dil. acids. Sol. in conc. H_2SO_4. (Maddrell, Phil. Mag. (3) **30.** 322.)

Iron (ferric) *ortho*phosphate, basic, $2Fe_2O_3$, $P_2O_5+xH_2O$.

Insol. in NH_4 citrate, sol. in NH_4 tartrate +Aq. (Wittstein.)

+$3H_2O$. Min. *Kraurite.* Easily sol. in HCl+Aq.

+$4H_2O$. Ppt. (Millot, C. R. **82.** 89.)

+$5H_2O$. Min. *Dufrenite.*

+$12H_2O$. Min. *Cacoxene.* Sol. in HCl+Aq.

+18, or $24H_2O$. Min. *Delvauxite.*

$5Fe_2O_3$, $3P_2O_5+14H_2O$. Min. *Beraunite.* Sol. in HCl+Aq.

$3Fe_2O_3$, $2P_2O_5+8H_2O$. Min. *Eleonorite.* Sol. in HCl+Aq.

Ferric *ortho*phosphate, $Fe_2(PO_4)_2+xH_2O$, or $2Fe_2O_3$, $3P_2O_5+xH_2O$.

+4, or $8H_2O$. (*Pptd. ferric phosphate.*) Insol. in H_2O. Sol. in 1500 pts. boiling H_2O. (Bergmann, **1815.**) Sol. in pure H_2O when all traces of soluble salts are absent. (Fresenius.) Very sl. sol. in, but decomp. by H_2O. (Lachowicz, W. A. B. **101, 2b.** 374.) For an extended discussion of solubility in and decomposition by H_2O and effect of salts see Cameron and Hurst, (J. Am. Chem. Soc. 1904, **26** 888.)

Easily sol. in dil. mineral acids, excepting H_3PO_4+Aq. Insol. in cold $HC_2H_3O_2$+Aq. (Wittstein.) 100 ccm. cold H_2O containing 10% $HC_2H_3O_2$ dissolve 0.007 g. salt. (Sestini, Gazz. ch. it. **5.** 252.) When freshly pptd. easily sol. in H_2SO_3+Aq, or $(NH_4)_2SO_3$+Aq. (Berthier.) Easily sol. in tartaric or citric acid+Aq, also in NH_4 salts of those acids, and Na citrate+Aq. (Heydenreich, C. N. **4.** 158.) See below.

Sol. in 12,500 pts. H_2O sat. with CO_2. (Pierre, A. ch. (3) **36.** 78.)

Insol. in NH_4 salts+Aq. (Wittstein.) Sol. in NH_4OH+Aq in presence of Na_2HPO_4; insol. in hot Na_2HPO_4+Aq; sol. in $(NH_4)_2CO_3$ +Aq (Berzelius). NH_4OH, KOH, or NaOH+Aq dissolve out H_3PO_4.

Sol. in ferric salts+Aq, even ferric acetate, but insol. in ferrous acetate+Aq.

Partially sol. in large amt. of Na_2CO_3+Aq. Not pptd. in presence of Na citrate. (Spiller.)

Arth (Bull. Soc. (3) **2.** 324) obtained a modification of $Fe_2(PO_4)_2$, insol. in HNO_3+Aq, but sol. in hot conc. HCl+Aq.

+$4H_2O$. Min. *Strengite.* Easily sol. in HCl+Aq; insol. in HNO_3+Aq.

+$5H_2O$. Only sl. sol. in H_2O. Slowly sol. in HNO_3, easily sol. in HCl. (Weinland, Z. anorg. 1913, **84.** 361.)

Diammonium citrate +Aq dissolves 4.8% of the P_2O_5; triammonium citrate, 5.8% P_2O_5; and with an excess of NH_4OH, 21.2% P_2O_5 is dissolved. (Erlenmeyer, B. **14.** 1253.)

+$9H_2O$. Dissolves in 35 min. in diammonium citrate +Aq (sp. gr. 1.09); in 55 min. in triammonium citrate +Aq (sp. gr. 1.09); citric acid +Aq (¼% citric acid) dissolves 17.5% of the P_2O_5. (Erlenmeyer, *l. c.*)

Iron (ferric) phosphate, acid, $8Fe_2O_3$, $9P_2O_5+3H_2O$.

Insol. in H_2O. (Rümpler, Z. anal. **12.** 151.)

$6Fe_2O_3$, $7P_2O_5+3H_2O$.

$4Fe_2O_3$, $5P_2O_5+3H_2O$.

$2Fe_2O_3$, $3P_2O_5+8H_2O$. Ppt. Decomp. by H_2O finally into $Fe_2(PO_4)_2$. (Erlenmeyer and Heinrich, A. **194.** 176.)

$8Fe_2O_3$, $11P_2O_5+9H_2O$. As above. (E. and H.)

$4Fe_2O_3$, $7P_2O_5+9H_2O$. As above. (E. and H.)

Fe_2O_3, $2P_2O_5+8H_2O$. Insol. in H_2O or $HC_2H_3O_2$+Aq; sol. in NH_4 citrate, alkali hydrates, or carbonates+Aq. (Winkler.) Slowly decomp. by H_2O. (E. and H.)

$+10H_2O$. (Vaine, C. N. **36.** 132.)

$2Fe_2O_3$, $5P_2O_5+17H_2O$.

Fe_2O_3, $3P_2O_5+6H_2O=FeH_6(PO_4)_3$. Deliquescent. Insol. in H_2O, but decomp. into $Fe_2(PO_4)_2$. (E. and H.)

$+4H_2O$. (Hautefeuille and Margottet, C. R. **106.** 135.)

Ferric *pyro*phosphate, $Fe_4(P_2O_7)_3$.

Two modifications.—(*a*) Sol. in acids, $Na_4P_2O_7$+Aq, $FeCl_3$+Aq, NH_4OH+Aq, and in $(NH_4)_2CO_3$+Aq.

Insol. in acetic, sulphurous acid, or NH_4Cl+Aq. Sol. in NH_4 citrate+Aq. (Schwarzenberg, A. **65.** 153.)

(*b*) Insol. in dil. acids, $Na_4P_2O_7$+Aq, $FeCl_3$+Aq. Sol. in NH_4OH+Aq. (Gladstone, Chem. Soc. (2) **5.** 435.)

Solubility of $Fe_4(P_2O_7)_3$ in NH_4OH+Aq at 0°.

100 g. sat. solution contain		100 g. sat. solution contain	
G. NH_3	G. $Fe_4(P_2O_7)_3$	G. NH_3	G. $Fe_4(P_2O_7)_3$
0.884	5.606	5.92	14.71
1.59	9.75	8.26	13.89
3.71	14.85	10.55	7.40
4.72	15.94	15.96	2.52
5.93	13.92	18.83	0.445
7.91	14.61		

(Pascal, A. ch. 1909, (8) **16.** 374.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. **6.** 184.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Ferroferric *ortho*phosphate, $2Fe_3(PO_4)_2$, $3(Fe_2O_3, 2P_2O_5)+16H_2O$.

Ppt. Sol. in HCl+Aq. (Rammelsberg.)

$4Fe_2O_3$, $6FeO$, $5P_2O_5+40H_2O$. Sol. in 40 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 55.7% of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Ferrous lithium phosphate, Li_3PO_4, $Fe_3(PO_4)_2$.

Min. *Triphylline.* Easily sol. in acids; not wholly decomp. by KOH+Aq.

Iron (ferrous) manganous phosphate, $Fe_3(PO_4)_2$, $Mn_3(PO_4)_2$.

Min. *Triplite.* Easily sol. in HCl+Aq.

$5(Mn,Fe)O$, $2P_2O_5+5H_2O$. Min. *Hureaulite.* Sol. in acids.

Ferric manganous sodium phosphate, $FePO_4$, $(Na_2,Mn)_3PO_4+\frac{1}{2}H_2O$.

Min.— (?).

Ferrous manganous phosphate chloride, $3(Mn,Fe)_3(PO_4)_2$, $MnCl_2$.

(Deville and Caron.)

Ferrous manganous phosphate fluoride, $(Mn,Fe)_3(PO_4)_2$, $(Mn,Fe)F_2$.

Min. *Triplite, Zwielesite.* Sol. in HCl+Aq.

$3(Mn,Fe)_3(PO_4)_2$, MnF_2. (Deville and Caron, C. R. **47.** 985.)

Ferric potassium phosphate, $2Fe_2O_3$, $3K_2O$, $3P_2O_5$.

Not attacked by boiling H_2O. (Ouvrard, A. ch. (6) **16.** 289.)

Fe_2O_3, K_2O, $2P_2O_5$. Insol. in H_2O; very sl. attacked by acids. (Ouvrard.)

Ferric silver *meta*phosphate, $2Fe_2O_3$, $2Ag_2O$, $5P_2O_5$.

(Hautefeuille and Margottet, C. R. **96.** 1142.)

Ferric silver *pyro*phosphate, $Fe_2Ag_6(P_2O_7)_3+4H_2O$.

Ppt. (Pascal, C. R. 1908, **146.** 232.)

Ferric sodium phosphate, $2Fe_2O_3$, $3Na_2O$, $3P_2O_5$.

Decomp. by H_2O. (Ouvrard.)

Ferrous sodium *tri*phosphate, $FeNa_3P_3O_{10}+11\frac{1}{2}H_2O$.

Stable dry; sol. in HNO_3; decomp. in contact with H_2O. (Stange, Z. anorg. 1896, **12.** 451.)

Ferric sodium hydrogen *ortho*phosphate, $Fe(PO_4)_2H_2Na+H_2O$.

Difficultly sol. in H_2O. Slowly decomp. by boiling with H_2O. Sol. in dil. HCl and dil. HNO_3. Decomp. by alkalies and alkali carbonates. (Weinland, Z. anorg. 1913, **84.** 354.)

$Fe(PO_4)_3H_5Na+H_2O$. Difficultly sol. in H_2O. Decomp. by boiling with H_2O. Sol. in dil. HCl and in dil. HNO_3. Decomp. by alkalies and alkali carbonates. (Weinland, Z. anorg. 1913, **84.** 358.)

Ferric sodium *pyro*phosphate, $Fe_4(P_2O_7)_3$, $2Na_4P_2O_7+7H_2O$.

Slowly but completely sol. in H_2O. Pptd. by alcohol. (Milck, J. B. **1865.** 263.)

Very sol. in H_2O. (Fleitmann and Henneberg.)

+5, and $6H_2O$. Easily sol. in H_2O, especially if warm. (Pahl, J. B. **1873.** 229.)

$FeNaP_2O_7$. Insol. in H_2O, dil. HCl, or HNO_3+Aq; sl. sol. in conc. HCl+Aq; decomp. by conc. hot H_2SO_4 without solution. (Jörgensen, J. pr. (2) **16.** 342.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$Na_6Fe_2(P_2O_7)_3+9H_2O$. Decomp. by H_2O. (Rosenheim, B. 1915, **48.** 586.)

$Fe_4(P_2O_7)_3$, $5Na_4P_2O_7+7H_2O$. (Pahl, J. B. **1873.** 229.)

Iron (ferric) phosphate sulphate, $3Fe_2(PO_4)_2$, $2Fe_2(SO_4)_3$, $2Fe_2O_6H_6$.

Min. *Diaochite.*

Lanthanum *meta*phosphate, $La_2(PO_3)_6$.

Precipitate. (Frerichs and Smith.)

La_2O_3, $5P_2O_5$. Insol. in H_2O, dil., or conc. acids. (Johnsson, B. **22.** 976.)

Lanthanum *ortho*phosphate, $LaPO_4$.

Precipitate. (Hermann.)

Insol. in H_2O and acids. (Ouvrard. C. R. **107.** 37.)

Lanthanum hydrogen phosphate, $La_2H_3(PO_4)_3$.

Precipitate. (Frerichs, B. **7.** 799.)

Existence is doubtful. (Cleve, B. **11.** 910.)

Lanthanum phosphate, acid, La_2O_3, $2P_2O_5$.

Precipitate. (Hermann.)

Lanthanum *pyro*phosphate, $LaHP_2O_7+3H_2O$. (Cleve.)

$La_2H_6(P_2O_7)_3$. Precipitate. (Frerichs and Smith.)

Does not exist. (Cleve.)

Lanthanum potassium *ortho*phosphate, $2La_2O_3$, $3K_2O$, $3P_2O_5=2LaPO_4$, K_3PO_4.

Insol. in H_2O. (Ouvrard, C. R. **107.** 37.)

Lanthanum sodium *ortho*phosphate, La_2O_3, $3Na_2O$, $2P_2O_5$.

Insol. in H_2O. (Ouvrard.)

Lanthanum sodium *pyro*phosphate, $LaNaP_2O_7$.

Insol. in acetic, and dil. cold mineral acids. Sol. in warm dil. acids. (Wallroth.)

Lead *dimeta*phosphate, PbP_2O_6.

Ppt. Almost insol. in H_2O. Sol. in HNO_3+Aq. (Fleitmann, Pogg. **78.** 253.)

Lead *trimeta*phosphate, $Pb_3(P_3O_9)_2+3H_2O$.

Nearly insol. in H_2O. Less sol. in H_2O than the corresponding Ag salt. (Fleitmann and Henneberg, A. **65.** 304.)

Most insol. of the *trimeta*phosphates. (Lindbom, Acta Lund. **1873.** 12.)

Anhydrous salt is insol. in H_2O; easily sol. in HNO_3+Aq. (Lindbom.)

Lead *tetrameta*phosphate, $Pb_2P_4O_{12}$.

Insol. in H_2O.

More easily decomp. by acids than the other insol. metaphosphates. Easily decomp. by alkali hydrosulphides+Aq in the cold. (Fleitmann, Pogg. **78.** 353.)

Lead *hexameta*phosphate, $Pb_3P_6O_{18}$.

Nearly insol. in H_2O sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Lead *ortho*phosphate, basic, 4PbO, P_2O_5.

(Gerhardt, A. **72.** 85.)

Lead *ortho*phosphate, $Pb_3(PO_4)_2$.

Insol. in H_2O; sol. in HNO_3+Aq. Insol. in $HC_2H_3O_2$+Aq.

Sl. sol. in H_2O. 1.35×10^{-4} g. is contained in 1 litre of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 604.)

Not hydrolyzed by boiling H_2O. Sol. in boiling KOH+Aq; insol. in NH_4OH+Aq. Insol. in $Pb(NO_3)_2$+Aq. (Cameron, J. Soc. Chem Ind. 1897, **16.** 30.)

Sol. in 782.9 pts. $HC_2H_3O_2$+Aq containing 38.94 pts. pure $HC_2H_3O_2$. (Bertrand, Monit. Scient. (3) **10.** 477.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Lead hydrogen phosphate, $PbHPO_4$.

Insol. in H_2O. Decomp. by H_2SO_4, or HCl +Aq. Sol. in HNO_3, or in KOH or NaOH+Aq. Insol. in $HC_2H_3O_2$+Aq. Sol. in cold NH_4Cl+Aq (Brett), from which it can be completely precipitated by a great excess of NH_4OH+Aq.

More sol. in $NH_4C_2H_3O_2$+Aq at 18.8-25° than in pure H_2O. (Wappen.)

Sol. in sat. NaCl+Aq, but less than $PbSO_4$. (Becquerel, C. R. **20.** 1524.)

Insol. in Pb salts+Aq.

Not pptd. in presence of Na citrate (Spiller.)

Lead *pyro*phosphate, $Pb_2P_2O_7+H_2O$.

Insol. in H_2O. Sol. in HNO_3, or KOH+Aq. Insol. in NH_4OH+Aq, $HC_2H_3O_2$, or SO_2+Aq. (Schwarzenberg, A. **65.** 133.) Sol. in $Na_4P_2O_7$+Aq. (Stromeyer.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Lead potassium phosphate, $PbKPO_4$.

Decomp. by hot H_2O. (Ouvrard, C. R. **110.** 1333.)

Lead sodium phosphate, $PbNaPO_4$.

Very sol. in dil. acids. (Ouvrard, C. R. **110.** 1333.)

10PbO, $8Na_2O$, $9P_2O_5$. (Ouvrard.)

Lead sodium *pyro*phosphate, $PbNa_2P_2O_7$.
Insol. in hot H_2O. (Gerhardt, A. ch. (3) **22.** 506.)

Lead *tri*phosphate sodium *pyro*phosphate, $Pb_5Na_4P_8O_{27}+10H_2O$.
Sol. in HNO_3 after melting. (Stange, Z. anorg. 1896, **12.** 459.)

Lead phosphate chloride, $2PbHPO_4$, $PbCl_2$.
Insol. in boiling H_2O; sol. in dil. HNO_3+Aq. (Gerhardt, A. ch. (3) **22.** 505.)
$2Pb_3(PO_4)_2$, $PbCl_2$. Ppt. (Heintz, Pogg. **73.** 119.)
$3Pb_3(PO_4)_2$, $PbCl_2$. Min. *Pyromorphite.* Sol. in HNO_3, and KOH+Aq.
Sl. sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)
$+H_2O$. Insol. in H_2O. Sol. in dil. HNO_3+Aq. (Heintz.)

Lithium *meta*phosphate, $LiPO_3$.
Insol. in boiling H_2O. Scarcely sol. in acetic acid. Easily sol. in mineral acids. (Merling, Z. anal. 1879, **18.** 565.)

Lithium *tetrameta*phosphate, $Li_4P_4O_{12}+4H_2O$.
Very sol. in H_2O. (Warschauer, Z. anorg. 1903, **36.** 180.)

Lithium *ortho*phosphate, Li_3PO_4.
Very slightly sol. in H_2O.
Sol. in 2539 pts. pure H_2O and 3920 pts. ammoniacal H_2O; much more readily in H_2O containing NH_4 salts. Easily sol. in HCl+Aq or HNO_3+Aq. (Mayer, A. **98.** 193.) Easily sol. in carbonic acid water. (Troost.) Sol. in dil. acids or acetic acid. (de Schulten, Bull. Soc. (3) **1.** 479.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)
$+\frac{1}{2}H_2O$, or H_2O.

Lithium hydrogen phosphate, Li_2HPO_4.
Nearly insol. in H_2O. (Gmelin.) Sol. in 833 pts. H_2O at 12°. (Rammelsberg.)
$Li_5H(PO_4)_2+H_2O$. Sol. in 200 pts. H_2O. (Rammelsberg.)

Lithium *di*hydrogen phosphate, LiH_2PO_4.
Deliquescent, and very sol. in H_2O. (Rammelsberg.)

***Hepta*lithium *di*hydrogen phosphate,** $Li_7H_2(PO_4)_3$.
$+1H_2O$, or $2H_2O$. Sol. in H_2O. (Rammelsberg.)

Lithium *penta*hydrogen phosphate, $LiH_5(PO_4)_2+H_2O$.
Deliquescent, and sol. in H_2O.

Lithium *pyro*phosphate, $Li_4P_2O_7+2H_2O$.
(Rammelsberg, B. A. B. **1883.** 21.)

Lithium manganous phosphate, Li_3PO_4, $Mn_3(PO_4)_2$.
Min. *Lithiophilite.*

Lithium potassium *meta*phosphate, Li_2O, $2K_2O$, $3P_2O_5+4H_2O$.
As NH_4 comp. (Tammann, J. pr. 1892, (2) **45.** 443.)

Lithium potassium *pyro*phosphate, $Li_3KP_2O_7$.
(Kraut, A. 1876, **182.** 170.)

Lithium sodium phosphate, $3Li_2O$, Na_2O, P_2O_5.
Insol. in H_2O. Sol. in dil. acids. (Ouvrard, C. R. **110.** 1333.)
$2Li_2O$, Na_2O, $2P_2O_5$. As above (Ouvrard.)

Lithium sodium *pyro*phosphate, Li_2O, Na_2O, P_2O_5.
$5Li_2O$, Na_2O, $3P_2O_5$.
$4Li_2O$, $6Na_2O$, $5P_2O_5$. (Kraut, A. 1876, **182.** 168.)

Magnesium *meta*phosphate, $Mg(PO_3)_2$.
Insol. in H_2O or dil. acids, but sol. in H_2SO_4+Aq. (Maddrell, A. **61.** 62.)
Not decomp. by very long digestion with alkali carbonates, or orthophosphates +Aq. (Fleitmann.)

Magnesium *dimeta*phosphate, $Mg_2(P_2O_6)_2+9H_2O$.
Insol. in H_2O; decomp. by acids. (Fleitmann, Pogg. **78.** 259.)

Magnesium *trimeta*phosphate, $Mg_3(P_3O_9)_2$.
Sl. sol. in cold H_2O, more easily in hot H_2O. When ignited, insol. in boiling HCl+Aq. (Lindbom.)
Cryst. with 12, or $15H_2O$.

Magnesium *tetrameta*phosphate, $Mg_2P_4O_{12}$.
Insol. in H_2O, somewhat sol. in HCl+Aq. More easily sol. in HNO_3+Aq, especially easily sol. in conc. H_2SO_4. (Glatzel, Dissert. **1880.**)
$+10H_2O$. Sol. in 70 pts. H_2O. (Glatzel.)

Magnesium *ortho*phosphate, $Mg_3(PO_4)_2$, and $+5$, or $7H_2O$.
1 litre H_2O dissolves 0.1 g. ignited $Mg_3(PO_4)_2$ in 7 days, but 0.205 g. if freshly precipitated. (Völcker, J. B. **1862.** 131.)
1 l. H_2O with 2 g. NaCl dissolves 75.8 mg.; 1 l. H_2O with 3 g. $NaNO_3$ dissolves 61.9 mg. $Mg_3(PO_4)_2$. (Liebig, A. **106.** 185.)
Easily sol. in acids, except in acetic acid. (Schaffner, A. **50.** 145.)
Easily sol. in H_2O in presence of alkali salts.

$+6\frac{1}{2}H_2O$. Sol. in 30 min. in diammonium citrate+Aq (sp. gr.=1.09); triammonium citrate+Aq (sp. gr.=1.09) dissolves 37.5% of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

$+20H_2O$. Sol. in 10 min. in diammonium citrate+Aq (sp. gr.=1.09); triammonium citrate+Aq (sp. gr.=1.09) dissolves 23.2% of the P_2O_5; sol. in 15 min. in ¼% citric acid +Aq. (Erlenmeyer, *l. c.*)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Magnesium hydrogen phosphate, $MgHPO_4+7H_2O$.

Sol. in 322 pts. cold H_2O in several days. If heated to 40° becomes milky, and separates a precipitate out at 100° of same salt, so that solution at 100° contains only 1 pt. salt in 498 pts. H_2O. Much more sol. in H_2O containing traces of acids, even dil. oxalic or acetic acids. (Graham, Phil. Mag. Ann. **2.** 20.) Easily sol. in H_2SO_3+Aq. (Gerland, J. pr. (2) **4.** 127.)

Sol. in aqueous solution of Mg salts, but insol. in Na_2HPO_4+Aq. (Rose.) Sol. in sodium citrate+Aq. (Spiller.) When freshly precipitated it is sol. in hot NH_4Cl+Aq, and NH_4OH+Aq does not completely reprecipitate it; less sol. in NH_4NO_3+Aq. (Brett, Phil. Mag. (3) **10.** 96.) Insol. in alcohol. (Berzelius.)

For solubility in H_3PO_4, see under MgO.

$+\frac{1}{2}H_2O$. (Debray.)

$+H_2O$. Easily sol. in dil. acids. (de Schulten, C. R. **100.** 263.)

$+3H_2O$. Sl. sol. in H_2O, easily in acids. (Stoklasa, Z. anorg. **3.** 67.)

$+4\frac{1}{2}H_2O$. (Bergmann.)

$+6H_2O$. (Debray.)

Magnesium *tetra*hydrogen phosphate, $MgH_4(PO_4)_2$.

Not hygroscopic. Sol. in 5 pts. H_2O without decomp. (Stoklasa, Z. anorg. **3.** 67.)

$+2H_2O$. Not hygroscopic. Sol. in H_2O without decomp. (Stoklasa, Z. anorg. **1.** 307.)

Decomp. by alcohol into $MgHPO_4+3H_2O$.

Magnesium *pyro*phosphate, $Mg_2P_2O_7$.

Nearly insol. in H_2O; readily sol. in HCl or HNO_3+Aq. (Fresenius.)

$+3H_2O$. Sl. sol. in H_2O, easily in HCl or HNO_3+Aq; sol. in H_2SO_3+Aq, and $Na_4P_2O_7$+Aq. (Schwarzenberg.)

Sol. in $MgSO_4$+Aq, and $(NH_4)_2CO_3$+Aq.

Magnesium *tetra*phosphate, $Mg_3P_4O_{13}$.

Insol. in H_2O. (Fleitmann and Henneberg, A. **65.** 331.)

Magnesium potassium *dimeta*phosphate, $K_2Mg_2(P_2O_6)_3$.

Very sol. in dil. acids. (Ouvrard, C. R. 1888, **106.** 1729.)

$+4H_2O$. Sol. in 10.2 pts. H_2O. (Glatzel.)

Magnesium potassium *ortho*phosphate, $MgKPO_4$.

Sl. sol. in H_2O. Decomp. by H_2O. Easily sol. in acids.

$+6H_2O$.

$2MgO, K_2O, 3P_2O_5$. Insol. in H_2O; sol. in dil. HCl+Aq. (Ouvrard, C. R. **106.** 1729.)

$Mg_2HK(PO_4)_2+15H_2O$. (Haushofer.)

Magnesium rubidium *ortho*phosphate, $RbMgPO_4+6H_2O$.

Easily sol. in warm dil. HCl+Aq.

Not decomp by boiling H_2O. (Erdmann, A. 1897, **294.** 73.)

Magnesium sodium *tri*phosphate, $MgNa_3P_3O_{10}+13H_2O$.

Decomp. in the air. (Stange, Z. anorg. 1896, **12.** 454.)

Magnesium sodium *meta*phosphate, $3MgO, Na_2O, 4P_2O_5$.

Insol. in H_2O or H_3PO_4+Aq. Scarcely sol. in HCl+Aq, or aqua regia. Not decomp. by $(NH_4)_2CO_3$+Aq. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 53.)

Magnesium sodium *dimeta*phosphate, $MgNa_2(P_2O_6)_2+4H_2O$.

Sol. in 25 pts. H_2O. (Glatzel, Dissert. **1880.**)

Magnesium sodium *trimeta*phosphate, $MgNa_4(P_3O_9)_2+5H_2O$.

Sl. sol. in H_2O. After ignition is insol. in H_2O. (Lindbom.)

Magnesium sodium phosphate, $10MgO, 8Na_2O, 9P_2O_5$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

Magnesium sodium *ortho*phosphate, $MgNaPO_4$.

Insol. in H_2O. (Rose.)

$+9H_2O$. (Schoecker and Violet, A. **140.** 232.)

$MgO, 2Na_2O, P_2O_5$. Insol. in H_2O. (Ouvrard.)

$3MgO, 3Na_2O, 2P_2O_5$. Insol. in H_2O. (Ouvrard.)

Magnesium sodium *pyro*phosphate, basic (?).

Precipitate; sl. sol. in H_2O. Easily in HCl+Aq, HNO_3+Aq, and $Na_4P_2O_7$+Aq. (Baer, Pogg. **75.** 168.)

Sol. in $(NH_4)_2CO_3$+Aq, and in $MgSO_4$+Aq.

Insol. in alcohol.

Magnesium phosphate chloride, $Mg_3(PO_4)_2, MgCl_2$.

(Deville and Caron, A. ch. (3) **67.** 455.)

Magnesium *pyro*phosphate nitrogen *di*oxide, $Mg_2P_2O_7$, H_2O, NO_2.

Scarcely sol. in water. (Luck, Z. anal. **13.** 255.)

Magnesium phosphate fluoride, $Mg_3(PO_4)_2$, MgF_2.

Min. *Wagnerite.* Slowly sol. in hot HNO_3, and H_2SO_4.

Magnesium phosphate calcium fluoride, $2Mg_3(PO_4)_2$, CaF_2.

Min. *Kjerulfite.*

Manganous *dimeta*phosphate, $Mn_2(P_2O_6)_2$.

Anhydrous. Insol. in H_2O and dil. acids. (Fleitmann.) Sol. in conc. H_2SO_4. (Maddrell.) Scarcely attacked by warm Na_2S+Aq, and not much more by $(NH_4)_2S+$Aq. Decomp. by Na_2CO_3+Aq.

$+8H_2O$. Insol. in H_2O and dil. acids. (Fleitmann, Pogg. **78.** 257.)

Manganous *trimeta*phosphate, $Mn_3(P_3O_9)_2+11H_2O$.

Difficultly sol. in cold or warm H_2O. More easily sol. in cold, very easily in warm $HCl+$Aq. When ignited, is insol. in acids, even aqua regia. (Lindbom.)

Manganous *hexameta*phosphate.

Sol. in sodium hexametaphosphate+Aq. (Rose, Pogg. **76.** 4.)

$Mn_3P_6O_{18}$. Nearly insol. in H_2O; easily sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Manganic *meta*phosphate, $Mn(PO_3)_3$.

Insol. in H_2O or acids; decomp. by alkalies. (Schjerning, J. pr. (2) **45.** 515.)

Insol. in H_2O; sol. in HCl; decomp. by alkalies+Aq. (Barbier, C. R. 1902, **135.** 1055.)

$+H_2O$. Insol. in H_2O or acids, except $HCl+$Aq. Sl. decomp. by boiling with H_2SO_4. (Hermann, Pogg. **74.** 303.)

Manganous *tetrameta*phosphate, $Mn_2(PO_3)_4$.

Not attacked by acids. (Glatzel, Dissert. **1880.**)

$+10H_2O$. Sol. only in boiling conc. H_2SO_4. (Glatzel.)

Manganous *dekameta*phosphate, $5MnO$, $5P_2O_5+12H_2O$.

Ppt. (Tammann, J. pr. 1892, (2) **45.** 450.)

Manganous *ortho*phosphate, $Mn_3(PO_4)_2$.

$+H_2O$. (Debray.)

$+3H_2O$. Sol. in 20 min. in diamonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 30.2% of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

$+4\frac{1}{2}-5\frac{1}{2}H_2O$. Efflorescent. (Erlenmeyer and Heinrich, A. **190.** 208.)

$+7H_2O$. Very sl. sol. in H_2O. (Berzelius.) Easily sol. in mineral acids; sol. in $HC_2H_3O_2+$Aq.

Easily sol. in SO_2+Aq. (Gerland, J. pr. (2) **4.** 97.)

Somewhat sol. in boiling $(NH_4)_2CO_3+$Aq, but deposited on cooling. (Berzelius.)

Partly sol. in cold NH_4Cl, or NH_4NO_3+Aq. (Brett.)

Sol. in cold or hot solutions of ammonium sulphate or succinate. (Wittstein.)

Sl. sol. in Mn salts+Aq. (Rose, Pogg. **76.** 25.)

Insol. in alcohol.

Sol. in 10 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 53% of the P_2O_5. (Erlenmeyer, B. **14.** 1253.)

Manganous *di*hydrogen *ortho*phosphate, $MnHPO_4+3H_2O$.

Sl. sol. in H_2O. Solution decomp. at 100°. (Debray.) Slowly decomp. by cold H_2O into $Mn_3(PO_4)_2$. (Erlenmeyer and Heinrich, A. **190.** 208.)

Easily sol. in H_2SO_3+Aq. (Gerland.)

Sl. sol. in $HC_2H_3O_2$, easily in conc. mineral acids. (Heintz.) Sol. in $(NH_4)_2CO_3+$Aq, from which it is repptd. on boiling. Decomp. by boiling KOH+Aq.

Insol. in alcohol.

$Mn_3(PO_4)_2$, $2MnHPO_4+4H_2O$. (de Schulten, C. C. **1905,** I. 188.)

Manganous *tetra*hydrogen phosphate, $MnH_4(PO_4)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O, with decomp. to $MnHPO_4$. (Erlenmeyer and Heinrich, A. **190.** 208.)

Not decomp. by H_2O. (Otto, C. C. **1887.** 1563.)

H_2O decomp. it into $MnHPO_4$ and H_3PO_4 containing some dissolved salt. The less H_2O used, the more $MnHPO_4$ separates. The acid filtrate separates $MnHPO_4$ on boiling. At 0° the decomp. increases in proportion to the amt. of salt, but 1 g. of the salt is unchanged in 100 g. H_2O. With less than 20 g. of salt to 100 g. H_2O the decomp. is analogous to that of $CaH_4(PO_4)_2$, but with larger amts. of salt it is the opposite, becoming less with increasing amts. of the salt. (Viard, C. R. 1899, **129.** 412.)

Alcohol dissolves out H_3PO_4. (Heintz.)

***Penta*manganous *di*hydrogen phosphate,** $Mn_5H_2(PO_4)_4+4H_2O$.

Not decomp. by boiling H_2O. (Erlenmeyer and Heinrich, A. **190.** 208.)

Manganic *ortho*phosphate, basic, $Mn_2P_2O_9+H_2O$.

Sl. sol. in H_2O.

Manganic *ortho*phosphate, $MnPO_4+H_2O$.

Sol. in acids. (Christensen, J. pr. (2) **28.** 1.)

Manganous *pyro*phosphate, $Mn_2P_2O_7$.

Anhydrous. (Lewis, Sill. Am J. (3) **14.** 281.)

$+H_2O$.

$+3H_2O$. Insol. in H_2O. Insol. in $MnSO_4$+Aq, but sol. in $Na_4P_2O_7$+Aq. (Rose.)

Difficultly sol. in $Na_4P_2O_7$+Aq, but easily sol. in $K_4P_2O_7$+Aq. (Pahl.) Decomp. by KOH+Aq. Sol. in H_2SO_3+Aq. (Schwarzenberg.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Manganous hydrogen *pyro*phosphate, $MnH_2P_2O_7+4H_2O$.

Sol. in H_2O. (Pahl.)

Manganic *pyro*phosphate, $Mn_4P_6O_{21}+14H_2O$.

Sol. in H_2SO_4, and H_3PO_4. (Auger, C. R. 1901, **133.** 95.)

$MnHP_2O_7$. Insol. in H_2O; very sl. attacked by dil. HCl+Aq, easily by conc. Sol. in conc. H_2SO_4. (Schjerning, J. pr. (2) **45.** 515.)

Manganous potassium *dimeta*phosphate, $K_2Mn(PO_3)_4+6H_2O$.

Sol. in 95 pts. H_2O. When ignited is not attacked by acids. (Glatzel, Dissert. **1880.**)

Manganous potassium *ortho*phosphate, $MnKPO_4$.

Insol. in H_2O; easily sol. in dil. acids. (Ouvrard.)

Manganic potassium *pyro*phosphate, $MnKP_2O_7$.

$+5H_2O$. Sl. sol. in cold H_2O.

$+3H_2O$. Sl. sol. in cold H_2O. (Rosenheim, B. 1915, **48.** 584.)

Manganous potassium phosphate, $MnK_2P_2O_7$.

Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$+8H_2O$. Sl. sol. in H_2O. (Pahl.)

$Mn_2P_2O_7$, $2K_4P_2O_7+10H_2O$. Difficultly sol. in H_2O. (Pahl.)

Manganic potassium *pyro*phosphate, $MnKP_2O_7$.

Insol. in H_2O. Decomp. by acids and bases. (Schjerning.)

Manganic silver *pyro*phosphate, $AgMnP_2O_7+3H_2O$.

Almost insol. in H_2O. (Rosenheim, B. 1915, **48.** 585.)

Manganous sodium *tri*phosphate, $MnNa_3P_3O_{10}+12H_2O$.

Sl. sol. in H_2O; the melt obtained by heating the salt is readily sol. in H_2SO_4. (Stange, Z. anorg. 1896, **12.** 455.)

Manganous sodium *dimeta*phosphate, $MnNa_2(PO_3)_4+6H_2O$

Easily sol. in boiling H_2SO_4, but not attacked by acids after boiling. (Glatzel, Dissert. 1880.)

Manganous sodium *trimeta*phosphate,

Sol. in H_2O. (Fleitmann and Henneberg.)

$MnNa(PO_3)_3$. Insol. in H_2O, dil. acids, or alkalies. (Schjerning, J. pr. (2) **45.** 515.)

Manganous sodium *octometa*phosphate, $Mn_3Na_2(PO_3)_8$

Insol. in acids except conc. H_2SO_4. (Tammann, J. pr. 1892, (2) **45.** 469.)

$+5H_2O$. Almost insol. in cold H_2O.

Decomp. by boiling H_2O with separation of Mn_2O_3. (Rosenheim, B. 1915, **48.** 584.)

Manganous sodium *ortho*phosphate, $MnNaPO_4$.

Insol. in H_2O. (Ouvrard, C. R. **106.** 1729.)

MnO, $2Na_2O$, P_2O_5. As above.

Manganous sodium *pyro*phosphate, $MnNa_2P_2O_7$.

Insol. in H_2O; easily sol. in dil. acids. (Wallroth.)

$+4\frac{1}{2}H_2O$. Very sl. sol. in H_2O. (Pahl.)

$3Mn_2P_2O_7$, $2Na_4P_2O_7+24H_2O$. Very sl. sol. in H_2O. (Pahl.)

Manganic sodium *pyro*phosphate, $MnNaP_2O_7+H_2O$.

(Christensen, J. pr. (2) **28.** 1.)

Manganic *dipyro*phosphate ammonia, $Mn_2P_4O_{14}$, $2NH_3$.

Insol. in H_2O.

Decomp. by HCl and by alkalies. (Barbier, C. R. 1902, **135.** 1109.)

Manganous phosphate chloride, $Mn_3(PO_4)_2$, $MnCl_2$.

Insol. in H_2O. (Deville and Caron, A. ch. (3) **67.** 459.

$3Mn_3(PO_4)_2$, $MnCl_2$. Insol. in H_2O. (Deville and Caron.)

Mercurous *hexameta*phosphate (?).

Ppt. Sol. in sodium hexametaphosphate +Aq. (Rose.)

$Hg_6P_6O_{18}$. Insol. in H_2O; very sl. sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Moderately sol. in H_2O when freshly pptd. More sol. in acids than the mercurous salt. (Lüdert.)

Mercurous *ortho***phosphate,** $(Hg_2)_2(PO_4)_2$.

Ppt. Decomp. by boiling with H_2O. (Gerhardt.)

Sol. in HNO_3+Aq. Sol. in $Hg_2(NO_3)_2$+Aq. Insol. in H_3PO_4+Aq.

Mercuric *ortho***phosphate,** $Hg_3(PO_4)_2$.

Insol. in H_2O. Sl. sol. in hot H_2O, crystallizing out on cooling. (Haack, A. **262.** 185. Slowly sol. in cold dil., quickly in hot dil. or cold conc. HCl+Aq. Less easily sol. in HNO_3+Aq. Sol. in H_3PO_4+Aq. (Berzelius.) Insol. in H_3PO_4+Aq. (Haack.) Decomp. by NaCl+Aq into insol. $HgCl_2$, 3HgO, but sol. in NaCl+Aq, containing HNO_3. (Haack.)

Sol. in 6 pts. NH_4Cl in aqueous solution by heating. (Trommsdorff.)

Sol. in $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Wittstein.)

Insol. in alcohol.

Mercuromercuric *ortho***phosphate,** $7Hg_2O$, $14HgO$, $2P_2O_5+20H_2O$.

(Brooks, Pogg. **66.** 63.)

Mercurous *pyro***phosphate,** $Hg_4P_2O_7+H_2O$.

Sol. in $Na_4P_2O_7$+Aq, when recently pptd. Insol. in $Na_4P_2O_7$+Aq, when heated to 100°. Sol. in HNO_3+Aq. Decomp. by HCl+Aq. (Schwarzenberg, A. **65.** 133.)

Mercuric *pyro***phosphate,** $Hg_2P_2O_7$.

Sol. in acids; insol. in $Na_4P_2O_7$+Aq, after being heated to 100°. Sol. in NaCl+Aq; quickly decomp. by NaOH+Aq, and Na_2HPO_4+Aq.

Sol. in 6 pts. NH_4Cl+Aq. (Trommsdorff.)

Sol. in NH_4NO_3,$(NH_4)SO_4$, and $(NH_4)_2CO_3$+Aq; also in KI+Aq.

Mercurous silver *ortho***phosphate,** $AgHg_2PO_4$.

Sol. in HNO_3. (Jacobsen, Bull. Soc. 1909, (4) **5.** 949.)

Molybdenum phosphate, $Mo_2(PO_4)_2$ (?).

Insol. in H_2O. Sol. in $MoCl_2$+Aq.

Molybdenum sodium *pyro***phosphate,** $Na(MoP_2O_7)+12H_2O$.

Ppt. (Rosenheim, B. 1915, **48.** 589.)

Nickel *dimeta***phosphate,** NiP_2O_6.

Insol in H_2O or dil.acids. Sol. in conc. H_2SO_4. Not decomp. by boiling alkali carbonates or sulphides + Aq. (Maddrell, A. **61.** 58.

$+4H_2O$. Sol. in cold acids. (Glatzel, Dissert. **1880.**)

Nickel *tetrameta***phosphate,** $Ni_2P_4O_{12}$.

Insol. in HCl. Sol. in conc. HNO_3 and especially sol. in H_2SO_4 on boiling. (Glatzel.)

Nickel *tetrameta***phosphate,** $Ni_2P_4O_{12}+12H_2O$.

Easily sol. in acids. (Glatzel.)

Nickel *ortho***phosphate,** $Ni_3(PO_4)_2+7H_2O$.

Insol. in H_2O. Sol. in acids. (Rammelsberg, Pogg. **68.** 383.)

Sol. in Ni salts+Aq. (Rose, Pogg. **76.** 25.)

Insol. in Na_2HPO_4+Aq. (Tupputi, **1811.**)

Very sl. sol. in hot $(NH_4)_2HPO_4$+Aq.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethylacetate. (Naumann, B. 1910, **43.** 314.)

Nickel *pyro***phosphate,** $Ni_2P_2O_7+6H_2O$.

Insol. in H_2O; sol. in mineral acids, $Na_4P_2O_7$+Aq, and NH_4OH+Aq. Not pptd. from $Ni_2P_2O_7$+Aq by alcohol. (Schwarzenberg, A. **65.** 158.)

Nickel potassium *dimeta***phosphate,** $NiK_2P_4O_{12}+6H_2O$.

Sol. in 130 pts. H_2O. (Glatzel.)

Nickel potassium *ortho***phosphate,** $NiKPO_4$.

Insol. in H_2O; sol. in dil. acids. (Ouvrard, R. **106.** 1729.)

3NiO, $3K_2O$, $2P_2O_5$. As above.

Nickel sodium *tri***phosphate,** $Na_3NiP_3O_{19}+12H_2O$.

Very sol. in H_2O; decomp. in Aq solution. (Schwarz, Z. anorg. 1895, **9.** 261.)

Nickel sodium *meta***phosphate,** $3Ni(PO_3)_2$, $NaPO_3$.

Insol. in H_2O and dil. acids. Sol. in conc. H_2SO_4. (Maddrell, A. **61.** 56.)

$NiNa_4(PO_3)_3+8H_2O$. Easily sol. in H_2O. (Lindbom.)

Nickel sodium *dimeta***phosphate,** $NiNa_2P_4O_{12}+6H_2O$.

Sl. sol. in H_2O. Moderately sol. in acids. (Glatzel, Dissert. **1880.**)

Nickel sodium *trimeta***phosphate,** $Ni_2Na_2(P_3O_9)_2+9H_2O$.

1 l. H_2O dissolves 60.6 g. at 20°. (Tammann, J. pr. 1892, (2) **45.** 426.)

$Na_3NiP_3O_{10}+12H_2O$. Insol. and not decomp. by H_2O. Sol. in acids. (Schwarz, Z. anorg. 1895, **9.** 261.)

Nickel sodium *octometa***phosphate,** $Na_2Ni_3(PO_3)_8$.

(Tammann, J. pr. 1892, (2) **45.** 469.)

Nickel sodium *ortho***phosphate,** $NiNaPO_4+7H_2O$.

Ppt. (Debray, C. R. **59.** 40.)

NiO, $2Na_2O$, P_2O_5. Insol. in H_2O. Easily sol. in dil. acids. (Ouvrard.)

Nickel sodium ***pyro*****phosphate,** $\cdot Ni_{10}Na_{16}(P_2O_7)_9$.

Insol. in H_2O. Moderately sol. in acids. (Wallroth.)

Osmium phosphate (?).

Sl. sol. in H_2O; sol. in HNO_3+Aq. (Berzelius.)

Palladium ***ortho*****phosphate** (?).

Ppt.

Phosphorus phosphate, $4P_4O, 3P_2O_5$ (?).

Decomp. spontaneously. Sol. in H_2O and alcohol when fresh; insol. in ether. (le Verrier, A. **27.** 167; Reinitzer, B. **14.** 1884.)

Platinum phosphate, PtP_2O_7.

Insol. in H_2O, acids and alkalies. Decomp. by fusing with potassium carbonate. (Barnett, C. N. 1895, **71.** 256.)

Potassium ***monometa*****phosphate,** KPO_3.

Nearly insol. in H_2O; sol. in weak acids, even in acetic acid. (Maddrell, A. **61.** 62.)

Insol. in H_2O and weak acids. (Fleitmann, Pogg. **78.** 250.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Potassium ***dimeta*****phosphate,** $K_2P_2O_6+H_2O$.

Sol. in 1.2 pts. cold H_2O, but not more in hot H_2O. (Fleitmann, Pogg. **78.** 250.)

Potassium ***trimeta*****phosphate,** $K_3P_3O_9$.

Very sol. in cold H_2O before it is fused. (Lindbom, Acta Lund. **1873.** 14.)

Potassium ***ortho*****phosphate,** K_3PO_4.

Not deliquescent. Very sol. in H_2O. (Graham, Pogg. **32.** 47.)

Very sl. sol. in cold, easily in hot H_2O. (Darracq.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
K	PO_4
9.14	3.13
8.84	3.22
8.42	3.44
7.52	3.78
6.90	4.15
6.88	4.12

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 103.)

Insol. in alcohol.

Potassium hydrogen ***ortho*****phosphate,** $2K_2HPO_4, KH_2PO_4+H_2O$.

Very unstable; very sol. in H_2O with decomp. Identical with the substance described as dipotassium phosphate by Berzelius. (Staudenmaier, Z. anorg. 1894, **5.** 389.)

$3K_2HPO_4, KH_2PO_4+2H_2O$. Very unstable; very sol. in H_2O with decomp. (Staudenmaier.)

Potassium hydrogen ***ortho*****phosphate,** K_2HPO_4.

Deliquescent. Very sol. in H_2O and alcohol.

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
K	PO_4
6.80	4.08
6.80	4.05
6.76	3.96
6.50	3.81
6.16	3.61
5.24	3.25
4.42	2.94

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 103.)

Potassium ***di*****hydrogen phosphate,** KH_2PO_4.

Deliquescent. Easily sol. in H_2O. (Vauquelin, A. ch. **74.** 96.)

1 l. sat. aq. solution at 7° contains 249.9 g. KH_2PO_4. (Muthmann and Kuntze, Z. Kryst. Min. 1894, **23.** 308.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
K	PO_4
2.90	2.36
1.70	1.71
1.60	1.67
1.48	1.46
1.78	3.15
2.18	4.65
2.54	6.32
2.66	6.76
2.98	8.03
3.32	8.80

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 103.)

Sp. gr. of KH_2PO_4+Aq at 18° containing:

5	10	15% KH_2PO_4.
1.0341	1.0691	1.1092

(Kohlrausch, W. Ann. **1879.** 1.)

Sol. in 20% $KC_2H_3O_2+Aq$. (Stromeyer.)

For solubility in H_2O, see K_2HPO_4, H_3PO_4.

Insol. in alcohol.

Potassium ***ortho*****phosphate, acid,** KH_2PO_4, H_3PO_4.

Solubility in H_2O at t°.

t°	% KH_2PO_4,H_3PO_4	Solid phase
−0.6	3.337	Ice
−2.5	12.13	"
−6.7	29.43	"
−9.2	36.98	"
−13	44	Ice+KH_2PO_4
0 (?)	45.8	KH_2PO_4
+10.9	50.3	"
65.2	68.44	"
78	72.43	"
87.5	7[illegible].6	"
105.5	85.9	"
120	92.1	"+KH_2PO_4, H_3PO_4
135	96.1	KH_2PO_4, H_3PO_4
139	100	"

(Parravano and Mieli, Gazz. ch. it. **38.** II, 536.)

Solubility in anhydrous H_3PO_4 at t°.

t°	% KH_2PO_4, H_3PO_4
38.5	18.17
84	58.42
110	77.53
126.5	92.26

(Parravano and Mieli.)

Potassium ***pyro*****phosphate,** $K_4P_2O_7+3H_2O$.

Very deliquescent, and sol. in H_2O.

Precipitated from aqueous solution by alcohol. (Schwarzenberg, A. **65.** 136.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Potassium hydrogen ***pyro*****phosphate,** $K_2H_2P_2O_7$.

Very deliquescent, and sol. in H_2O. Insol. in alcohol. (Schwarzenberg.)

Potassium silver ***meta*****phosphate,** $K_2Ag_4(PO_3)_6+H_2O$.

(Tammann, J. pr. 1892, (2) **45.** 417.)

Potassium sodium ***dimeta*****phosphate,** $KNaP_2O_6+H_2O$.

Sol. in 24 pts. H_2O. (Fleitmann, Pogg. **78.** 339.)

Potassium sodium phosphate, $KNaHPO_4+7H_2O$.

Not efflorescent. Sol. in H_2O.

Tri**potassium** ***tri*****sodium** ***hexa*****hydrogen phosphate,** $H_6Na_3K_3(PO_4)_4+22H_2O$.

Sol. in H_2O. (Filhol and Senderens, C. R. **93.** 388.)

Potassium sodium ***pyro*****phosphate,** $K_2Na_2P_2O_7+12H_2O$.

Sol. in H_2O. (Schwarzenberg, A. **65.** 140.)

Potassium strontium ***dimeta*****phosphate,** $K_2Sr(P_2O_6)_2+4H_2O$.

As the KBa comp. (Glatzel, Dissert. **1880.**)

Potassium strontium ***hexameta*****phosphate,** $K_2Sr_2P_6O_{18}$.

(Tammann, J. pr. 1892, (2) **45.** 435.)

Potassium strontium ***ortho*****phosphate,** $KSrPO_4$.

Insol. in H_2O; sol. in dil. acids. (Grandeau, A. ch. (6) **8.** 193.)

Potassium strontium ***pyro*****phosphate,** $K_2SrP_2O_7$.

Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1599.)

Potassium thorium phosphate, K_2O, $4ThO_2$, $3P_2O_5$.

Insol. in HCl, HNO_3, or aqua regia. (Troost and Ouvrard, C. R. **102.** 1422.)

K_2O, ThO_2, P_2O_5. Insol. in H_2O; sol. in HNO_3+Aq. (Troost and Ouvrard.)

$6K_2O$, $3ThO_2$, $4P_2O_5$. Sol. in acids. (Troost and Ouvrard.)

Potassium tin (stannic) phosphate, K_2O, $4SnO_2$, $3P_2O_5$.

(Ouvrard, C. R. **111.** 177.)

K_2O, $2SnO_2$, P_2O_5. (Ouvrard.)

Potassium titanium phosphate, K_2O, $4TiO_2$, $3P_2O_5$.

(Ouvrard, C. R. **111.** 177.)

K_2O, $2TiO_2$, P_2O_5. (Ouvrard.)

Potassium uranous phosphate, $4UO_2$, K_2O, $3P_2O_5$.

Practically insol. in conc. HNO_3 and HCl, even when the acids are boiling. Attacked by HF+HNO_3. (Colani, A. ch. 1907, (8) **12.** 133.)

Potassium uranous ***meta*****phosphate,** UO_2, K_2O, P_2O_5.

Easily sol. in HNO_3. Sol. in conc. HCl. (Colani.)

Potassium uranous ***pyro*****phosphate,** $3UO_2$, $6K_2O$, $4P_2O_5$.

Sol. in acids. (Colani.)

Potassium uranyl phosphate, K_2O, UO_3, P_2O_5.

(Ouvrard, C. R. **110.** 1333.)

$2K_2O$, UO_3, P_2O_5. (Ouvrard.)

K_2O, $2UO_3$, P_2O_5. (Ouvrard.)

Potassium uranyl *ortho*phosphate, $K(UO_2)PO_4+3H_2O$.

As NH_4 comp. (Lienau, Dissert. **1898.**)

Potassium vanadium phosphate.

See **Phosphovanadate, potassium.**

Potassium yttrium phosphate, $3K_2O, Y_2O_3, 2P_2O_5$.

$K_2O, Y_2O_3, 2P_2O_5$.

$3K_2O, 5Y_2O_3, 6P_2O_5$. (Duboin, C. R. **107.** 622.)

Potassium zinc *tetrameta*phosphate, $K_2Zn(PO_3)_4+6H_2O$.

Sol. in 70 pts. H_2O. (Glatzel, Dissert. **1880.**)

Potassium zinc phosphate, $KZnPO_4$.

Insol. in H_2O. Sol. in dil. acids. (Ouvrard, C. R. **106.** 1729.)

$K_2ZnP_2O_7$. As above.

Potassium zirconium phosphate, $K_2O, 4ZrO_2, 3P_2O_5$.

Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. **102.** 1422.)

K_2O, ZrO_2, P_2O_5. Insol. in H_2O, HNO_3, HCl, or aqua regia. Sol. in hot conc. H_2SO_4. (Troost and Ouvrard.)

Potassium phosphate selenate.

See **Selenophosphate, potassium.**

Potassium hydrogen phosphate sulphate, $KH_2PO_4, KHSO_4$.

Decomp. by H_2O and alcohol. (Jacquelain.)

Rhodium phosphate, basic, $4Rh_2O_3, 3P_2O_5+32H_2O$.

Insol. in H_2O or acids. (Claus.)

$Rh_2O_3, P_2O_5+6H_2O=RhPO_4+3H_2O$. Sol. in H_2O. (Claus.)

Rubidium *meta*phosphate, $RbPO_3$.

Sol. in H_2O. (von Berg, B. 1901, **34.** 4183.)

Rubidium *ortho*phosphate, $Rb_3PO_4+4H_2O$.

Hydroscopic; sol. in H_2O; pptd. by alcohol. (von Berg, B. 1901, **34.** 4183.)

Rubidium hydrogen *ortho*phosphate, $Rb_2HPO_4+H_2O$.

Sol. in H_2O; insol. in conc. NH_4OH+Aq; insol. in alcohol. (von Berg.)

Rubidium *di*hydrogen *ortho*phosphate, RbH_2PO_4.

Very sol. in H_2O; pptd. by alcohol. (von Berg.)

Rubidium *pyro*phosphate, $Rb_4P_2O_7$.

Hydroscopic; sol. in H_2O. (von Berg.)

Samarium *anhydrometa*phosphate, $Sm_2O_3, 5P_2O_5$.

Insol. in H_2O or HNO_3+Aq. (Cleve.)

Samarium *ortho*phosphate, $SmPO_4$.

Scarcely attacked by boiling HNO_3+Aq. (Cleve.)

$+2H_2O$.

Samarium *pyro*phosphate, $SmHP_2O_7+1\frac{1}{2}H_2O$.

(Cleve.)

Silicon phosphate.

See **Silicophosphoric acid.**

Silver *meta*phosphate, $Ag_2O, 2P_2O_5+H_2O$.

Kroll, Z. anorg. 1912, **76.** 408.)

Silver *dimeta*phosphate, $Ag_2P_2O_6$.

Very sl. sol. in H_2O. (Fleitmann, Pogg. **78.** 253.)

Sol. in cold aniline metaphosphate+Aq. (Nicholson.)

Very sl. sol. in H_2O. (Warschauer, Dissert. **1903.**)

$+H_2O$. Very sol. in H_2O. (Langheld, B. 1912 **45.** 3760.)

Silver *trimeta*phosphate, $Ag_3P_3O_9$.

Sol. in 60 pts. cold H_2O. Can be crystallized from conc. HNO_3+Aq. (Fleitmann and Henneberg.)

$+H_2O$. (Lindbom.)

Silver *hexameta*phosphate, $Ag_6P_6O_{18}$.

Insol. in H_2O. Sol. in HNO_3 or NH_4OH+Aq, and in a large excess of sodium hexametaphosphate+Aq. (Rose.)

Easily decomp. by Na_2S+Aq.

Decomp. gradually by hot H_2O into $Ag_6P_4O_{13}$.

When freshly pptd., easily sol. in H_2O. Easily sol. in dil. acids. (Lüdert, Z. anorg. **5.** 15.)

Silver *ortho*phosphate, Ag_3PO_4.

Very sl. sol. in H_2O. 1 l. H_2O dissolves 6.5×10^{-3} g. Ag_3PO_4 at 19.46°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Sol. in H_3PO_4, HNO_3, or $HC_2H_3O_2$+Aq, in NH_4OH or $(NH_4)_2CO_3$+Aq. Less easily in ammonium nitrate or succinate, and incompletely in $(NH_4)_2SO_4$+Aq. (Lassaigne, J. Pharm. (3) **16.** 289.)

Insol. in Na_2HPO_4+Aq. (Stromeyer.)

Not pptd. in presence of Na citrate. (Spiller.)

If 1 mol. Ag_3PO_4 is boiled with 1 mol. Na_2CO_3, 44% of it is decomp. (Malaguti.)

Readily sol. in soluble hyposulphites+Aq with decomp. (Herschel.)

Insol. in Ag salts+Aq. (Rose.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. **1014**; Naumann, B. 1904, **37.** 4329.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Silver hydrogen *ortho*phosphate, Ag_2HPO_4.
Decomp. by H_2O or alcohol into H_3PO_4 and Ag_3PO_4. (Joly, C. R. **103.** 1071.)
Sol. in H_3PO_4+Aq; insol. in ether. (Schwarzenberg, A. **65.** 162.)

Silver *pyro*phosphate, $Ag_4P_2O_7$.
Insol. in hot or cold H_2O. Sol. in cold HNO_3+Aq without decomp. Decomp. by hot HNO_3 or H_2SO_4 into orthophosphate. Decomp. by HCl+Aq into AgCl and H_3PO_4. Insol. in $HC_2H_3O_2$+Aq. Sol. in NH_4OH+Aq without decomp. (Stromeyer, Schw. J. **58.** 126.)
Insol. in $Na_4P_2O_7$+Aq. Very sl. sol. in $AgNO_3$+Aq. (Schwarzenberg, A. **65.** 161.)
Not completely insol. in $Na_4P_2O_7$+Aq. (Rose.)
Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37.** 4329.)

Silver hydrogen *pyro*phosphate, $Ag_2H_2P_2O_7$.
Decomp. by H_2O into $Ag_4P_2O_7$. (Hurtzig and Geuther, A. **111.** 160.)
Decomp. by cold H_2O. (Cavalier, C. R. 1904, **139.** 285.)

Silver hydrogen *pyro*phosphate *meta*phosphate, $2Ag_2HP_2O_7$, HPO_3.
Decomp. by H_2O. Easily sol. in HNO_3+Aq. (H. and G.)

Silver *tetra*phosphate, $6Ag_2O$, $4P_2O_5$ = $Ag_6P_4O_{13}$.
Insol. in, but gradually decomp. by boiling H_2O. (Berzelius.)
Sol. in large excess of the corresponding Na salt+Aq.

Silver *deka*phosphate, $Ag_{12}P_{10}O_{31}$.
Easily sol. in sodium dekaphosphate+Aq. (Fleitmann and Henneberg, A. **65.** 330.)

Silver *ultra*phosphate, Ag_2O, $3P_2O_5$.
(Kroll, Z. anorg. 1912, **76.** 407.)

Silver sodium *dimeta*phosphate, $AgNaP_2O_6$.
Sol. in H_2O. (Fleitmann and Henneberg, Pogg. **65.** 310.)

Silver sodium *pyro*phosphate, $6Ag_4P_2O_7$, $Na_4P_2O_7+4H_2O$.
Not completely sol. in $Na_4P_2O_7$+Aq. Easily sol. in HNO_3+Aq. (Baer, Pogg. **75.** 152.)
Easily sol. in H_2O. (Stromeyer.)
$Ag_3NaP_2O_7+\frac{1}{4}H_2O$. Ppt. (Stange, Z. anorg. 1896, **12.** 460.)

Silver uranyl phosphate, $2Ag_2O$, $6UO_3$, $3P_2O_5$ $+30H_2O$.
(Blinkoff, Dissert. **1900.**)

Silver phosphate ammonia, Ag_3PO_4, $4NH_3$.
(Widmann, B. **17.** 2284.)

Sodium *tri*phosphate, $Na_5P_3O_{10}$.
Very sol. in H_2O; decomp. easily in aq. solution at 100°. (Schwarz, Z. anorg. 1895, **9.** 253.)

Sodium *monometa*phosphate, $NaPO_3$.
Insol. in H_2O. Sol. in dil. and conc. acids. (Maddrell, A. **61.** 63.)
Insol. in acids. (Graham.)
Gradually decomp. by alkalies.

Sodium *dimeta*phosphate, $Na_2P_2O_6+2H_2O$.
Deliquescent. Sol. in 7.2 pts. of cold or hot H_2O. Very sol. in conc. HCl+Aq. Sol. in NaOH+Aq. Insol. in strong, very sl. sol. in dilute alcohol. (Fleitmann, Pogg. **78.** 246.)

Sodium *trimeta*phosphate, $Na_3P_3O_9+6H_2O$.
Sol. in 4.5 pts. cold H_2O. Insol. in strong, very sl. sol. in dil. alcohol. (Fleitmann and Henneberg, A. **65.** 307.)
Decomp. by boiling H_2O. (Lindbom.)

Sodium *tetrameta*phosphate, $Na_4P_4O_{12}$.
Sol. in H_2O; cryst. with about $4H_2O$. Less sol. in alcohol than in H_2O. (Fleitmann, Pogg. **78.** 854.)

Sodium *hexameta*phosphate, $Na_6P_6O_{18}$.
Deliquescent. Very sol. in H_2O. Insol. in alcohol. (Graham, Pogg. **32.** 56.)

Sodium *ortho*phosphate, $Na_3PO_4+12H_2O$.
Not deliquescent in dry air.
100 pts. H_2O dissolve 19.6 pts. crystals at 15.5°. (Graham.)
100 pts. H_2O dissolve 28.3 pts. Na_3PO_4+$12H_2O$ at 15°. (Schiff.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.

Na	PO_4
4.28	0.040
3.24	0.183
2.24	0.752
2.73	1.08

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 101.)

Sp. gr. of Na_3PO_4+Aq at 15°.
% = $\%Na_3PO_4+12H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0043	9	1.0399	17	1.0778
2	1.0086	10	1.0455	18	1.0827
3	1.0130	11	1.0492	19	1.0876
4	1.0174	12	1.0539	20	1.0925
5	1.0218	13	1.0586	21	1.0975
6	1.0263	14	1.0633	22	1.1025
7	1.0308	15	1.0681	23	1.1076
8	1.0353	16	1.0729	24	1.1127

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+10H_2O$. (Rammelsberg.)

Could not be obtained. (Hall, J. pr. **94.** 237.)

$+7H_2O$. (Hall.)

Melts in crystal water at 76.6°. (Graham.)

Sodium hydrogen phosphate, Na_2HPO_4.

Sol. in H_2O with evolution of heat.

100 pts. H_2O dissolve at t°.

t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4
0	1.55	40	30.88	80	81.29
10	4.10	50	43.31	90	95.02
20	11.08	60	55.29	100	108.20
30	19.95	70	68.72	106.2	114.43

(Poggiale, J. Pharm. (3) **44.** 273.)

100 pts. H_2O at 13° dissolve 3.4 pts. Na_2HPO_2 (Ferein, Ph. Viertelj. **7.** 244); at 15°, 5.9 pts. (Neese); at 16°, 6.3 pts. (Mulder); at 16°, 8.4 pts. (Müller, J. pr. **95.** 52); at 20°, 6.8 pts. (Neese, Russ. Z. Pharm. **1.** 101); at 25°, 12.5 pts. (*ibid.*).

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4	t°	Pts. Na_2HPO_4
0	2.5	35	39.3	69	94.8
1	2.6	36	43.6	70	95.0
2	2.6	37	49.5	71	95.1
3	2.7	38	55.5	72	95.2
4	2.7	39	60.6	73	95.4
5	2.8	40	63.9	74	95.6
6	3.0	41	66.2	75	95.8
7	3.2	42	68.6	76	96.0
8	3.4	43	70.8	77	96.1
9	3.6	44	72.9	78	96.3
10	3.9	45	74.8	79	96.5
11	4.2	46	76.5	80	96.6
12	4.5	47	78.2	81	96.8
13	4.9	48	79.7	82	96.9
14	5.3	49	81.2	83	97.0
15	5.8	50	82.5	84	97.1
16	6.3	51	83.7	85	97.2
17	6.9	52	84.8	86	97.4
18	7.6	53	85.8	87	97.5
19	8.4	54	86.7	88	97.6
20	9.3	55	87.7	89	97.7
21	10.3	56	88.6	90	97.8
22	11.4	57	89.4	91	97.9
23	12.6	58	90.2	92	98.0
24	14.0	59	90.9	93	98.1
25	15.4	60	91.6	94	98.2
26	16.9	61	92.2	95	98.4
27	18.5	62	92.7	96	98.5
28	20.2	63	93.1	97	98.6
29	22.0	64	93.5	98	98.7
30	24.1	65	93.8	99	98.8
31	26.4	66	94.1	105	82.5
32	29.1	67	94.4	105.57	80.7
33	32.1	68	94.6	106.4	79.2
34	35.5	..	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 103.)

Solubility in H_2O at t°.

t°	G. Na_2HPO_4 in 100 g. H_2O
10.26	3.55
25.15	12.02
40.29	54.88
60.23	83.00
99.77	102.15

Three breaks in the curve: at 36.45°, transition from dodecahydrate to heptahydrate; at 48°, transition from heptahydrate to the dihydrate; at 95.2°, transition from dihydrate to the monohydrate. (Shiomi, C. C. **1909,** II. 106.)

Solubility of Na_2HPO_4 in H_2O at t°.

t°	G. Na_2HPO_4 in 100 g. H_2O	Solid phase
−0.43	1.42	Ice
−0.24	0.70	"
−0.5*		
+0.05	1.67	$Na_2HPO_4+12H_2O$
20.0	7.66	"
25.0	12.0	"
32.0	25.7	"
34.0	33.8	"
35.2*		
39.2	51.8	$Na_2HPO_4+7H_2O$
45.0	67.3	"
48.3*		
50.0	80.2	$Na_2HPO_4+2H_2O$
60.0		
80.0	82.9	"
90.0	92.4	"
95*	101.0	"
96.2	104.6	Na_2HPO_4
105.0	102.3	"
120	99.2	"

(Menzies and Humphery, Int. Cong. App. Chem. 1912, **2.** 177.)

* Transition points.

Solubility in H_2O at t°.

t°	100 g. H_2O dissolve g. Na_2HPO	Solid phase
0°	2.51	$Na_2HPO_4, 12H_2O$
25	12.47	"
35.4*	46.11	$Na_2HPO_4, 7H_2O$
40.3	54.80	"
48.35*	79.00	$Na_2HPO_4, 2H_2O$
59.7	91.3	
71	95.1	
91	98.15	

(D'Ans and Schreiner. Z. phys. Ch. 1911, **75.** 99.)

*Transition points.

The composition of the hydrates formed by this salt at different dilutions is calculated

from determinations of the lowering of the fr.-pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, **34.** 318.)

Na_2HPO_4+Aq saturated at 15° has 1.0469 sp. gr. (Michel and Krafft); saturated at 16°, 1.0511 (Stolba).

Sp. gr. of Na_2HPO_4+Aq at 19°.

% $Na_2HPO_4+12H_2O$	Sp. gr.	% $Na_2HPO_4+12H_2O$	Sp. gr.	% $Na_2HPO_4+12H_2O$	Sp. gr.
1	1.0041	5	1.0208	9	1.0376
2	1.0083	6	1.0250	10	1.0418
3	1.0125	7	1.0292	11	1.0460
4	1.0166	8	1.0332	12	1.0503

(Schiff, A. **110.** 70.)

Saturated solution freezes at —0.45° (Rüdorff, Pogg. **122.** 337), and boils at 105° (Griffiths), 105–106.4° (Mulder), 106.5° (Legrand).

Sat. Na_2HPO_4+Aq boils at 105.5° (Griffiths); at 106.5°, and contains 113.2 pts. Na_2HPO_4 to 100 pts. H_2O (Legrand); forms a crust at 106.4°, and contains 108.8 pts. Na_2HPO_4 to 100 pts. H_2O; highest temp. observed, 106.8°. (Gerlach, Z. anal. **26.** 427.)

B.-pt. of Na_2HPO_4+Aq containing pts. Na_2HPO_4 to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 450); L = according to Legrand (A. ch. (2) **59.** 426.)

B.-pt.	G	L	B.-pt.	G	L
100.5°	8.6	11.0	104°	68.4	76.4
101	17.2	21.0	104.5	76.9	84.2
101.5	25.8	31.0	105	85.3	91.5
102	34.4	40.8	105.5	93.7	98.4
102.5	42.9	50.3	106	102.1	105.0
103	51.4	59.4	106.5	110.5	111.4
103.5	59.9	68.1	106.6	...	112.6

+H_2O. Transition point, 95.2°. (Shiomi.)

+$2H_2O$. Transition point, 48.35°. (D'Ans and Schreiner); 48° (Shiomi); 48.3° (Menzies and Humphery).

+$7H_2O$. Not efflorescent. Sol. in H_2O with absorption of heat.

Sol. in 8 pts. H_2O at 23°. (Neese, J. B. **1863.** 181.)

Transition point, 35.4° (D'Ans and Schreiner); 36.45° (Shiomi); 35.2° (Menzies and Humphery).

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
Na	PO_4
6.31	4.63
6.76	4.88
7.31	5.55

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 101.)

See also above.

+$12H_2O$. Efflorescent. Sol. in H_2O with absorption of heat.

14 pts. $Na_2HPO_4+12H_2O$ mixed with 100 pts. H_2O at 10.8° lower the temperature 3.7°. (Rüdorff, B. **2.** 68.)

Sol. in 8.48 pts. H_2O at 17°, or 100 pts. H_2O dissolve 11.8 pts. at 17°, and solution has sp. gr. = 1.0422. (Schiff.)

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Pagens.)

Sol. in 4 pts. H_2O at 18.75°. (Abl.)

100 pts. H_2O dissolve 12.735 pts. $Na_2HPO_4+12H_2O$. (Michel and Krafft.)

100 pts. H_2O dissolve 6.5 pts. $Na_2HPO_4+12H_2O$ at 0°; 27.5 pts. at 30°. (Tilden, Chem. Soc. **45.** 409.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
Na	PO_4
2.62	1.09
1.56	0.78
2.38	1.60
3.18	2.24
4.65	3.55
5.63	3.87

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 101.)

See also above.

Melts in crystal water below 100°, and easily forms supersaturated solutions. (Gay-Lussac.)

Melts in crystal H_2O at 34.6° (Persoz), 35° (Kopp), 40–41° (Mulder).

Melts in crystal H_2O at 35°. (Tilden, Chem. Soc. **45.** 409.)

Supersaturated solutions are brought to crystallization by addition of a crystal of $Na_2HPO_4+12H_2O$ or an isomorphous substance as $Na_2HAsO_4+12H_2O$. (Thomson, Chem. Soc. **35.** 200.)

Insol. in alcohol.

Sodium *di*hydrogen phosphate, $NaH_2PO_4+H_2O$.

Very sol. in H_2O. Insol. in alcohol. (Graham.)

+$2H_2O$. Unchanged on air. Very sol. in H_2O, and solubility increases rapidly with the temperature. (Joly and Dufet, C. R. **102.** 1391.)

100 pts. H_2O dissolve 59.9 pts. at 0°; 84.6 pts. at 18°. (Joly and Dufet.)

Solubility of NaH_2PO_4 in H_2O at t°.
G. of anydrous NaH_2PO_4 in 100 g. H_2O.
Solid phase; $NaH_2PO_4+2H_2O$.

t°	G. NaH_2PO_4	t°	G. NaH_2PO_4
0.1	57.86	28.0	101.71
1.0	59.08	30.0	106.45
3.0	61.47	31.0	108.93
5.0	63.82	33.0	114.31
10.0	69.87	34.0	117.14
15.0	76.72	35.0	120.44
20.0	85.21	37.0	126.76
25.0	94.63	40.2	138.16
26.0	96.73	40.55	110.83
27.0	99.20	...	...

40.8°; transition point.

Solid phase; $NaH_2PO_4+H_2O$.

41	142.55	52	163.84
42	143.83	55	170.85
45	148.20	56	173.23
50	158.61	57	175.81

57.4°; transition point.

Solid phase; NaH_2PO_4.

58	177.24	69.	190.24
60	179.33	80.	207.29
62	181.35	90.	225.31
65	184.99	99.1	246.56

(Imadzu, Chem. Soc. 1912, **33.** 359.)

Solubility in H_3PO_4+Aq at 25°.

In 1000 g. of the solution, mols.	
Na	PO_4
6.19	4.68
6.01	4.67
5.12	4.36
4.81	4.22
4.36	4.08
4.06	4.03
4.19	4.38
4.32	4.96
4.65	5.89
4.88	6.40

(D'Ans and Schreiner, Z. phys. Ch. 1910, **75.** 101.)

***Tri*sodium *tri*hydrogen phosphate,** $Na_3H_3(PO_4)_2$.

Not hydroscopic. Sol. in H_2O in all proportions. (Joulie, C. R. 1902, **134.** 604.)

$+1\frac{1}{2}H_2O$. Sol. in H_2O. (Filhol and Senderens, C. R. **93.** 388.)

$+7H_2O$. (Salzer, Arch. Pharm. 1894, **232.** 365.)

$+7\frac{1}{2}H_2O$. (Joulie.)

Sodium *ortho*phosphate acid, NaH_2PO_4, H_3PO_4.

Hygroscopic. Decomp. by alcohol. (Staudenmaier, Z. anorg. 1894, **5.** 395.)

Solubility of NaH_2PO_4, H_3PO_4 in H_2O at t°.

t°	% NaH_2PO_4, H_3PO_4	Solid phase
− 5.7	20.77	Ice
− 7.9	26.92	"
−11.4	34.15	"
− 38	56.66	"
−34	80.46	NaH_2PO_4
+41	81.82	"
51.7	83.68	"
79.7	87.48	"
85	88.65	"
101.7	91 47	"+NaH_2PO_4, H_3PO_4
104.5	92.67	NaH_2PO_4, H_3PO_4
110	95.79	"
119	97.99	"
126.5	100	"

(Parravano and Mieli, Gazz. ch. it. **38,** II. 536.)

Solubility in anhydrous H_3PO_4.

t°	% NaH_2PO_4, H_3PO_4
98.5	52.72
111	69.59
119	77.55
122	81.71
123	87.20

(Parravano and Mieli.)

$+H_2O$. Very deliquescent. (Salzer, Arch. Pharm. 1894, **232.** 369.)

Sodium *pyro*phosphate, $Na_4P_2O_7$, and $+10H_2O$.

Less sol. in H_2O than sodium hydrogen orthophosphate. (Clark, Ed. J. Sci. **7.** 298.)

100 pts. H_2O dissolve (a) pts. $Na_4P_2O_7$, (b) pts. $Na_4P_2O_7+10H_2O$ at:

	0°	10°	20°	30°	40°	50°
a.	3.16	3.95	6.23	9.95	13.50	17.45
b.	5.41	6.81	10.92	18.11	24.97	33.25

	60°	70°	80°	90°	100°
a.	21.83	25.62	30.04	35.11	40.26
b.	44.07	52.11	63.40	77.47	93.11

(Poggiale.)

Sol. in H_2SO_4. (Walden, Z. anorg. **1902,** **29.** 384.)

Crystallizes unchanged from NH_4Cl+Aq (Winkler), or conc. NH_4OH+Aq. (Uelsmann.)
Decomp. into orthophosphate by heating with H_2SO_4, HCl, $HC_2H_3O_2$, or H_3PO_4+Aq.
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
Insol. in alcohol. Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sodium hydrogen ***pyro*****phosphate,** $Na_2H_2P_2O_7$.
Decomp. by H_2O. Sol. in H_2O containing $HC_2H_3O_2$ without decomp. (Bayer, J. pr. **106.** 501.)
Sl. sol. in alcohol. Much more sol. in H_2O than NaH_2PO_4.
$+6H_2O$. (Rammelsberg, B. A. B. **1883.** 21.)
100 g. sat. solution contain 14.95 g. $Na_2H_2P_2O_7$ at 18°. (Giran, A. ch. 1902, (7) **30.** 249.)
$NaH_3P_2O_7$. Very hydroscopic. (Salzer, Arch. Pharm. 1894, **232.** 369.)
100 g. sat. solution contain 62.7 g. at 18°. (Giran, A. ch. 1902, (7) **30.** 249.)
$Na_3HP_2O_7+H_2O$. Sol. in 3 pts. H_2O. (Salzer, Arch. Pharm. 1894, **232.** 366.)
$+6H_2O$. 100 g. sat. solution contain 28.17 g. $Na_3HP_2O_7$ at 18°. (Giran.)

Sodium ***tetra*****phosphate,** $Na_6P_4O_{13}$.
Slowly sol. in 2 pts. cold H_2O. Easily decomp.
$+18H_2O$. (Uelsmann.)

Sodium hydrogen ***tetra*****phosphate,** $Na_4H_2P_4O_{13}$.
Sol. in H_2O.

Sodium ***deka*****phosphate,** $Na_{12}P_{10}O_{31}$.
Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 333.)

Sodium strontium ***dimeta*****phosphate,** $Na_2Sr(P_2O_6)_2+4H_2O$.
As the NaBa comp. (Glatzel, Dissert. **1880.**)

Sodium strontium ***trimeta*****phosphate,** $NaSrP_3O_9+3H_2O$.
Easily sol. in H_2O and acids. (Fleitmann, A. **65.** 315.)

Sodium strontium ***ortho*****phosphate,** $NaSrPO_4+H_2O$.
Scarcely sol. in H_2O; sol. in acids.
$+9H_2O$. (Joly, C. R. **104.** 905.)

Sodium strontium ***pyro*****phosphate** (?).
Sl. sol. in H_2O. Insol. in $Na_4P_2O_7$+Aq. (Baer, Pogg. **75.** 166.)
Easily sol. in HCl+Aq, or HNO_3+Aq.
Sol. in NH_4OH+Aq.

Sodium thallium ***pyro*****phosphate,** $Na_5[Tl(P_2O_7)_2]+6H_2O = Na(TlP_2O_7)$, $Na_4P_2O_7+6H_2O$.
Decomp. by H_2O. (Rosenheim, B. 1915, **48.** 588.)

Sodium thorium ***ortho*****phosphate,** $NaTh_2(PO_4)_3$.
Insol. in acids. (Wallroth, Bull. Soc. (2) **39.** 316.)

Sodium thorium phosphate, Na_2O, $4ThO_2$, $3P_2O_5$.
Insol. in HNO_3, HCl, or aqua regia. (Troost and Ouvrard, C. R. **105.** 30.)
$5Na_2O$, $2ThO_2$, $3P_2O_5$. Sol. in HNO_3+Aq. (T. and O.)
Na_2O, ThO_2, P_2O_5. (T. and O.)

Sodium thorium ***pyro*****phosphate,** $Na_4P_2O_7$, $ThP_2O_7+2H_2O$.
(Cleve.)

Sodium tin (stannic) phosphate, $NaSn_2(PO_4)_3$.
(Ouvrard, C. R. **111.** 177.)
$Na_2Sn(PO_4)_2$. (Wunder, J. pr. (2) **4.** 339.)
$6Na_2O$, $3SnO_2$, $4P_2O_5$. (Ouvrard.)

Sodium titanium phosphate, $NaTi_2(PO_4)_3$.
Insol. in acids. (Rose, J. B. **1867.** 9.)
$6Na_2O$, TiO_2, $4P_2O_5$. (Ouvrard, C. R. **111.** 177.)

Sodium uranium phosphate, UO_2,Na_2O, P_2O_5.
Easily attacked by acids. (Colani, A. ch. 1907, (8) **12.** 137.)

Sodium uranium ***meta*****phosphate,** $4UO_2$, Na_2O, $3P_2O_5$.
Insol. in boiling HNO_3. (Colani.)

Sodium uranium ***pyro*****phosphate,** $3UO_2$, $6Na_2O$, $4P_2O_5$.
Sol. in acids. (Colani.)

Sodium uranyl phosphate, Na_2O, UO_3, P_2O_5.
(Ouvrard, C. R. **110.** 1333.)
$2Na_2O$, UO_3, P_2O_5. (Ouvrard.)
Na_2O, $5UO_3$, $2P_2O_5+3H_2O$. Insol. in H_2O; decomp. by acetic acid. (Werther, A. **68.** 312.)

Sodium uranyl ***pyro*****phosphate.**
Very sol. in H_2O. (Persoz, A. ch. (3) **20.** 322.)

Sodium ytterbium ***pyro*****phosphate,** $NaYbP_2O_7$.
Easily sol. in the strong acids. (Wallroth.)

Sodium yttrium ***pyro*****phosphate,** $NaYP_2O_7$.
Sol. in H_2O. (Stromeyer.)
Insol. in H_2O. Easily sol. in strong acids. (Wallroth.)

Sodium zinc *tri*phosphate, Na_2O, $4ZnO$, $3P_2O_5+19H_2O$.

Sol. in H_2O. (Schwarz, Z. anorg. 1895, **9.** 266.)

Sodium zinc *trimeta*phosphate, Na_2O, $2ZnO$, $3P_2O_5$.

Ppt. Sol. in H_2O. (Fleitmann and Henneberg, A. **65.** 304.)

Sodium zinc *tetrameta*phosphate, $Na_2Zn(PO_3)_4+6H_2O$.

As K comp. (Glatzel, Dissert. **1880.**)

Sodium zinc *octometa*phosphate, $Na_2Zn_3(PO_3)_8$

Insol. in acids.

Sol. in conc. H_2SO_4. (Tammann, J. pr. 1892, (2) **45.** 420.)

Sodium zinc *ortho*phosphate, $NaZnPO_4$.

Difficultly sol. in H_2O or acetic acid. Easily sol. in dil. mineral acids. (Scheffer, A. **145.** 53.)

$2Na_2O$, ZnO, P_2O_5. Insol. in H_2O; sol. in dil. acids. (Ouvrard, C. R. **106.** 1796.)

Sodium zinc *pyro*phosphate, $Na_2ZnP_2O_7$.

Insol. in H_2O; sol. in dil. acids. (Wallroth.)

$3Na_4P_2O_7$, $Zn_2P_2O_7+24H_2O$. Very efflorescent. (Pahl.)

$Na_4P_2O_7$, $Zn_2P_2O_7+2\frac{1}{2}$, 3, $3\frac{1}{2}$, and $8H_2O$. Insol. in H_2O; sol. in $Na_4P_2O_7$+Aq. (Pahl, Sv. V. A. F. **30, 7.** 35.)

$4Na_4P_2O_7$, $5Zn_2P_2O_7+20H_2O$. Insol. in H_2O. (Pahl.)

$Na_4P_2O_7$, $4Zn_2P_2O_7+12H_2O$. Sl. sol. in H_2O. (Pahl.)

Sodium zirconium phosphate, Na_2O, $4ZrO_2$, $3P_2O_5 = NaZr_2(PO_4)_3$.

Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. **105.** 30.)

$6Na_2O$, $3ZrO_2$, $4P_2O_5$. Sol. in acids. (T. and O.)

$4Na_2O$, ZrO_2, $2P_2O_5$. Sol. in acids. (T. and O.)

Sodium phosphate fluoride, Na_3PO_4, $NaF+12H_2O$.

100 pts. H_2O dissolve, at 25°, 12 pts. salt and form solution of 1.0329 sp. gr.; at 70°, 57.5 pts. salt and form solution of 1.1091 sp. gr. (Briegleb, A. **97.** 95.)

$2Na_3PO_4$, $NaF+19H_2O$, and 22 H_2O. Sol. in H_2O. (Baumgarten, J. B. **1865.** 219.)

Sodium phosphate stannate, $4Na_3PO_4$, $Na_2SnO_3+48H_2O$.

(Prandtl, B. 1907, **40.** 2132.)

Sodium phosphate titanate, Na_2O, TiO_3, $P_2O_5+3H_2O$.

Hygroscopic. (Mazzuchelli and Pantanelli, C. C. **1909,** II. 420.)

Sodium phosphate vanadate.

See **Phosphovanadate, sodium.**

Strontium *monometa*phosphate, $Sr(PO_3)_2$.

Insol. in H_2O and acids. Not decomp. by alkali carbonates+Aq. (Maddrell, A. **61.** 61.)

Strontium *hexameta*phosphate.

Nearly insol. in H_2O; easily sol. in acids. (Lüdert, Z. anorg. **5.** 15.)

Strontium *ortho*phosphate, basic, $Sr(OH)_2$, $Sr_3(PO_4)_2$.

(Woyczynski, Z. anorg. 1894, **6.** 311.)

Strontium *ortho*phosphate, $Sr_3(PO_4)_2$.

Insol. in H_2O. Sol. in HCl+Aq. (Erlenmeyer, J. B. **1857.** 145.)

Strontium hydrogen phosphate, $SrHPO_4$.

Insol. in H_2O. Sol. in H_3PO_4, HCl, or HNO_3+Aq. (Vauquelin.) Easily sol. in cold ammonium nitrate, chloride, or succinate+Aq, but is partly precipitated by a little NH_4OH+Aq. (Brett.)

Sol. in boiling NH_4Cl+Aq. (Fuchs, **1834.**)

Sol. in Na citrate+Aq. (Spiller.)

Partly decomp. by boiling Na_2CO_3, and K_2CO_3+Aq. (Dulong.)

$SrH_4(PO_4)_2+2H_2O$. Decomp. by treating with H_2O, leaving 4.29% $SrHPO_4$. (Barthe.)

Strontium phosphate, acid, H_2O, $2SrO$, $3P_2O_5+xH_2O$.

Entirely sol. in H_2O. (Barthe, C. R. **114.** 1267.)

Strontium *pyro*phosphate, $Sr_2P_2O_7+H_2O$.

Somewhat sol. in H_2O. Easily sol. in HCl or HNO_3+Aq. Insol. in $HC_2H_3O_2$ or $Na_4P_2O_7$+Aq. (Schwarzenberg, A. **65.** 144.)

$+2\frac{1}{2}H_2O$. (Knorre and Oppelt, B. **21.** 773.)

Strontium hydrogen *pyro*phosphate, $SrH_2P_2O_7$, $2Sr_2P_2O_7+6H_2O$.

Ppt. (Knorre and Oppelt, B. **21.** 772.)

$SrH_2P_2O_7$, $3Sr_2P_2O_7+H_2O$, and $+2H_2O$. (Knorre and Oppelt.)

$Sr_9H_2(P_2O_7)_5+8H_2O$, and $+12H_2O$.

Ppt. (Pahl, Gm. – K. 2, **2.** 172.)

$Sr_{19}H_2(P_2O_7)_{10}+5H_2O$, $+18H_2O$ and $+20H_2O$.

Insol. in $Sr(NO_3)_2$+Aq or $Na_4P_2O_7$+Aq. (Pahl, Gm. – K. 2, **2.** 171.)

Strontium thorium phosphate, Th_2O, SrO, P_2O_5.

(Colani, C. R. 1909, **149.** 209.)

Strontium uranium *meta*phosphate, UO_2, SrO, P_2O_5.
(Colani, A. ch. 1907, (8) **12.** 141.)

Strontium uranyl phosphate, SrO, $4UO_3$, $2P_2O_5+21H_2O$.
(Blinkoff, Dissert. **1900.**)
$2SrO$, $5UO_3$, $2P_2O_5+24H_2O$. As Ba comp. (Blinkoff.)

Strontium phosphate chloride, $3Sr_3(PO_4)_2$, $SrCl_2$.
Strontium apatite. Insol. in H_2O. (Deville and Caron.)

Tellurium phosphate (?).
Insol. in H_2O. (Berzelius.)

Thallous *meta*phosphate, $TlPO_3$.
Two modifications:
α. Difficultly sol. in H_2O.
β. Extremely easily sol. in H_2O. (Lamy.)

Thallous *ortho*phosphate, Tl_3PO_4.
1 pt. is sol. in 201.2 pts. H_2O at 15°, and 149 pts. boiling H_2O; sol. in HNO_3+Aq. (Crookes.) Sl. sol. in $HC_2H_3O_2$+Aq. Very easily sol. in solutions of NH_4 salts. (Carstanjen.) Insol. in alcohol. (Lamy.)

Thallous hydrogen phosphate, Tl_2HPO_4.
Anhydrous. Much less sol. in H_2O than the hydrous salt, but easily sol. in a solution of the hydrous salt. (Lamy.)
$+\frac{1}{2}H_2O$. Easily sol. in H_2O. Insol. in alcohol. (Lamy.)
Composition is HTl_2PO_4, $2H_2TlPO_4$. (Rammelsberg, W. Ann. **16.** 694.)

Thallous *di*hydrogen phosphate, TlH_2PO_4.
Very easily sol. in H_2O. Insol. in alcohol. (Rammelsberg, B. **3.** 278.)

***Tri*thallous *tri*hydrogen phosphate, Tl_2HPO_4, $2TlH_2PO_4$.**
True composition of Tl_2HPO_4 of Lamy. (Rammelsberg.)

Thallous *pyro*phosphate, $Tl_4P_2O_7$.
Sol. in 2.5 pts. H_2O with slight decomposition. (Lamy.)
$+2H_2O$. More sol. in H_2O than the above salt, with partial decomp. (Lamy.)

Thallous hydrogen *pyro*phosphate, $H_2Tl_2P_2O_7+H_2O$.
Very sol. in H_2O. (Lamy.)

Thallic phosphate, basic, $2Tl_2O_3$, $P_2O_5+5H_2O$.
Insol. in H_2O.

Thallic phosphate, basic, $Tl_8P_9O_{27}+13H_2O$.
(Rammelsberg, W. Ann. **16.** 694.)
$Tl_6P_4O_{19}+12H_2O$. (R.)

Thallic phosphate, $TlPO_4+2H_2O$.
Completely insol. in H_2O. Sol. in conc. HNO_3, and dil. HCl+Aq. (Willm.)

Thorium *meta*phosphate, $Th(PO_3)_4$.
Insol. in H_2O. (Troost, C. R. **101.** 210.)

Thorium *meta*phosphate, ThO_2, $2P_2O_5$.
Insol. in acids. (Johnsson, B. **22.** 976.)

Thorium *ortho*phosphate, $Th_3(PO_4)_4+4H_2O$.
Insol. in H_2O and phosphoric acid (Berzelius); also acetic acid. (Cleve.)
Sol. in HCl, and HNO_3+Aq. (Cleve.)

Thorium hydrogen phosphate, $ThH_2(PO_4)_2+H_2O$.
Precipitate.

Thorium *pyro*phosphate, $ThP_2O_7+2H_2O$.
Precipitate. Insol. in H_2O. Sol. in great excess of pyrophosphoric acid or sodium pyrophosphate+Aq. (Cleve.)

Thorium phosphate bromide.
See **Bromophosphate, thorium.**

Thorium phosphate chlroide.
See **Chlorophosphate, thorium.**

Tin (stannous) phosphate, $5SnO$, $4P_2O_5+4H_2O$.
Insol. in H_2O. (Lenssen, A. **114.** 113.)
$Sn_3(PO_4)_2$. Insol. in H_2O. Sol. in mineral acids. (Kühn.)
Insol. in NH_4Cl or NH_4NO_3+Aq. Sol. in KOH+Aq.

Tin (stannic) phosphate, $2SnO_2$, $P_2O_5+10H_2O$.
Insol. in H_2O or HNO_3+Aq. (Reynoso, J. pr. **54.** 261.)
Anhydrous. Insol. in acids. (Hautefeuille and Margottet, C. R. **102.** 1017.)

Tin (stannic) phosphate, SnP_2O_7.
Insol. in acids. (Hautefeuille and Margottet, C. R. **102.** 1017.)

Tin (stannous) phosphate chloride, $3SnO$, P_2O_5, $SnCl_2+H_2O$.
Not decomp. by hot H_2O. (Lenssen, A. **114.** 113.)

Titanium phosphate, $Ti_2P_2O_9=2TiO_2$, P_2O_5.
Insol. in acids. (Hautefeuille and Margottet, C. R. **102.** 1017.)
(Ouvrard, C. R. **111.** 177.)
$+3H_2O$. Ppt. Insol. in H_2O. (Merz.)

TiO_2, P_2O_5. (Knop.) Is $NaTi_2(PO_4)_3$. (Wunder, J. B. **1871.** 324.)

H_3TiPO_7. Sol. in HCl, HNO_3, H_2SO_4.

Sl. sol. in H_3PO_4.

Sol. in KOH, NH_4OH, $(NH_4)_2CO_3$ and $(NH_4)_2HPO_4$+Aq.

Very sl. sol. in acetic acid. (Faber, Z. anal. 1907, **46.** 288.)

Uranous *meta*phosphate, $U(PO_3)_4$.

Insol. in HNO_3, HCl, or H_2SO_4, even when hot and conc. (Colani, A. ch. 1907, (8) 12. 105.)

Uranic *meta*phosphate, $U_2(PO_3)_6$.

Insol. in H_2O and acids. (Hautefeuille and Margottet, C. R. **96.** 849.)

Uranous *ortho*phosphate, $U_3(PO_4)_4$.

More easily attacked by acids than the pyro and meta phosphates, especially by HNO_3. (Colani, A. ch. 1907, (8) **12.** 123.)

Uranous hydrogen *ortho*phosphate, $UHPO_4+H_2O$.

Insol. in H_2O. Insol. in dil., sl. sol. in conc. HCl+Aq. Decomp. by KOH+Aq, not by NH_4OH+Aq. (Rammelsberg, Pogg. **59.** 1.)

Uranous *pyro*phosphate, UP_2O_7.

Insol. in H_2O.

Sl. sol. in min. acids. (Colani.)

Uranous phosphate, $2UO_2$, P_2O_5.

Easily attacked by boiling HNO_3. (Colani.)

UO_2, $P_2O_5+5H_2O$. Insol. in H_2SO_4 and in HCl+Aq of medium concentration. Sol. in very conc. HCl+Aq. (Aloy, Dissert. 1901.)

Uranyl *meta*phosphate, $UO_2(PO_3)_2$.

(Rammelsberg, B. A. B. **1872.** 447.)

UO_3, $2P_2O_5$. Insol. in acids. (Johnsson, B. **22.** 976.)

Uranyl *ortho*phosphate, $UO_2HPO_4+1\frac{1}{2}H_2O$.

Insol. in H_2O.

$+3H_2O$.

$+4H_2O$.

$+4\frac{1}{2}H_2O$. Insol. in H_2O. Sol. in 67,000 pts. $HC_2H_3O_2$+Aq, 50,000 pts. $NH_4C_2H_3O_2$+Aq, and 300,000 pts. of a mixture of the above two solutions. Sol. in K_2CO_3 or Na_2CO_3+Aq. (Kitschin, C. N. **27.** 199.)

Uranyl *di*hydrogen phosphate, $UO_2H_4(PO_4)_2+3H_2O$.

Decomp. by H_2O. Sol. in H_3PO_4+Aq. (Werther, J. pr. **43.** 322.)

Uranyl *pyro*phosphate, $(UO_2)_2P_2O_7+5H_2O$.

Efflorescent. Insol. in H_2O. Sol. in HNO_3+Aq, and $Na_4P_2O_7$+Aq. **Insol. in Na_2HPO_4+Aq. Insol. in alcohol or ether.** (Girard, C R. **34.** 22.)

$+4H_2O$. (Casteing, Bull. Soc. (2) **34.** 20.)

Uranyl *tetra*phosphate (?), $UO_2P_4O_{11}$.

(Johnsson, B. **22.** 978.)

Uranous *ortho*phosphate chloride, $U_3(PO_4)_4$, UCl_4.

Sl. sol. in HCl+Aq. Sol. in HNO_3 and HNO_3+HCl. (Colani, A. ch. 1907, (8) **12.** 127.)

Uranous hydrogen *ortho*phosphate chloride, $U(HPO_4)_2$, UCl_4.

Very sl. sol. in H_2O. (Aloy Dissert. **1901.**)

Vanadium phosphate, $(VO_2)H_2PO_4+4\frac{1}{2}H_2O$.

Sol. in H_2O.

See **Phosphovanadic acid.**

Vanadium *pyro*phosphate, $V_4(P_2O_7)_3+30H_2O$.

Insol. in H_2O. (Rosenheim, B. 1915, **48.** 590.)

***Di*vanadyl phosphate.**

Very deliquescent, and sol. in H_2O. Insol. in alcohol. (Berzelius.)

Ytterbium *meta*phosphate, $Yb(PO_3)_3$.

Insol. in H_2O. (Cleve, Z. anorg. 1902, **32.** 149.)

Ytterbium *ortho*phosphate, $YbPO_4+4\frac{1}{2}H_2O$.

Ppt. (Cleve.)

Ytterbium phosphate, Yb_2O_3, $2P_2O_5+5H_2O$.

Sol. in H_2O. (Cleve.)

Yttrium *meta*phosphate, $Y(PO_3)_3$.

Insol. in H_2O or acids. (Cleve.)

Yttrium *ortho*phosphate, YPO_4.

Anhydrous. Insol. in H_2O or acids after ignition.

Min. *Xenotime.* Insol. in conc. acids. Sl. sol. in much conc. HCl+Aq, but easily sol. therein when first heated with a little HCl+Aq. (Wartha, A. **139.** 237.)

Yttrium hydrogen *ortho*phosphate, $Y_2(HPO_4)_3$.

Decomp. by boiling with H_2O into insol. YPO_4 and sol. acid salt.

Yttrium *pyro*phosphate, $YHP_2O_7+3\frac{1}{2}H_2O$.

Difficultly sol. in acids. Decomp. by H_2SO_4. Sol. in $Na_4P_2O_7$+Aq. (Cleve.)

$2Y_2O_3$, $3P_2O_5$. Insol. in acids. (Johnsson, B. **22.** 976.)

Zinc *meta*phosphate.
Sol. in H_2O. (Berzelius.)

Zinc *dimeta*phosphate, ZnP_2O_6.
Sol. only in boiling H_2SO_4. (Fleitmann, Pogg. **78.** 350.)
Not decomp. by boiling Na_2S or $(NH_4)_2S+$Aq.
$+4H_2O$. Insol. in H_2O, but decomp. by boiling therewith. (Fleitmann, Pogg. **78.** 258.)
Sol. in 4 pts. H_2O. Conc. H_2SO_4 decomp. it easily; other acids act slightly. (Glatzel, Dissert. **1880.**)
Difficultly decomp. by boiling acids.

Zinc *trimeta*phosphate, $Zn_3(PO_3)_6+9H_2O$.
1 l. H_2O dissolves 0.1 g. at 20°. (Tammann, J. pr. 1892, (2) **45.** 426.)

Zinc *tetrameta*phosphate, $Zn_2(PO_3)_4+10H_2O$.
Sol. in 55 pts. H_2O. Decomp. by acids only on boiling. (Glatzel, Dissert. **1880.**)
Somewhat sol. in HNO_3+Aq. Sol. in boiling H_2SO_4. (Glatzel.)

Zinc *ortho*phosphate, $Zn_3(PO_4)_2+4H_2O$.
Insol. in H_2O. Easily sol. in acids, NH_4OH, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, or NH_4NO_3+Aq. (Heintz, A. **143.** 356.)
Sol. in NH_4Cl+Aq. (Fuchs.)
Easily sol. in Zn salts+Aq. (Rose.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)
Min. *Hopeite.*
$+6H_2O$. (Reynoso.)

Zinc hydrogen phosphate, $ZnHPO_4+H_2O$.
Insol. in H_2O; sol. in H_3PO_4+Aq. (Graham.)

Zinc *tetra*hydrogen phosphate, $ZnH_4(PO_4)_2+2H_2O$.
Nearly insol. in H_2O, but decomp. thereby into H_3PO_4 and $10ZnO$, $4P_2O_5+10H_2O$. (Demel, B. **12.** 1171.)

Zinc phosphate, $10ZnO$, $4P_2O_5+10H_2O$.
Insol. in H_2O. (Demel, B. **12.** 1171.)

Zinc *pyro*phosphate, $Zn_2P_2O_7+{}^3/_2H_2O$.
Ppt. Sol. in H_2SO_3+Aq. Sol. in acids, $KOH+$Aq, NH_4OH+Aq. (Schwarzenberg, A. **65.** 151.)
Sol. in $Na_4P_2O_7+$Aq (Gladstone), and in $ZnSO_4+$Aq. (Rose.)
Insol. in acetic acid. (Knorre, Z. anorg. 1900, **24.** 389.)
$+5H_2O$. Insol. in H_2O. (Pahl, J. B. **1873.** 229.)

Zinc hydrogen *pyro*phosphate.
Sol. in H_2O. (Pahl, Sv. V. A. F. **30, 7.** 45.)

Zinc *meta*phosphate ammonia.
Ppt. (Bette.)

Zinc *ortho*phosphate ammonia, $2ZnO$, P_2O_5, $3NH_3+8H_2O$.
(Rother, A. **143.** 356.)
$6ZnO$, $3P_2O_5$, $8NH_3+4H_2O$. (Schweikert, A. **145.** 517.)

Zinc *pyro*phosphate ammonia, $3Zn_2P_2O_7$, $4NH_3+9H_2O$.
Ppt. Insol. in H_2O. (Bette.)

Zirconium *ortho*phosphate, $5ZrO_2$, $4P_2O_5+8H_2O$.
Somewhat sol. in acids. (Hermann, J. pr. **97.** 321.)
Insol. in acids. (Paykull, Bull. Soc. (2) **20.** 65.)
$2ZrO_2$, P_2O_5. Not attacked by acids. (Hautefeuille and Margottet, C. R. **102.** 1017.)

Zirconium *pyro*phosphate, $Zr(PO_3)_2$.
(Knop, A. **159.** 36.)

Phosphoricovanadicotungstic acid.

Ammonium phosphoricovanadicotungstate, $14(NH_4)_2O$, $2P_2O_3$, $7V_2O_3$, $31WO_3+78H_2O$.
Sol. in H_2O. Insol. in alcohol, ether, CS_2 and benzene. (Rogers, J. Am. Chem. Soc. 1903, **25.** 305.)

Phosphorimidamide, PN_2H_3.
(Joannis, C. R. 1904, **139.** 365.)

Phosphorimide, $P_2(NH)_3$.
Very sol. in ammoniacal solution of NH_4I. (Hugot, C. R. 1905, **141.** 1236.)

Phosphornitryl, PON.
See **Phosphoryl nitride.**

Phosphorosomolybdic acid, P_2O_3, $24MoO_3+63H_2O$.
(Rosenheim and Pinsker, Z. anorg. 1911, **70.** 77.)

Ammonium phosphorosomolybdate, $2(NH_4)_2O$, $2H_3PO_3$, $12MoO_3+12\frac{1}{2}H_2O$.
Insol. in cold, slightly sol. in hot H_2O. (Gibbs, Am. Ch. J. **5.** 361.)

Phosphorosophosphomolybdic acid.

Ammonium phosphorosophosphomolybdate, $9(NH_4)_2O$, $2H_3PO_3$, $3P_2O_5$, $72MoO_3+38H_2O$.
Nearly insol. in H_2O. (Gibbs.)

Phosphorosophosphotungstic acid.

Potassium phosphorosophosphotungstate, $5K_2O, 2H_3PO_3, P_2O_5, 24WO_3+13H_2O$.

Sol. in much boiling H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Phosphorosotungstic acid.

Ammonium phosphorosotungstate, $6(NH_4)_2O, 4H_3PO_3, 22WO_3+25H_2O$.

Sl. sol. in cold H_2O.

Potassium ——, $5K_2O, 16H_3PO_3, 32WO_3+46H_2O$.

Sl. sol. in hot H_2O.

Sodium ——, $2Na_2O, 8H_3PO_3, 22WO_3+35H_2O$.

Nearly insol. in cold, sl. sol. in hot H_2O. (Gibbs, Am. Ch. J. **7.** 313.)

Phosphorous anhydride, P_2O_3.

See **Phosphorus *tri*oxide.**

Phosphorous acid, H_3PO_3.

Deliquescent. Very sol. in H_2O.

Phosphites.

The neutral alkali phosphites are sol. in H_2O; most of the others are sl. sol. in H_2O, but sol. in H_3PO_3+Aq; all are insol. in alcohol.

Aluminum phosphite, basic, $Al_2(HPO_3)_3$. $Al_2(OH)_6$.

Ppt. (Grützner, Arch. Pharm. 1897, **235.** 698.)

Aluminum phosphite.

Precipitate. (Rose, Pogg. **9.** 39.)

Sl. sol. in H_2O.

Ammonium phosphite, $(NH_4)_2HPO_3+H_2O$.

Very deliquescent, and sol. in H_2O. (Rose, Pogg. **9.** 28.)

Sol. in 2 pts. cold, and less hot H_2O. Insol. in alcohol. (Berzelius.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Ammonium hydrogen phosphite, $(NH_4H)HPO_3$.

Very deliquescent, and sol. in H_2O. 1 pt. H_2O dissolves 1.71 pts. salt at 0°; 1.9 pts. at 14.5°; and 2.60 pts. at 31°. (Amat, C. R. **105.** 809.)

Ammonium hydroxylamine phosphite, $NH_4(NH_3OH)HPO_3$.

Sol. in H_2O and abs. alcohol. (Hofmann, Z. anorg. 1898, **16.** 466.)

Ammonium magnesium phosphite, $(NH_4)_2Mg_3(PHO_3)_4+16H_2O$.

Slightly sol. in H_2O. (Rammelsberg, Pogg. **131.** 367.)

Antimonyl phosphite, $(SbO)H_2PO_3$.

Very sol in H_2O containing HCl. (Grützner, Arch. Pharm. 1897, **235.** 694.)

Barium phosphite, $BaHPO_3$.

100 pts. H_2O dissolve 0.25 pt. (Ure.)

Very slightly sol. in H_2O, and decomp. by boiling H_2O. (Dulong.)

Easily sol. in H_2O containing NH_4Cl. (Wackenroder, A. **41.** 315.)

Sol. in H_3PO_3+Aq or HCl+Aq. (Railton.)

Barium hydrogen phosphite, $Ba_2H_2(HPO_3)_3+8H_2O$.

Easily sol. in H_2O, but decomp. by boiling therewith. Insol. in alcohol. (Rammelsberg, Pogg. **132.** 496.)

Barium *di*hydrogen phosphite, $BaH_2(HPO_3)_2+\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Rose, Pogg. **9.** 215.)

$+H_2O$. Sol. in H_2O; decomp. by boiling H_2O into a neutral insol., and an acid sol. salt. (Wurtz, A. **58.** 66.)

$+2H_2O$. Easily sol. in H_2O. (Rammelsberg, Pogg. **132.** 496.)

Insol. in alcohol. (Wurtz.)

Bismuth phosphite, $2Bi_2O_3, 3P_2O_3$.

Insol. in H_2O.

$Bi_2(HPO_3)_3+3H_2O$. Ppt. (Grützner, Arch. Pharm. 1897, **235.** 696.)

Decomp. by H_2S. Not decomp. by KOH +Aq. (Vanino, J. pr. 1906, (2) **74.** 151.)

Cadmium phosphite, $CdHPO_3+3H_2O$.

Ppt. (Rose, Pogg. **9.** 41.)

Calcium phosphite, $CaHPO_3+{}^3/_2H_2O$.

Sl. sol. in H_2O; the aqueous solution is decomp. by boiling.

$+H_2O$. Sol. in NH_4Cl+Aq. (Wackenroder, A. **41.** 315.)

Insol. in alcohol.

Calcium hydrogen phosphite, $CaH_2(HPO_3)_2+H_2O$.

Sol. in H_2O. Aqueous solution is decomp. by alcohol. (Wurtz, A. ch. (3) **7.** 212.)

Chromic phosphite.

Precipitate. Almost insol. in H_2O. (Rose, Pogg. **9.** 40.)

Cobaltous phosphite, $CoPHO_3+2H_2O$.

Ppt. Sl. sol. in H_2O. (Rose.)

Cupric phosphite, $CuHPO_3+2H_2O$.

Ppt. Insol. in H_2O. (Wurtz, A. ch. (3) **16.** 213.)

Didymium phosphite, $Di_2(HPO_3)_3$.

Precipitate. (Frerichs and Smith, A. **191.** 331.)

Glucinum phosphite.

Precipitate. Insol. in H_2O. (Rose, Pogg. **9.** 39.)

Iron (ferrous) phosphite, $FeHPO_3+xH_2O$.

Ppt. Nearly insol. in H_2O. (Rose, Pogg. **9.** 35.)

Iron (ferric) phosphite, basic, $Fe_2(HPO_3)_3$, $Fe_2(OH)_6$.

(Grützner, Arch. Pharm. 1897, **235.** 697.)

$Fe_4(HPO_3)_6$, $Fe(OH)_3+5H_2O$. Hydroscopic. (Berger, C. R. 1904, **138.** 1500.)

Iron (ferric) phosphite, $Fe_2(HPO_3)_2+9H_2O$.

Ppt. Sol. in iron alum+Aq. (Rose.)

Lanthanum phosphite, $La_2(HPO_3)_3$.

Precipitate. (Smith.)

Lead phosphite, basic, $4PbO$, $P_2O_3+2H_2O$.

Ppt. (Rose, Pogg. **9.** 222.)

$3PbO$, $P_2O_3+H_2O$. Insol. in H_2O. Sol. in warm dil. H_3PO_3+Aq, from which it is pptd. by NH_4OH+Aq. (Wurtz, A. ch. (3) **16.** 214.)

Lead phosphite, $PbHPO_3$,

Insol. in H_2O. Very sl. sol. in a solution of phosphorous acid; easily sol. in cold HNO_3 +Aq. (Wurtz.)

Lead hydrogen phosphite, $PbH_4(PO_3)_2$.

Decomp. by H_2O. (Amat, C. R. **110.** 901.)

Lead *pyro*phosphite, $PbH_2P_2O_5$.

Gradually decomp. by H_2O into H_3PO_3 and $PbHPO_3$. (Amat, C. R. **110.** 903.)

Lithium hydrogen phosphite, LiH_2PO_3.

Very sol. in H_2O. (Amat, A. ch. (6) **24.** 309.)

Lithium *pyro*phosphite, $Li_2H_2P_2O_5$.

Very sol. in H_2O. (Amat. A. ch. 1891, (6) **24.** 352.)

Magnesium phosphite, $MgHPO_3+3H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **9.** 28.)

Sol. in 400 pts. H_2O. (Berzelius.)

$+4H_2O$.

Magnesium *pyro*phosphite, $Mg(H_2PO_3)_2$.

Very sol. in H_2O. (Amat. A. ch. 1891, (6) **24.** 313.)

Manganous phosphite, $MnHPO_3+\frac{1}{2}H_2O$.

Difficultly sol. in H_2O, easily in $MnCl_2$ or $MnSO_4$+Aq. (Rose, Pogg. **9.** 33.)

Nickel phosphite, $NiHPO_3+3\frac{1}{2}H_2O$.

Ppt. Sl. sol. in H_2O.

Potassium phosphite, K_2HPO_3.

Very deliquescent. Very sol. in H_2O. Insol. in alcohol. (Dulong.)

Potassium hydrogen phosphite, $(KH)HPO_3$.

1 pt. H_2O dissolves about 1.72 pts. salt at 20°. (Amat. C. R. **106.** 1351.)

K_2HPO_3, $2H_3PO_3$. Very sol. in H_2O. (Wurtz, A. **58.** 63.)

Sol. in 3 pts. cold, and in less hot H_2O. (Fourcroy and Vauquelin.)

Potassium *pyro*phosphite, $K_2H_2P_2O_5$.

Very sol. in H_2O. (Amat. A, ch. (6) **24.** 351.)

Sodium phosphite, basic, Na_2HPO_3, $NaOH$ (?).

Not obtained in pure state (Zimmerman, B. **7.** 290); $=Na_3PO_3$ (Wislicenus.)

Does not exist. (Amat.)

Sodium phosphite, $Na_2HPO_3+5H_2O$.

Deliquescent, and very sol. in H_2O. Insol. in alcohol.

Correct formula for Na_3PO_3 of Rose and Dulong.

Sodium hydrogen phosphite, $(NaH)HPO_3+2\frac{1}{2}H_2O$.

0.56 pt. salt dissolves in 1 pt. H_2O at 0°; 0.66 pt. at 10°; 1.93 pts. at 42.° (Amat, C. R. **106.** 1351.)

$Na_2H_4(HPO_3)_3+H_2O$. Deliquescent in moist air. Sol. in 2 pts. cold, and about the same amt. hot H_2O. Sl. sol. in spirit. (Fourcroy and Vauquelin.)

Sodium *pyro*phosphite, $Na_2H_2P_2O_5$.

Very sol. in H_2O with gradual decomp. into Na_2HPO_3. (Amat.)

Strontium phosphite, $SrHPO_3+1\frac{1}{2}H_2O$.

Difficultly sol. in H_2O. Aqueous solution decomp. on heating into a sol. acid salt and an insol. basic salt.

Strontium hydrogen phosphite, $SrH_4(PO_3)_2$.

Very sol. in H_2O. (Amat, A. ch. (6) **24.** 312.)

Thallous hydrogen phosphite, TlH_2PO_3.

Very sol. in H_2O. (Amat, A. ch. (6) **24.** 310.)

Thallous *pyro*phosphite, $Tl_2H_2P_2O_5$.

Deliquescent. Very sol. in H_2O. (Amat.)

Tin (stannous) phosphite, $SnHPO_3$.
Ppt. Sol. in HCl+Aq. (Rose, Pogg. **9.** 45.)

Tin (stannic) phosphite, $2SnO_2$, P_2O_3.
Ppt. (Rose, Pogg. **9.** 47.)

Titanium phosphite (?)
Precipitate. (Rose, Pogg. **9.** 47.)

Uranyl phosphite, $(UO_2)_3H_2(HPO_3)_4+12H_2O$.
Precipitate. (Rammelsberg. Pogg. **132.** 500.)

Zinc phosphite, $ZnHPO_3$.
Sol. in H_2O. (Rammelsberg, Pogg. **132.** 481.)
$+2\frac{1}{2}H_2O$. More easily sol. in cold than warm H_2O. (Rammelsberg.)

Zinc phosphite, acid, $Zn_2H_3P_3O_8$.
Sol. in H_2O.
$+2H_2O$. Sol. in H_2O. (Rammelsberg, Pogg. **132.** 498.)
$Zn_3H_6P_6O_{13}$. Sol. in H_2O.
$+3H_2O$. Sol. in H_2O. (Rammelsberg.)
$Zn_2H_9P_5O_{14}$. Sol. in H_2O.
$+H_2O$. Sol. in H_2O. (Rammelsberg.)

Zirconium phosphite, $Zr(PO_3)_2+H_2O$.
Ppt. Nearly insol. in dil. mineral acids. (Hauser, Z. anorg. 1913, **84.** 92.)

Phosphorous anhydride, P_2O_3.

See **Phosphorus** *tri*oxide.

Phosphorus, P.

(a) *Ordinary white phosphorus.* Insol. in H_2O, but slowly decomp. thereby (G. K.); very sl. sol. in H_2O. (Berzelius and others.)
A pure aqueous solution containing 0.1 g. P in 500 cc. H_2O can be obtained by dissolving 0.1 g. P in CS_2 mixed with ether and hot alcohol; this solution is poured into 500 cc. boiling H_2O free from air, and the boiling continued with stirring until the alcohol, ether and CS_2 are boiled off. (Bokorny, Ch. Ztg. 1896, **20.** 1022.)
100 g. H_2O sat. with P contains 0.0003 g. P. (Stich, C. C. **1903,** I. 1291.)
Sol. with decomp. in hot conc. HNO_3+Aq.
Decomp. by boiling caustic alkalies+Aq.
Easily sol. in SCl_2, especially if hot. (Wöhler.)
Sol. in sulphur phosphides.
Largely sol. in PCl_3.
Easily sol. in PCl_5.
Sol. in PBr_3. Sol. in $PSCl_3$, easily on warming, separating on cooling. (Serullas, A. ch. 1829, **42.** 25.)
Sol. in liquid SO_2. (Sestini, Bull. Soc. 1868, (2) **10.** 226.)
Sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)
Sol. in S_2Cl_2 without foaming. (Nicolardot, C. R. 1908, **147.** 1304.)
Sol., in PS_4Cl_5. (Gladstone, A. 1850, **74.** 91.)
Sol. in 320 pts. cold alcohol of 0.799 sp. gr., and in 240 pts. of the same when warm. Pptd. from alcoholic solution by H_2O. (Büchner.)
One grain P dissolves in 1 ounce abs. alcohol. (Schacht.)
Sol. in 20 pts. absolute ether at 20° and 240 pts. ordinary ether at 20°. (Bucholz.)
Sol. in 80 pts. absolute ether at 15.5°, and 240 pts. ordinary ether at 15.5°. (Brugnatelli, A. ch. **24.** 73.)

Solubility of P_4 in 100 g. ether at t°.

t°	G. phosphorus	Sp. gr.
0	0.4335	...
5	0.62	...
8	0.79	...
10	0.85	...
15	0.9	at 13° 0.7257
18	1.005	...
20	1.04	at 19° 0.7187
23	1.121	...
25	1.39	0.7283
28	1.601	...
30	1.75	...
33	1.8	...
35	1.9984	...

(Christomanos, Z. anorg. 1905, **45.** 136.)

Solubility of P_4 in 100 g. benzene at t°.

t°	G. phosphorus	Sp. gr.
0	1.513	...
5	1.99	...
8	2.31	...
10	2.4	...
15	2.7	at 13° 0.8959
18	3.1	...
20	3.21	at 19° 0.8912
23	3.3995	at 22° 0.8875
25	3.7	0.8861
28	4.35	...
30	4.601	...
33	5.0	...
35	5.17	...
40	5.75	...
45	6.105	...
50	6.8	...
55	7.315	...
60	7.9	...
65	8.4	...
70	8.898	...
75	9.4	...
81	10.027	...

(Christomanos.)

Sol. to about 1% in acetic acid. (Vulpius, Arch. Pharm. 1878, **213.** 38.)

100 g. 96% acetic acid dissolve 0.105% P. (Stich, Pharm. Ztg. 1903, **48.** 343.)

Sol. in 0.05 pt. CS_2 (Böttger); 0.125 pt. (Trommsdorf.)

Alcohol ppts. P from CS_2 solution.

1 pt. CS_2 dissolves 17–18 pts. P. (Vogel, J. B. **1868.** 149.)

Solubility in CS_2 at t°.
(g. per 100 g. of solution.)

t°	G. P_4	t°	G. P_4
−10	31.40	−2.5	75.00
−7.5	35.85	0.0	81.27
−5	41.95	+5.0	86.30
−3.5	66.14	+10.0	89.80
−3.2	71.72	...	...

(Cohen and Inouye, Z. phys. Ch. 1910, **72.** 418.)

Very sol. in methylene iodide. (Retgers, Z. anorg. **3.** 343.)

Strong vinegar dissolves P. (Beudet.)

Sol. in considerable amount in stearic acid. (Vulpius, Arch. Pharm. (3) **13.** 38.)

Sol. in ethyl chloride, benzoyl chloride, stannic chloride, and in liquid cyanogen.

Sl. sol. in ethyl nitrite, and wood-spirit.

Sl. sol. in acetone, with gradual decomposition.

Insol. in nicotine, and coniine.

Sl. sol. in cold, more sol. in hot benzene. (Mansfield.)

Sol. in 14 pts. hot, and less in cold petroleum from Amiano. (Saussure.)

Sl. sol. in "liquid paraffine." (Crismer, B. **17.** 649.)

Sl. sol. in warm essential oils, as oil of turpentine, and in the fatty oils.

Sol. in hot oil of copaiba, separating out on cooling.

Sol. in hot oil of caraway, and mandarin oil. (Luca.)

Sl. sol. in cold, more sol. in hot caoutchin, depositing on cooling.

Readily sol. in warm, less in cold styrene.

Sol. in aniline, and quinoline. (Hofmann.)

Sl. sol. in cold creosote.

Somewhat sol. in fusel oil.

Easily sol. in valerianic acid, and amyl valerate.

Sol. in hexyl alcohol, ethylene chloride, allyl sulphocyanide, mercury methyl, chloroform, bromoform, warm chloral, acetic ether, aldehyde, hot cacodyl sulphide, and in cacodyl oxide.

100 g. oil of almonds sat. with P contain 1.25 g. (Stich, C. C. **1903,** I. 1291.)

100 g. oleic acid sat. with P contain 1.06 g. (Stich.)

100 g. paraffine sat. with P contain 1. g. (Stich.)

(b) *Amorphous phosphorus.* Insol. in H_2O. Insol. in NH_4OH+Aq. (Flückiger.)

Sol. in boiling KOH+Aq.

The statement of Burgess and Chapman, (Chem. Soc. **79.** 1235) that red P is sol. in aqueous alcoholic alkali is incorrect. Both ordinary crystalline and amorphous red P are insol. in aqueous alcoholic alkali. (Michaelis, A. 1902, **325.** 367.)

Insol. in liquid NH_3. (Hugot, A. ch. 1900 (7) 21, **31**); (Franklin, Am. Ch. J. 1898, **20.** 828.)

Bright red variety is sol. in liquid NH_3 at ord. temp. leaving a black residue. (Stoch, Böttcher and Lenger, B. 1909, **42.** 2854.)

Red. Amorphous.

Sol. in S_2Cl_2 with foaming. (Nicolardot, C. R. 1908, **147.** 1304.)

Solubility of amorphous bright red P_4 in PBr_3 is diminished by long heating as follows:

	172°	185°	198°	218°
Initial concentration	0.555	0.476	0.592	0.476
Final concentration	0.374	0.397	0.416	0.592
Length of expt. in hours	34	24	18	17

(Buck, Dissert. **1904.**)

Ordinary amorphous P_4 is sol. in PBr_3.

A sample prepared by heating bright red amorphous P with 94.2% P dissolved by heating in PBr_3 as follows:

% P	0.106	0.121	0.178
hours	10	20	42

A finely pulverized commercial product containing 98.0% P:

% P	0.92	0.116
hours	10	20

An ordinary commercial product with 98% P:

% P	0.056	0.108
hours	10	42

(Buck.)

100 g. PBr_3 dissolve 0.2601 g. bright red phosphorus at 172°; 0.3634 g. at 184°. (Schenk, B. 1902, **35.** 353.)

Insol. in KOH+Aq.

Conc. H_2SO_4 does not act upon it in the cold, but dissolves easily when hot.

Insol. in dil., easily sol. in conc. HNO_3+Aq with decomposition.

Much more sol. in HNO_3+Aq than ordinary P. (Personne, C. R. **45.** 115.)

Insol. in methylene iodide. (Retgers.)

Appreciably sol. in isobutyl alcohol. (Svedberg.)

Insol. in CS_2, alcohol, ether, naphtha, ligroine, PCl_3, etc.

Sl. sol. in boiling oil of turpentine and

other high-boiling liquids, with conversion into ordinary phosphorus.
Insol. in oil of turpentine even at 270°. (Colson, A. ch. 1908, (8) **14.** 554.)
(c) *Crystalline.* Insol. in, and not attacked by dil. HNO_3+Aq.
Sol. in CS_2.

Phosphorus *tri*bromide, PBr_3.
Decomposed by H_2O, slowly at 8°, but very rapidly at 25°. (Löwig, Pogg. **14.** 485.)
Sol. in liquid H_2S. (Antony and Magri, Gazz. ch. it. 1905, **35.** (1) 206.)
Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)
Sol. in ether, acetone, $CHCl_3$, C_6H_6 and CS_2. (Christomanos, Z. anorg. 1904, **41.** 287.)

Phosphorus *penta*bromide, PBr_5.
Fumes on air, and is violently decomp. by H_2O.

Phosphorus *tri*bromide ruthenium bromide, $Ru_2P_6Br_{19}$.
Decomp. by boiling H_2O.
Slowly sol. in hot alcohol with decomp.
Insol. in benzene, CCl_4, ligroin and cold alcohol. (Strecker, B. 1909, **42.** 1775.)

Phosphorus thiophosphoryl bromide, PBr_3, $PSBr_3$.
Decomp. by H_2O into $PSBr_3$. (Michaelis.)

Phosphorus *tri*bromide ammonia, $3PBr_3$, $5NH_3$.
Slowly but completely sol. with decomp. in H_2O. (Storer's Dict.)

Phosphorus *penta*bromide ammonia, PBr_5, $9NH_3$.
(Besson, C. R. **111.** 972.)

Phosphorus *mono*bromo*tetra*chloride, $PBrCl_4$.
Decomp. by H_2O. (Prinvault, C. R. **74.** 868.)

Phosphorus *di*bromo*tri*chloride, PCl_3Br_2.
Very unstable. (Michaelis, B. **5.** 9.)

Phosphorus *tetra*bromo*tri*chloride, PCl_3Br_4.
Decomp. with H_2O. (Geuther.)

Phosphorus *hepta*bromo*di*chloride, PCl_2Br_7.
Very unstable. (Prinvault, C. R. **74.** 868.)

Phosphorus *octo*bromo*tri*chloride, PCl_3Br_8.
Very easily decomp. (Michaelis, B. **5.** 9.)

Phosphorus bromofluoride, PF_3Br_2.
Decomp. violently with H_2O. (Moissan, Bull. Soc. (2) **43.** 2.)

Phosphorus bromonitride.
See **Nitrogen bromophosphide.**

Phosphorus *di*chloride, P_2Cl_4.
Decomp. by H_2O. (Besson, C. R. 1910, **150.** 103.)

Phosphorus *tri*chloride, PCl_3.
Gradually decomp. by H_2O.
0.11 g. is sol. in 100 ccm. liquid H_2S. (Antony, Gazz. ch. it. 1905, **35** (1) 206.)
Acted upon by liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)
Miscible with CS_2, C_6H_6, $CHCl_3$, and ether.
Decomp. with alcohol.

Phosphorus *penta*chloride, PCl_5.
Very deliquescent, and sol. in H_2O with violent decomp. and evolution of heat. Sol. in liquid HCl. Acted upon by liquid NH_3. Somewhat sol. without decomp. in CS_2. (Schiff, A. **102.** 118. (Franklin, Am. Ch. J. 1898, **20.** 828.)
Sol. without decomp. in benzoyl chloride. (Gerhardt.)
Sol. in oil of turpentine with evolution of heat.

***Mono*phosphorus platinous chloride,** PCl_3, $PtCl_2$.
Deliquescent. Sol. in H_2O with formation of chloroplatinophosphoric acid. Similarly decomp. by alcohol. Abundantly sol. in hot benzene, toluene, chloroform, or carbon tetrachloride, and crystallizes on cooling. (Schützenberger, Bull. Soc. (2) **17.** 482.)

***Di*phosphorus platinous chloride,** $2PCl_3$, $PtCl_2$.
Decomp. by H_2O with formation of chloroplatino*di*phosphoric acid. Similarly decomp. by alcohol. Sol. without decomp. in PCl_3, CCl_4, $CHCl_3$, C_6H_6, or C_7H_8. (Schützenberger.)
Sol. in propyl alcohol with formation of the propyl ether of platinochlorophosphorous acid and HCl. (Pomey, C. R. **104.** 364.)

Phosphorus *di*platinous chloride, PCl_3, $2PtCl_2$.
Sol. in alcohol, with formation of ether $(PtCl_2)_2P(OC_2H_5)_3$. (Cochin, C. R. **86.** 1402.)

Phosphorus platinic chloride, PCl_3, $PtCl_4$.
(Schützenberger.)

Phosphorus *penta*chloride platinic chloride, PCl_5, $PtCl_4$, or $(PCl_4)_2PtCl_6$.
Decomp. at once by H_2O. (Baudrimont, A. ch. (4) **2.** 47.)

Phosphorus ***penta*****chloride selenium** ***tetra*****chloride,** $2PCl_5$, $SeCl_4$.

Sol. in H_2O with decomp. (Baudrimont, A. ch. (4) **2.** 5.)

Phosphorus ***tri*****chloride ruthenium chloride,** $Ru_2P_5Cl_{19}$.

Slowly decomp. by boiling H_2O.
Sol. in benzene and $CHCl_3$.
Sl. sol. in CCl_4. Insol. in ligroin. (Strecker, B. 1909, **42.** 1774.)

Phosphorus tellurium chloride, PCl_5, $2TeCl_4$.

Very deliquescent.
Sol. in H_2O. (Metzner, A. ch. 1898, (7) **15.** 203.)

Phosphorus ***penta*****chloride stannic chloride,** PCl_5, $SnCl_4$.

Very deliquescent. Sol. in much H_2O with evolution of heat, forming $SnCl_4$, HCl, and H_3PO_4, and soon separates out stannic phosphate. (Casselmann, A. **83.** 257.)

Phosphorus ***tri*****chloride titanium chloride,** PCl_3, $TiCl_4$.

(Bertrand, Bull. Soc. (2) **33.** 565.)

Phosphorus ***penta*****chloride titanium chloride,** PCl_5, $TiCl_4$.

Deliquescent. Decomp. by H_2O and alcohol. Sol. in ether. Sl. sol. in PCl_3. (Tüttschew, A. **141.** 111.)
Completely sol. in dil. acids. (Weber.)

Phosphorus uranium ***penta*****chloride,** PCl_5, UCl_5.

Decomp. with H_2O.

Phosphorus ***penta*****chloride zirconium chloride,** PCl_5, $ZrCl_4$.

Decomp. by H_2O with pptn. of Zr phosphate. (Paykull.)

Phosphorus ***tri*****chloride ammonia,** PCl_3, $5NH_3$.

Insol. as such in H_2O, but slowly decomp. by boiling H_2O. More easily sol. with decomp. in acids. Sol. with decomp. by boiling with KOH or NaOH+Aq. (Berzelius.)

Phosphorus ***penta*****chloride ammonia,** PCl_5, $5NH_3$.

Properties as PCl_3, $5NH_3$. (Berzelius.)
PCl_5, $8NH_3$. Sl. decomp. on air. (Besson, C. R. **111.** 972.)

Phosphorus ***penta*****chloride tungsten** ***tri*****oxide,** $2PCl_5$, WO_3(?).

(Persoz and Bloch, C. R. **28.** 389.)

Phosphorus chlorobromide.

See **Phosphorus bromochloride.**

Phosphorus chlorofluoride, PCl_2F_3.

Absorbed by H_2O with decomp. Absorbed by alcohol or ether. (Poulenc, A. ch. (6) **24.** 555.)

Phosphorus chloroiodide, PCl_3I_2.

Decomp. by moist air or H_2O. Sol. in CS_2. (Most, B. **13.** 2029.)

Phosphorus chloronitride.

See **Nitrogen chlorophosphide.**

Phosphorus ***tri*****fluoride,** PF_3.

Decomp. slowly by H_2O. (Moissan, Bull. Soc. (2) **43.** 2.)
Rapidly absorbed by KOH or NaOH+Aq, slowly by BaO_2H_2, and K_2CO_3+Aq. Absorbed by absolute alcohol with decomp. (Moissan, C. R. **99.** 655.)

Phosphorus ***penta*****fluoride,** PF_5.

Fumes on air. (Thorpe, A. **182.** 20.)

Phosphorus ***penta*****fluoride ammonia,** $2PF_5$, $5NH_3$.

(Moissan, C. R. **101.** 1490.)

Phosphorus ***penta*****fluoride nitrogen** ***per*****oxide.**

Decomp. by H_2O. (Tassel, C. R. **110.** 1264.

Phosphorus fluobromide.

See **Phosphorus bromofluoride.**

Phosphorus fluochloride.

See **Phosphorus chlorofluoride.**

Phosphorus ***sub*****iodide,** P_4I.

Sol. in dil. HNO_3 and in alkalies+Aq. (Boulouch, C. R. 1905, **141.** 257.)

Phosphorus ***di*****iodide,** P_2I_4.

Decomp. by H_2O. Sol. in CS_2. (Corenwinder, A. ch. (3) **30.** 242.)
0.09 g. is sol. in 100 ccm. liquid H_2S. (Antony, C. C. **1905,** I. 1692.)

Phosphorus ***tri*****iodide,** PI_3.

Very deliquescent. Decomp. in moist air and by H_2O. (Corenwinder, A. ch. (3) **30.** 242.)
Very sol. in CS_2.

Phosphorus ***penta*****iodide,** PI_5 (?).

(Hampton, C. N. **42.** 180.)

Phosphorus iodosulphide.

See **Phosphorus sulphoiodide.**

Phosphorus nitride, P_3N_5.

Very slightly decomp. by long boiling with H_2O.
Completely insol. in any solvent. (Stock, B. 1903, **36.** 317.)

Phosphorus *sub*oxide, P_4O.

Unchanged in dry, gradually oxidized in moist air. Insol. in H_2O, alcohol, ether, and oils; not acted on by $HCl+Aq$; oxidized by HNO_3 or H_2SO_4. (Marchand, J. pr. **13.** 442.)

Sl. sol. in H_2O. (le Verrier, A. **27.** 167.)

Forms hydrate $P_4O, 2H_2O$, which gives up its H_2O when dried.

Two modifications: (*a*) decomp. slowly by H_2O or alkalies, (*b*) not decomp. by H_2O or alkalies. (Reinitzer and Goldschmidt, B. **13.** 847.)

Is oxyphosphuretted hydrogen (?), $P_4H(OH)$. (Franke, J. pr. (2) **35.** 341.)

—— H_3P_5O.

Insol. in all solvents. Decomp. by H_2O. Not attacked by non-oxidizing acids. Decomp. by dil. alkalies. (Gautier, C. R. **76.** 173.)

—— P_4HO.

Insol. in nearly all substances. Not attacked by dilute acids; oxidized by ordinary HNO_3, and conc. H_2SO_4 at 200°. Attacked by very dil. alkaline solutions. Perhaps identical with phosphorus *sub*oxide P_4O. (Gautier, C. R. **76.** 49.)

Phosphorus oxide, P_2O.

Decomp. by heating with H_2O at 100°. (Besson, C. R. 1897, **124.** 764.)

Phosphorus *tri*oxide, P_4O_6(formerly P_2O_3).

Deliquescent, but very slowly dissolved by cold H_2O to form H_3PO_3. Violently decomp. by hot H_2O or alcohol.

Sol. without decomp. in ether, carbon disulphide, benzene, or chloroform. (Thorpe and Tutton, Chem. Soc. **57.** 545.)

Phosphorus *tetr*oxide, P_2O_4.

Very deliquescent. Sol. with evolution of heat in H_2O. (Thorpe and Fulton, Chem. Soc. **49.** 833.)

Phosphorus *pent*oxide, P_2O_5.

Very deliquescent. Sol. in H_2O with great evolution of heat, forming H_3PO_4.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014); (Naumann, B. 1904, **37.** 4329.)

Phosphorus sulphur oxide, $P_2O_5, 3SO_3 = (PO)_2(SO_4)_3$(phosphoryl sulphate) (?).

Decomp. by H_2O. Sol. in cold, more sol. in warm SO_3. (Weber, B. **20.** 86.)

Phosphorus oxy-compounds.

See under **Phosphoryl compounds.**

Phosphorus oxysulphide.

See **Phosphorus sulphoxide.**

Phosphorus *semi*selenide, P_4Se.

Decomp. with H_2O. Insol. in cold, decomp by boiling $KOH+Aq$. Insol. in, but apparently decomp. by alcohol and ether. Easily sol. in CS_2. (Hahn, J. pr. **93.** 430.)

Phosphorus *mono*selenide, P_2Se.

Stable in dry, decomp. in moist air and by H_2O. Insol. in alcohol and ether. Decomp. by boiling $KOH+Aq$. CS_2 dissolves out P. (Hahn, J. pr. **93.** 430.)

Sl. sol. in CS_2. (Gore, Phil. Mag. (4) **30.** 414.)

Phosphorous *sesqui*selenide, P_4Se_3.

Sol. in CCl_4; sl. sol. in CS_2. (Meyer, Z. anorg. 1902, **30.** 258.)

Phosphorus *tri*selenide, P_2Se_3.

Decomp. by boiling H_2O and slowly in moist air. Easily sol. in cold $KOH+Aq$, less easily in M_2CO_3+Aq. Insol. in alcohol, ether, and CS_2. (Hahn, J. pr. **93.** 430.)

Phosphorus *penta*selenide, P_2Se_5.

Slowly decomp. in moist air or by H_2O, easily by $KOH+Aq$ or alcohol. Insol. in CS_2. Sol. in CCl_4. (Hahn, J. pr. **93.** 430.)

Phosphorus selenides *with* M_2Se.

See **M phosphoselenide,** *under* M.

Phosphorus *semi*sulphide, P_4S(?).

1. *Liquid.* Not decomp. by, and insol. in boiled H_2O. Insol. in alcohol and ether. Sl. sol. in fats and volatile oils; decomp. by alkalies. Dissolves P on warming, with separation on cooling. Sol. in CS_2.

2. *Red modification.* Not attacked at first by HNO_3+Aq (sp. gr. 1.22), but after a time is attacked with the greatest violence. Weak acids attack only when hot. (Berzelius, A. **46.** 129.)

Existence is doubtful. (Schulze, B. **13.** 1862; Isambert, C. R. **96.** 1628.)

Phosphorus *mono*sulphide, P_2S(?).

1. *Ordinary.* Same properties as phosphorus *semi*sulphide, 1.

2. *Red modification.* Unchanged by air, H_2O, or alcohol. Decomp. by conc. $KOH+Aq$, not by dilute. Sl. sol. in NH_4OH+Aq. (Berzelius, A. **46.** 129.)

Existence is doubtful. (Schulze; Isambert.)

Does not exist. (Helff, Z. phys. Ch. **12.** 206.)

Phosphorus *sesqui*sulphide, P_4S_3.

Not attacked by cold, slowly by hot H_2O. Cold $KOH+Aq$ dissolves with decomp.

Oxidized by HNO_3 and aqua regia. Sol. in alcohol and ether with decomp. Sol. in CS_2 (100 pts. CS_2 dissolve 60 pts. P_4S_3), PCl_3, and $PSCl_3$, and in K_2S or Na_2S+Aq. (Lemoine, Bull. Soc. (2) **1.** 407.)
Very sol. in CS_2. (Rebs, A. **246.** 367.)
Decomp. by dil. and conc. KOH+Aq.
1 pt. P_4S_3 is sol. in 9 pts. CS_2 at $-20°$; in 3.7 pts. CS_2 at 0°; in 1 pt. CS_2 at 17°; in 40 pts. benzene at 17°; in 9 pts. benzene at 80°; in 32 pts. toluene at 17°; in 6.5 pts. toluene at 111°. (Stock, B. 1910, **43.** 156.)

Phosphorus *tri*sulphide, P_2S_3.
Decomp. by water. (Kekulé, A. **90.** 310.)
Sol. in M_2CO_3+Aq with separation of S. Easily sol. in KOH, NaOH, NH_4OH+Aq. (Berzelius, A. **46.** 129.)
Sol. in alcohol and ether. (Lemoine.)
Correct formula is P_4S_6. (Isambert, C. R. **102.** 1386.)
Extremely sl. sol. in CS_2. (Rebs, A. **246.** 368.)
Existence doubtful. (Helff, Z. phys. Ch. **12.** 210.)

Phosphorus sulphide, P_4S_7.
Sl. sol. in CS_2. (Mai, A. **265.** 192.)
Slowly decomp. by cold, rapidly by hot H_2O.
Sol. in cold alkalies.
1 pt. is sol. in 3500 pts. CS_2 at 17°; in 20,000 pts. at 0°. (Stock, B. 1910, **43.** 416.)

Phosphorus *di*sulphide, P_3S_6 (formerly P_2S_4).
Almost insol. in CS_2. (Helff.)

Phosphorus *penta*sulphide, P_2S_5.
Very deliquescent. Decomp. by H_2O. Very sol. in KOH, NaOH, NH_4OH+Aq. Sol. in M_2CO_3+Aq with separation of S at low temp. Decomposes alcohol, acetic acid, etc. (Kekulé, A. **106.** 331.)
Sol. in CS_2. (Isambert, C. R. **102.** 1386.)
Not very sol. in CS_2. (Rebs, A. **246.** 367.)
Mpt., 290°; bpt., 513–515° at 760 mm.
Decomp. by H_2O.
Easily sol. in warm NaOH+Aq.
1 pt. is sol. in 450 pts. CS_2 at room temp.; in 550 pts. at 0°; in 1200 pts. at $-20°$. (Stock, B. 1910, **43.** 1225.)
Ordinary form.
Sol. in 195 pts. boiling CS_2.
New form.
Sol. in 32 pts. CS_2. (Stock, B. 1905, **38.** 2722.)

Phosphorus *per*sulphide, P_2S_{12} (?).
Decomp. by H_2O, alkalies, etc. Consists of S, and mechanically united P. (Ramme, B. **12.** 941.)

Phosphorus sulphides *with* M_2S.
See **M Phosphosulphide,** *under* M.

Phosphorus zinc sulphide, ZnP_3S_2.
Sol. in HCl+Aq with separation of P_3S (?). (Berzelius, A. **46.** 150.)

Phosphorus *tri*sulphide ammonia, P_2S_3, $2NH_3$.
Decomp. by H_2O. (Bineau.)

Phosphorus *penta*sulphide ammonia, P_2S_5, $6NH_3$.
Sol. in liquid NH_3. (Stock, B. 1903, **36.** 314.)
P_2S_5, $7NH_3$. (Stock.)

Phosphorus sulphobromide.
See **Thiophosphoryl bromide.**

Phosphorus sulphochloride.
See **Thiophosphoryl chloride.**

Phosphorus sulphoiodide, P_2S_3I.
Sl. attacked by cold, rapidly by hot H_2O; violently decomp. by fuming HNO_3. Easily sol. in CS_2. Sl. sol. in C_6H_6 or $CHCl_3$, and still less in ether or absolute alcohol. (Ouvrard, C. R. **115.** 1301.)
$P_2S_2I_2$. Easily sol. in CS_2. More easily than $P_4S_3I_2$ and less than PI_3. (Ouvrard, A. ch. 1894, (7) **2.** 224.)
P_2SI_4. Easily decomp. (Ouvrard.)
$P_4S_3I_2$. Insol. in H_2O; sol. in warm ether. Sl. sol. in benzene, $CHCl_3$ and glacial acetic acid; sol. in toluene and xylene. (Wolter, Ch. Ztg. 1907, **31.** 640.)
Easily sol. in CS_2. Sl. sol. in benzene, ether, absolute alcohol and $CHCl_3$. (Ouvrard, C. R. 1892, **115.** 1301.)

Phosphorus sulphoxide, $P_4O_6S_4$.
Deliquescent. Easily sol. in H_2O with decomp. Sol. in 2 pts. CS_2 without decomp. Sol. in benzene with decomp. (Thorpe and Tutton, Chem. Soc. **59.** 1019.)
$P_2O_2S_3$. Slowly decomp. by H_2O. Violently attacked by fuming HNO_3. (Besson, C. R. 1897, **124.** 152.)
$P_4S_3O_4$. Deliquescent; sol. in H_2O with decomp.; insol. in most solvents. (Stock, B. 1913, **46.** 1382.)

Phosphoryl *tri*amide, $PO(NH_2)_3$.
Insol. in boiling H_2O, KOH+Aq, or dil. acids. Decomp. by long boiling with HCl or HNO_3+Aq. More easily decomp. with aqua regia. Easily sol. in warm H_2SO_4 or nitrosulphuric acid. (Schiff, A. **101.** 300.)
Does not exist. (Gladstone; Mente, A. **248.** 238.)

Phosphoryl bromide, $POBr_3$.
Not miscible with H_2O, but gradually decomp. in contact with it. Sol. in H_2SO_4, ether, oil of turpentine (Gladstone, Phil. Mag. (3) **35.** 345); in $CHCl_3$, CS_2 (Baudrimont, Bull. Soc. **1861.** 118).

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in CCl_4, and in C_6H_6. (Oddo, Chem. Soc. 1900, **78.** (2) 75.)

Phosphoryl bromide sulphide.

See **Thiophosphoryl bromide.**

Phosphoryl bromochloride, $POCl_2Br$.

Decomp. by H_2O. (Menschutkin, A. **139.** 343.)

Phosphoryl ***di*****bromochloride,** $POClBr_2$.

Decomp. by H_2O. (Geuther, Jena Zeit. **10.** 130.)

Phosphoryl chloride, $POCl$.

Very hygroscopic. Sol. in H_2O with decomp. Insol. in most solvents. Sol. in PCl_3. (Besson, C. R. 1897, **125.** 772.)

$POCl_3$. Decomp. by H_2O. Not acted on by liquid CO_2, P, PH_3, CS_2, I, Br, Cl, etc. Sol. in CCl_4, C_6H_6, CS_2, $CHCl_3$ and ether. (Oddo, Gazz. ch. it. 1899, **29.** (2) 318; Chem. Soc. 1900, **78** (2) 74.)

Phosphoryl boron chloride, $POCl_3$, BCl_3.

See **Boron phosphoryl chloride.**

Phosphoryl stannous chloride, $POCl_3$, $SnCl_2$.

Deliquescent. Decomp. by H_2O (Casselmann, A. **91.** 242.)

Phosphoryl stannic chloride, $POCl_3$, $SnCl_4$.

Deliquescent. Decomp. by H_2O. (Casselmann.)

Phosphoryl titanium chloride, $POCl_3$, $TiCl_4$.

Deliquescent, and decomp. by H_2O. (Weber, Pogg. **132.** 453.)

Pyro**phosphoryl chloride,** $P_2O_3Cl_4$.

Decomp. violently with H_2O. (Geuther and Michaelis, B. **4.** 766.)

Very sol. in H_2O with decomp.; very unstable. (Besson, C. R. 1897, **124.** 1100.)

Meta**phosphoryl chloride,** PO_2Cl.

Decomp. by H_2O. (Gustavson.)

Does not exist. (Michaelis.)

Phosphoryl fluoride, POF_3.

Absorbed and decomp. at once by H_2O or alcohol. (Moissan, C. R. **102.** 1245.)

Phosphoryl imidoamide, $PN_2H_3O = PO(NH)NH_2$.

Insol. in H_2O; gradually decomp. by boiling with H_2O, more rapidly in presence of KOH. Insol. in boiling conc. HCl+Aq. Insol. in cold, decomp. by hot H_2SO_4. Moderately dil. H_2SO_4+Aq dissolves without evolution of gas. Insol. in boiling nitric or nitrosulphuric acid. (Gerhardt, A. ch. (3) **20.** 255.)

Insol. in alcohol, oil of turpentine, etc.

Phosphoryl iodide, $P_2I_6O_8$ (?).

Sol. in H_2O, alcohol, and ether. (Burton, Am. Ch. J. **?.** 280.)

PO_2I_2. (Burton.)

Phosphoryl nitride, PON.

Insol. in H_2O, acids, or alkalies. (Gladstone, Chem Soc. **2.** 121.)

Phosphoryl chlorosulphide, $P_2O_2SCl_4$.

Slowly decomp. in contact with H_2O. (Besson, C. R. 1897, **124.** 153.)

Phosphoryl thio-compounds.

See **Thiophosphoryl compounds.**

Phosphoselenic acid.

See **Selenophosphoric acid.**

Phosphoselenide, M.

See under **M.**

Phosphosilicic acid.

See **Silicophosphoric acid.**

Phosphosilicosovanadicotungstic acid.

Ammonium phosphosilicosovanadicotungstate.

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1225.)

Phosphosilicovanadic acid, $3SiO_2$, $2V_2O_5$, $2P_2O_5+6H_2O$.

Sol. in H_2O. (Berzelius.)

Phosphostannosovanadicotungstic acid.

Ammonium phosphostannosovanadicotungstate.

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1226.)

Phosphosulphide, M.

See under **M.**

Phosphosulphuric anhydride, P_2O_5, $3SO_3$.

Very easily decomp. (Weber, B. **19.** 3190.)

Phosphotelluric acid.

Ammonium phosphotellurate, $2(NH_4)_2O$, P_2O_5, TeO_3+4H_2O.

Easily sol. in H_2O. (Weinland, Z. anorg. 1901, **28.** 61.)

$4(NH_4)_2O$, $3P_2O_5$, $2TeO_3+11H_2O$. Sol. in H_2O without decomp. (Weinland.)

Potassium phosphotellurate, $1.5K_2O$, P_2O_5, TeO_3.

$+17.5\ H_2O$. Very sol. in H_2O.
$+4.5\ H_2O$. Ppt. (Weinland.)

Rubidium phosphotellurate, $1.5Rb_2O$, P_2O_5, $TeO_3+4.5H_2O$.

Ppt. (Weinland.)

Sodium phosphotellurate, $2Na_2O$, P_2O_5, $2TeO_3+9H_2O$.

Difficultly sol. in cold H_2O. (Weinland.)

Phosphothorosovanadicotunstic acid.

Ammonium phosphothorosovanadicotungstate.

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1226.)

Phosphotitanosovanadicotunstic acid.

Ammonium phosphotitanosovanadicotungstate.

Formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1226.)

Phosphotungstic acid, P_2O_5, $12WO_3+42H_2O$.

Not efflorescent. Sol. in H_2O, alcohol, and ether. (Péchard, C. R. **110.** 754.)

P_2O_5, $16WO_3+69H_2O$. Very efflorescent. Sol. in H_2O, alcohol, and ether. (Péchard, C. R. **109.** 301.)

$+xH_2O=H_5PW_8O_{29}+xH_2O$ (α-phospholuteotungstic acid). Known only in aqueous solution. (Kehrmann, B. **20.** 1808.)

$+48H_2O=H_3PW_8O_{28}+16H_2O$ (α-anhydrophospholuteotungstic acid). Sol. in its crystal H_2O by warmth of the hand; sol. in less than $^1/_8$ pt. H_2O. (Kehrmann.)

Correct composition is represented by $H_8PW_9O_{31}+9H_2O$. (Kehrmann, Z. anorg. **1.** 422.)

P_2O_5, $20WO_3+8H_2O$. Very efflorescent. (Gibbs, B. **10.** 1386.)

$+19H_2O=H_{11}PW_{10}O_{38}+8H_2O$. Sol. in H_2O. (Scheibler, B. **5.** 801.)

$+50$, and $62H_2O$. Very efflorescent. (Péchard, C. R. **109.** 301.)

$3H_2O$, P_2O_5, $21WO_3+30H_2O$. Efflorescent. Sol. in H_2O in nearly every proportion.

P_2O_5, $22WO_3+28H_2O=H_6PW_{11}O_{43}+18H_2O$. Efflorescent. (Scheibler, B. **5.** 801.)

Composition is $6H_2O$, $22WO_3$, $P_2O_5+45H_2O$. (Gibbs.)

H_3PO_4, $12WO_3+18H_2O$, or P_2O_5, $24WO_3+39H_2O$. Sol. in H_2O, alcohol and ether. (Soboleff, Z. anorg. 1896, **12.** 18.)

P_2O_5, $24WO_3+40H_2O=6H_2O$, P_2O_5, $24WO_3+34H_2O$. Very efflorescent. Sol. in H_2O. (Gibbs.)

$+45H_2O$.

Solubility in H_2O at t°.

t°	100 ccm. H_2O dissolve g. of the cryst. acid	Sp. gr. of the solution
0	16.206	1.1890
22	49.718	1.6913
43	53.64	1.8264
92	86.75	2.5813

(Soboleff, Z. anorg. 1896, **12.** 31.)

Solubility in ether at t°.

t°	100 ccm. ether dissolves g. of the cryst. acid.
0	81.196
7.8	85.327
18.2	96.017
24.2	101.348

(Soboleff.)

$+53H_2O=6H_2O$, P_2O_5, $24WO_3+47H_2O$. Sol. in H_2O. (Gibbs.)

Sol. in ether. If an equal vol. of ether is placed above a layer of conc. aqueous solution of acid, oily drops form between the two layers, which sink to bottom, forming a third layer. The sp. gr. of the latter is 1.525. The crystallized acid dissolved in smallest amt. ether forms an oil of sp. gr. $=2.083$. Ethereal solution is miscible with alcohol, and also with a large quantity of H_2O. (Drechsel, B. **20.** 1452.)

$+61H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 116.)

Aluminum ammonium phosphotungstate.

See **Aluminicophosphotungstate, ammonium.**

Ammonium phosphotungstate, $3(NH_4)_2O$, P_2O_5, $7WO_3+Aq$.

Sl. sol. in cold H_2O without decomp. Decomp. by hot H_2O. (Kehrmann, Z. anorg. 1892, **1.** 438.)

$2(NH_4)_2O$, P_2O_5, $12WO_3+5H_2O$. Insol. in cold H_2O. (Péchard, C. R. **110.** 754.)

$6(NH_4)_2O$, P_2O_5, $16WO_3+10H_2O$. Easily sol. in hot H_2O. (Péchard.)

$5(NH_4)_2O$, P_2O_5, $16WO_3+xH_2O=(NH_4)_5PW_8O_{29}+xH_2O$. (Ammonium α-phospholuteotungstate). Sl. sol. in H_2O. (Kehrmann.)

$3(NH_4)_2O$, P_2O_5, $16WO_3+16H_2O=(NH_4)_3PW_8O_{28}+8H_2O$. (Ammonium α-anhydrophospholuteotungstate). Efflorescent. Easily sol. in H_2O. (Kehrmann.)

$5(NH_4)_2O$, P_2O_5, $17WO_3+16H_2O$. Very sl. sol. in cold H_2O. (Kehrmann, Z. anorg. 1894, **6.** 387.)

$3(NH_4)_2O$, P_2O_5, $18WO_3+14H_2O$. (Phospholutestungstate.) (Kehrmann, Z. anorg. 1893, **4.** 140.)

$3(NH_4)_2O$, P_2O_5, $21WO_3+xH_2O$. Rather sl. sol. in cold, easily in hot H_2O and alcohol. Insol. in sat. NH_4Cl+Aq. (Kehrmann and Freinkel, B. **25.** 1972.)

$3(NH_4)_2O$, $3H_2O$, P_2O_5, $22WO_3+18H_2O$. Sl. sol. in cold H_2O. (Gibbs.)

$3(NH_4)_2O$, $3H_2O$, P_2O_5, $24WO_3+26H_2O$. Very sl. sol. even in hot H_2O. (Gibbs, Proc. Am. Acad. **16.** 122.)

Ammonium barium *α-anhydro***phospholuteotungstate,** $NH_4BaPW_8O_{28}+xH_2O$ = $(NH_4)_2O$, $2BaO$, P_2O_5, $16WO_3+xH_2O$.

Sol. in H_2O. (Kehrmann.)

Barium phosphotungstate, $2BaO$, P_2O_5, $12WO_3+15H_2O$.

Very efflorescent. Sol. in H_2O; insol. in alcohol. (Péchard, C. R. **110.** 754.)

$3BaO$, P_2O_5, $16WO_3+xH_2O=Ba_3(PW_8O_{28})+xH_2O$. (Barium α-anhydrophospholuteotungstate). Not efflorescent. Quite difficultly sol. in H_2O. (Kehrmann.)

$2BaO$, P_2O_5, $16WO_3+10H_2O$. Efflorescent. (Péchard, A. ch. (6) **22.** 240.)

$2BaO$, $6H_2O$, P_2O_5, $20WO_3+24H_2O$. Sol. in H_2O. (Gibbs, B. **10.** 1386.)

$6BaO$, $2H_2O$, P_2O_5, $20WO_3+46H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 126.)

$7BaO$, P_2O_5, $22WO_3+59H_2O$. Sol. in H_2O, (Sprenger, J. pr. (2) **22.** 418.)

$+53H_2O$. (Kehrmann, B. **24.** 2335.)

$4BaO$, $2H_2O$, P_2O_5, $22WO_3+39H_2O$. Sol. in H_2O without decomp. (Gibbs.)

BaO, P_2O_5, $24WO_3+59H_2O$. Sol. in H_2O. (Sprenger.)

$2BaO$, P_2O_5, $24WO_3+59H_2O$. Sol. in H_2O. (Sprenger.)

$3BaO$, P_2O_5, $24WO_3+46H_2O=3BaO$, $3H_2O$, P_2O_5, $24WO_3+43H_2O$. Easily sol. in hot H_2O. (Gibbs.)

$3BaO$, P_2O_5, $24WO_3+48H_2O$. Sol. in H_2O. (Soboleff, Z. anorg. 1896, **12.** 18.)

$+58H_2O$. Sol. in H_2O. (Sprenger.)

Efflorescent. Sl. sol. in dil. $BaCl_2$+Aq. (Kehrmann, Z. anorg. **1.** 423.)

Barium potassium phosphotungstate, $5BaO$, $2K_2O$, P_2O_5, $22WO_3+48H_2O$.

Sol. in H_2O. (Kehrmann and Freinkel, B. **25.** 1968.)

Barium silver phosphotungstate, $4BaO$, $3Ag_2O$, P_2O_5, $22WO_3+34H_2O$.

Very sl. sol. in H_2O. (Kehrmann and Freinkel, B. **25.** 1966.)

Barium sodium phosphotungstate, $2BaO$, Na_2O, P_2O_5, $24WO_3+46H_2O$.

Sol. in H_2O, forming cloudy liquid, which clears up. Solution in HCl is not cloudy. (Brandhorst and Kraut, A. **249.** 380.)

Calcium phosphotungstate, CaO, $5H_2O$, $16WO_3$, $P_2O_5+3H_2O$.

Readily sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 130.)

$2CaO$, P_2O_5, $12WO_3+19H_2O$. Efflorescent. Insol. in alcohol. (Péchard, C. R. **110.** 754.)

$2CaO$, P_2O_5, $20WO_3+22H_2O$. Efflorescent. (Péchard, A. ch. (6) **22.** 233.)

Cadmium phosphotungstate, $2CdO$, P_2O_5, $12WO_3+13H_2O$.

Sl. efflorescent. Very sol. in H_2O. (Péchard, C. R. **110.** 754.)

Cupric phosphotungstate, $3CuO$, $24WO_3$, $P_2O_5+58H_2O$.

Sol. in H_2O. (Sprenger, J. pr. (2) **22.** 418.)

$2CuO$, P_2O_5, $12WO_3+11H_2O$. Very efflorescent. (Péchard, C. R. **110.** 754.)

$2CuO$, P_2O_5, $20WO_3+13H_2O$. Efflorescent. (Péchard, A. ch. (6) **22.** 235.)

Lead phosphotungstate, $2PbO$, P_2O_5, $12WO_3+6H_2O$.

Insol. in cold, sol. in boiling H_2O. (Péchard, C. R. **110.** 754.)

$2PbO$, P_2O_5, $20WO_3+6H_2O$. Sol. in boiling H_2O. (Péchard, A. ch. (6) **22.** 236.)

Lithium phosphotungstate, Li_2O, P_2O_5, $12WO_3+21H_2O$.

Sol. in H_2O. (Péchard, C. R. **110.** 754.)

Magnesium phosphotungstate, $2MgO$, P_2O_5, $12WO_3$.

Sl. efflorescent. (Péchard, C. R. **110.** 754.)

$2MgO$, P_2O_5, $20WO_3+19H_2O$. Sl. efflorescent. (Péchard, A. ch. (6) **22.** 234.)

Mercurous phosphotungstate.

Insol. in dil. HNO_3+Aq. (Péchard, C. R. **110.** 754.)

Potassium phosphotungstate, K_2O, P_2O_5, $12WO_3+9H_2O$.

Insol. in cold, sl. sol. in hot H_2O. (Péchard, C. R. **110.** 754.)

$5K_2O$, P_2O_5, $16WO_3+xH_2O=K_5PW_8O_{29}+xH_2O$. (Potassium α-phospholuteotungstate). Very sl. sol. in cold, more easily in hot H_2O. Sol. in cold dil. HNO_3+Aq. (Kehrmann.)

$3K_2O$, P_2O_5, $16WO_3+16H_2O=K_3PW_8O_{28}+8H_2O$. (Potassium α-anhydrophospholuteotungstate). Efflorescent. Easily sol. in H_2O. (Kehrmann.)

$5K_2O$, P_2O_5, $17WO_3+21$ or $22H_2O$. Sl. sol. in cold H_2O. (Kehrmann, Z. anorg. 1894, **6.** 387.)

$3K_2O$, P_2O_5, $18WO_3+28H_2O$. (Duparc and Pearce, Bull. Soc. Min. 1895, **18.** 42.)

K_2O, $5H_2O$, P_2O_5, $18WO_3+14H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$6K_2O$, P_2O_5, $18WO_3+30H_2O$, and $23H_2O$.

The $23H_2O$ salt is more sol. in H_2O than the $30H_2O$ salt. (Gibbs.)

$7K_2O, H_2O, P_2O_5, 20WO_3+27H_2O$. Sol. in H_2O. (Gibbs, B. **10.** 1386.)

$K_2O, P_2O_5, 20WO_3+5H_2O$. Nearly insol. in H_2O. (Péchard, A. ch. (6) **22.** 231.)

$8K_2O, P_2O_5, 20WO_3+18H_2O$. Sl. sol. in H_2O. (Gibbs.)

$3K_2O, P_2O_5, 21WO_3+31H_2O$. Easily sol. in cold H_2O or alcohol. Much less sol. in very dil. HCl+Aq or KCl+Aq. Decomp. by boiling H_2O. (Kehrmann and Freinkel, B. **25.** 1971.)

$2K_2O, 4H_2O, P_2O_5, 22WO_3+2H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$7K_2O, P_2O_5, 22WO_3+31H_2O$. Easily sol. in cold or hot H_2O. Insol. in alcohol. (Kehrmann, B. **25.** 1966.)

$3K_2O, 3H_2O, P_2O_5, 24WO_3+8$, and $14H_2O$. Sol. in a large amount of H_2O with partial decomp. (Gibbs, Proc. Am. Acad. **16.** 120.)

Practically insol. in H_2O. Easily sol. in NH_4OH, alkalies, or alkali carbonates+Aq. (Kehrmann, B. **24.** 2329.)

$6K_2O, P_2O_5, 24WO_3+18H_2O$. Sol. in H_2O. (Gibbs, Proc. Am. Acad. **15.** 1.)

Potassium lead α-phospho*luteo*tungstate.

Sl. sol. in H_2O. (Kehrmann.)

Silver phosphotungstate, $Ag_2O, P_2O_5, 12WO_3 +8H_2O$.

Ppt. Insol. in H_2O. (Péchard, C. R. **110.** 754.)

$5Ag_2O, P_2O_5, 16WO_3+xH_2O = Ag_5PW_8O_{29} +xH_2O$ (Silver α-phospholuteotungstate). Ppt. (Kehrmann.)

$3Ag_2O, P_2O_5, 16WO_3+16H_2O = Ag_3PW_8O_{28} +8H_2O$. (Silver α-anhydrophospholuteotungstate). Easily sol. in H_2O. (Kehrmann.)

$Ag_2O, 24WO_3, P_2O_5+60H_2O$. Insol. in H_2O.

$3Ag_2O, 24WO_3, P_2O_5+58H_2O$. Insol. in H_2O. (Sprenger, J. pr. (2) **22.** 418.)

Sodium phosphotungstate, $3Na_2O, P_2O_5, 7WO_3+Aq$.

Sol in H_2O. (Kehrmann, Z. anorg. **1.** 437.)

$5Na_2O, 11H_2O, 2P_2O_5, 12WO_3+26H_2O = Na_5H_{11}P_2W_6O_{31}+13H_2O$ (?). (Scheibler, B. **5.** 801.)

$2Na_2O, P_2O_5, 12WO_3+18H_2O$. Sol. in H_2O. Insol. in alcohol. (Péchard, C. R. **110.** 754.)

$5Na_2O, 14WO_3, 2P_2O_5+42H_2O$. Easily sol. in H_2O. (Gibbs.)

$Na_2O, P_2O_5, 20WO_3, 2H_2O+19H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 183.)

$Na_2O, P_2O_5, 20WO_3+23H_2O = Na_2O, 7H_2O, P_2O_5, 20WO_3+16H_2O$. Easily sol. in H_2O. (Gibbs.)

$+25H_2O$. Sl. efflorescent; very sol. in H_2O; insol. in alcohol. (Péchard, A. ch. (6) **22.** 227.)

$2Na_2O, P_2O_5, 20WO_3+10H_2O$. Sol. in H_2O; insol. in alcohol. (Péchard.)

$+30H_2O$. (P.)

$3Na_2O, P_2O_5, 20WO_3+32H_2O$. As above. (P.)

$2Na_2O, P_2O_5, 22WO_3+9H_2O$. Very sl. sol. in H_2O. (Gibbs.)

$3Na_2O, P_2O_5, 24WO_3+22H_2O$. Sol. in H_2O. (Brandhorst and Kraut, A. **249.** 379.)

$+30H_2O$. Sol. in H_2O. (Soboleff, Z. anorg. 1896, **12.** 18.)

$+42H_2O$.

Solubility in H_2O at t°.

t°	100 ccm. H_2O dissolve g. of the cryst. salt
0	22.04
22	59.65
93	98.184

(Soboleff, Z. anorg. 1896, **12.** 31.)

$2Na_2O, 4H_2O, 24WO_3, P_2O_5+23H_2O$. Readily sol. in H_2O. (Gibbs, Proc. Am. Acad. **16.** 118.)

Sp. gr. at 20° of solutions of $2Na_2O, 4H_2O, P_2O_5, 24WO_3+23H_2O$ containing:

10.22	20.94	31.13% salt,
1.085	1.190	1.316
42.61	52.92	64.11% salt.
1.496	1.702	2.001

or, by calculation, a = sp. gr. if % is crystallized salt, b = sp. gr. if % is anhydrous salt:

	5	10	15	20	25% salt,
a	1.040	1.084	1.131	1.181	1.237
b	1.044	1.092	1.143	1.199	1.262
	30	35	40	45	50% salt,
a	1.299	1.370	1.449	1.538	1.640
b	1.333	1.414	1.507	1.613	1.734
	55	60	64% salt.		
a	1.754	1.884	1.998		
b	1.872	...	...		

(Brandhorst and Kraut, A. **249.** 377.)

Strontium phosphotungstate, $2SrO, P_2O_5, 12WO_3+17H_2O$.

Sol. in H_2O. Insol. in alcohol. (Péchard, C. R. **110.** 754.)

Thallium phosphotungstate, $Tl_2O, P_2O_5, 12WO_3+4H_2O$.

Ppt. (Péchard, C. R. **110.** 754.)

Zinc phosphotungstate, $2ZnO, P_2O_5, 12WO_3+7H_2O$.

Efflorescent. (Péchard, C. R. **110.** 754.)

***Monometa*phosphotungstic acid.**

Ammonium *monometa*phosphotungstate, $(NH_4)_2O, 2NH_4PO_3, 18WO_3+11H_2O$.

Sl. sol. in cold H_2O.

Potassium ***monometa*****phosphotungstate,** $3K_2O, 2KPO_3, 24WO_3+20H_2O$.

Very sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 319.)

*Orthometa*phosphotungstic acid.

Potassium sodium ***orthometa*****phosphotungstate,** $2K_2O, 4Na_2O, 6NaPO_3, 6K_3PO_4, 22WO_3+42H_2O$.

Sl. sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 319.)

*Pyro*phosphotungstic acid.

Ammonium manganous sodium ***pyro*****phosphotungstate,** $5(NH_4)_2O, 6MnO, 2Na_2O, 2P_2O_5, 28WO_3+48H_2O$.

Very sol. in cold and in hot H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 90.)

Ammonium sodium ***pyro*****phosphotungstate,** $6(NH_4)_4P_2O_7, 3Na_4P_2O_7, 2(NH_4)_2O, 22WO_3+31H_2O$.

Nearly insol. in cold H_2O or NH_4OH+Aq. Sol. in a large amount of hot H_2O.

Manganous sodium ***pyro*****phosphotungstate,** $6Na_2O, 3MnO, P_2O_5, 14WO_3+36H_2O$.

Efflorescent in dry air. Sol. in H_2O and can be recryst. therefrom. (Gibbs.)

Potassium ***pyro*****phosphotungstate,** $9K_4P_2O_7, 22WO_3+49H_2O$.

Very sl. sol. in cold H_2O.

$6K_4P_2O_7, 3H_4P_2O_7, 22WO_3, K_2O, H_2O+42H_2O$. Sl. sol. in cold. Sol. in much boiling H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Phosphovanadic acid, $P_2O_5, V_2O_5, 2H_2O+9H_2O$.

Sol. in H_2O.

Composition is vanadium phosphate $(VO_2)H_2PO_4+4\frac{1}{2}H_2O$. (Friedheim, B. **23.** 1531.)

This is the only "acid" which exists. (F.)

$P_2O_5, V_2O_5+14H_2O$. Sol. in H_2O; can be recryst. from dil. H_3PO_4+Aq. (Ditte, C. R. **102.** 757.)

$3P_2O_5, 2V_2O_5+9H_2O$. Sol. in H_2O. (Ditte.)

$P_2O_5, 3V_2O_5$. (Berzelius.)

$3H_2O, 7P_2O_5, 6V_2O_5+34H_2O$. Sol. in H_2O. Decomp. by much H_2O into—

$6H_2O, P_2O_5, 20V_2O_5+53H_2O$. Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

Ammonium phosphovanadate, $(NH_4)_2O, P_2O_5, V_2O_5+H_2O$.

Sl. sol. in cold H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

$+3H_2O$. Composition is $(VO_2)(NH_4)HPO_4+H_2O$. (Friedheim.)

$(NH_4)_2O, P_2O_5, 2V_2O_5+7H_2O$. Easily sol. in H_2O. (Gibbs.) Sl. sol. in H_2O. (Friedheim.) Composition is $(NH_4)_2O, V_2O_5, +2(VO_2)H_2PO_4+5H_2O$. (Friedheim.)

$5(NH_4)_2O, 2P_2O_5, 3V_2O_5+24H_2O$. Easily sol. in H_2O. (Ditte, C. R. **102.** 1019.) Could not be obtained. (Friedheim.)

$5(NH_4)_2O, 4P_2O_5, 2V_2O_5+24H_2O$. As above. (Ditte.) Could not be obtained. (Friedheim.)

$7(NH_4)_2O, P_2O_5, 12V_2O_5+26H_2O$. Easily sol. in H_2O. Composition is $2(NH_4)_2HPO_4+5(NH_4)_2O, 12V_2O_5+25H_2O$. (Friedheim.)

Potassium phosphovanadate, $K_2O, P_2O_5, 2V_2O_5+7H_2O$.

Sl. sol. in H_2O; decomp. thereby to $7K_2O, 12V_2O_5, P_2O_5+26H_2O$.

Composition is $K_2O, V_2O_5+2(VO_2)H_2PO_4+5H_2O$. (Friedheim.)

$3K_2O, 4P_2O_5, 6V_2O_5+21H_2O$. Sl. sol. in H_2O. (Gibbs.)

$7K_2O, P_2O_5, 12V_2O_5+26H_2O$. Easily sol. in H_2O. Composition is $2K_2HPO_4+5K_2O, 12V_2O_5+25H_2O$. (Friedheim.)

$2K_2O, P_2O_5, V_2O_5$.
$3K_2O, 2P_2O_5, 2V_2O_5+5H_2O$.
$13K_2O, 2P_2O_5, 22V_2O_5+58H_2O$.
$15K_2O, 2P_2O_5, 25V_2O_5+76H_2O$.
(Friedheim, Z. anorg. 1894, **5.** 446.)
$16K_2O, 2P_2O_5, 27V_2O_5+57H_2O$.
$6K_2O, P_2O_5, 11V_2O_5+33H_2O$.
$7K_2O, P_2O_5, 13V_2O_5+38H_2O$.
$4K_2O, P_2O_5, 3V_2O_5+3H_2O$.
(Friedheim, Z. anorg. 1894, **5.** 459–465.)

Silver phosphovanadate, $2Ag_2O, P_2O_5, V_2O_5+5H_2O$.

Sl. sol. in cold or hot H_2O. (Gibbs.)

Phosphovanadicotungstic acid.

Ammonium phosphovanadicotungstate, $(NH_4)_2O, P_2O_5, V_2O_3, WO_3+xH_2O$.

Ppt. (Smith, J. Am. Chem. Soc. 1902, **24.** 577.)

$15(NH_4)_2O, 2P_2O_5, 6V_2O_3, 44WO_3+106H_2O$. Sol. in H_2O. Insol. in alcohol, ether or benzene. (Rogers, J. Am. Chem. Soc. 1903, **25.** 303.)

Phosphovanadicovanadiotungstic acid.

Ammonium phosphovanadicovanadiotungstate, $14(NH_4)_2O, 2P_2O_5, 3V_2O_3, 7V_2O_5, 27WO_3+66H_2O$.

Sparingly sol. in cold H_2O. Sol. in hot H_2O. (Rogers, J. Am. Chem. Soc. 1903, **25.** 309.)

Phosphovanadicozirconosotungstic acid.

Ammonium phosphovanadicozirconosotungstate.

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1226.)

Phosphovanadicovanadic acid.

Ammonium phosphovanadicovanadate, $7(NH_4)_2O, 2P_2O_5, VO_2, 18V_2O_5+50H_2O$.

Sol. in H_2O. (Gibbs, Am. Ch. J. **7.** 209.)

$7(NH_4)_2O, 14P_2O_5, 16VO_2, 6V_2O_5+65H_2O$. Decomp. by boiling with H_2O into— $5(NH_4)_2O, 10P_2O_5, 11VO_2, V_2O_5+41H_2O$. Sol. in H_2O. (Gibbs.)

Potassium ——, $5K_2O, 12P_2O_5, 12VO_2, 6V_2O_5+40H_2O$.

Decomp. by hot H_2O into— $7K_2O, 12P_2O_5, 14VO_2, 6V_2O_5+52H_2O$. Sol. in H_2O. (Gibbs.)

Sodium ——, $4Na_2O, 5P_2O_5, VO_2, 4V_2O_5+37H_2O$.

Insol. in H_2O. (Gibbs.)

Phosphovanadiomolybdic acid.

Ammonium phosphovanadiomolybdate, $7(NH_4)_2O, 2P_2O_5, V_2O_5, 48MoO_3+30H_2O$.

Sl. sol. in cold, somewhat more in hot H_2O with partial decomp. (Gibbs, Am. Ch. J. **5.** 391.)

$8(NH_4)_2O, P_2O_5, 8V_2O_5, 14MoO_3+50H_2O$. Easily sol. in hot H_2O without decomp. (Gibbs.)

$5(NH_4)_2O, P_2O_5, 2\frac{1}{2}V_2O_5, 21\frac{1}{2}MoO_3+50H_2O$.

$8(NH_4)_2O, P_2O_5, 5V_2O_5, 18MoO_3+45H_2O$.

$7(NH_4)_2O, P_2O_5, 5\frac{1}{2}V_2O_5, 16\frac{1}{2}MoO_3+50H_2O$.

$8(NH_4)_2O, P_2O_5, 7V_2O_5, 15MoO_3+50H_2O$.

All above compounds are sol. in H_2O. (Blum, J. Am. Chem. Soc. 1908, **30.** 1859.)

$6(NH_4)_2O, P_2O_5, 7V_2O_5, 9MoO_3+28H_2O, +33H_2O$, and $+37H_2O$.

Can be recryst. from H_2O. (Hinsen, Dissert. **1904.**)

$4(NH_4)_2O, P_2O_5, 4V_2O_5, 11MoO_3+37H_2O$. (Jacoby, Dissert. **1900.**)

$6(NH_4)_2O, P_2O_5, 7V_2O_5, 11MoO_3+34H_2O$ and $+43H_2O$. (Hinsen, Dissert. **1904.**)

$8(NH_4)_2O, P_2O_5, 7V_2O_5, 11MoO_3+30H_2O$. (Hinsen.)

$5(NH_4)_2O, P_2O_5, 4V_2O_5, 12MoO_3+39H_2O$. 1 cc. of solution in H_2O contains 0.2624 g. of hydrous salt. Sp. gr. of solution at 18° = 1.0932. (Lahrmann, Dissert. **1904.**)

$6(NH_4)_2O, P_2O_5, 4V_2O_5, 12MoO_3+24H_2O$. Nearly insol. in cold H_2O. (Lahrmann.)

$7(NH_4)_2O, P_2O_5, 6V_2O_5, 12MoO_3+33H_2O$. (Stamm, Dissert. **1905.**)

$6(NH_4)_2O, P_2O_5, 4V_2O_5, 13MoO_3+37H_2O$. 1 cc. of solution sat. at 18° contains 0.1543 g. hydrous salt and has sp. gr. = 1.0900. (Toggenburg, Dissert. **1902.**)

$6(NH_4)_2O, P_2O_5, 5V_2O_5, 13MoO_3+29H_2O$. 1 cc. solution sat. at 18° contains 0.2533 g. hydrous salt. Sp. gr. = 1.0797. (Stamm, Dissert. **1905.**)

$+32H_2O$. (Stamm.)

$+34H_2O$. Stamm.)

$6(NH_4)_2O, P_2O_5, 4V_2O_5, 14MoO_3+28H_2O$. Easily sol. in H_2O with decomp. (Toggenburg, Dissert. **1902.**)

$8(NH_4)_2O, P_2O_5, 4V_2O_5, 14MoO_3+24H_2O$. Decomp. by cold H_2O. (Lahrmann, Dissert. **1904.**)

$5(NH_4)_2O, P_2O_5, 3V_2O_5, 5MoO_3+39H_2O$. 1 cc. of solution sat. at 18° contains 0.2445 g. hydrous salt and has sp. gr. = 1.144. (Jacoby, Dissert. **1900.**)

$6(NH_4)_2O, P_2O_5, 3V_2O_5, 15 MoO_3+41H_2O$. Extraordinarily easily sol. in H_2O. (Jacoby.)

$7(NH_4)_2O, P_2O_5, 3\ {}_2O_5, 18MoO_3+31H_2O$. (Schulz Dissert. **1905.**)

$6(NH_4)_2O, P_2O_5, 3V_2O_5, 18MoO_3+40H_2O$. (Schulz.)

$8(NH_4)_2O, P_2O_5, 5V_2O$, $73MoO_3+26H_2O$. $+33H_2O$. (Stamm, Dissert **1905.**)

Ammonium barium ——, $0.5(NH_4)_2O, 5.5BaO, P_2O_5, 6V_2O_5, 8MoO_3+38H_2O$. (Hinsen, Dissert. **1904.**)

$2(NH_4)_2O, 4BaO, P_2O_5, 7V_2O_5, 10 MoO_3+43H_2O$. Sl. sol. in H_2O. Decomp. on heating. (Toggenburg, Dissert. **1902.**)

$(NH_4)_2O, 5BaO, P_2O_5, 6V_2O_5, 12MoO_3+49 H_2O$. Less sol. in H_2O than NH_4 comp. (Jacoby, Dissert. **1900.**)

$2(NH_4)_2O, 4BaO, P_2O_5, 4V_2O_5, 13MoO_3+37 H_2O$. Sol. in much hot H_2O with decomp. (Toggenburg, Dissert. **1902.**)

$2(NH_4)_2O, 4BaO, P_2O_5, 5V_2O_5, 13MoO_3+46H_2O$. (Stamm, Dissert. **1905.**)

$3 NH_4)_2O, 4BaO, P_2O_5, 5V_2O_5, 13MoO_3+40H_2O$. (Stamm.)

$3(NH_4)_2O, 3BaO, P_2O_5, 4V_2O_5, 14MoO_3+39H_2O$. (Stamm.)

$2(NH_4)_2O, 4BaO, P_2O_5, 3V\ O_5, 17MoO_3+46H_2O$. (Schulz, Dissert. **1905.**)

Ammonium potassium ——, $(NH_4)_2O, 6K_2O, P_2O_5, 6V_2O_5, 10 MoO_3+38H_2O$.

(Jacoby, Dissert. **1900.**)

$(NH_4)_2O, 6K_2O, P_2O_5, 7V_2O_5, 11MoO_3+25H_2O$. (Jacoby, Dissert. **190?.**)

$(NH_4)_2O, 5K_2O, P_2O_5, 6V_2O_5, 12MoO_3+46H_2O$. (Jacoby.)

$(NH_4)_2O, 5K_2O, P_2O_5, 5V_2O_5, 13MoO_3+ +25H_2O; +29H_2O; +30H_2O$. Sl. sol. in cold, more easily in hot H_2O. (Stamm, Dissert. **1905.**)

$5K_2O, (NH_4)_2O, P_2O_5, 4V_2O_5, 14MoO_3+31\ {}_2O$. (Stamm.)

$(NH_4)_2O, 4K_2O, P_2O_5, 3V_2O_5, 15MoO_3+36H_2O$. (Jacoby, Dissert. **1900.**)

$(NH_4)_2O, 6K_2O, P_2O_5, 3V_2O_5, 18MoO_3+43H_2O$. (Schulz, Dissert. **1905.**)

$5(NH\ )_2O, K_2O, P_2O_5, 2V_2O_5, 20MoO_3+52H_2O$. (Schulz.)

Barium potassium ——, $2BaO, 2K_2O, P_2O_5, 2V_2O_5, 18 MoO_3+47H_2O$.

(Schulz, Dissert. **1905.**)

Potassium phosphovanadiomolybdate, $7K_2O, P_2O_5, 7V_2O_5, 9MoO_3+25H_2O$.

(Hinsen, Dissert. **1904.**)

$5K_2O, P_2O_5, 2V_2O_5, 20MoO_3+53H_2O$. (Schulz, Dissert. **1905.**)

Phosphovanadiotungstic acid.

Ammonium phosphovanadiotungstate, $10(NH_4)_2O, 3P_2O_5, V_2O_5, 60WO_3+60H_2O$.

Nearly insol in cold, sl. sol. in hot H_2O. Sol. in $(NH_4)_2HPO_4$+Aq, and in NH_4OH+Aq.

$5(NH_4)_2O, P_2O_5, 3V_2O_5, 16WO_3+37H_2O$. Easily sol. in H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

$13(NH_4)_2O, 2P_2O_5, 8V_2O_5, 34WO_3+86H_2O$. Very sol. in cold and hot H_2O.

nsol. in alcohol, ether, CS_2, benzene and nitrobenzene. (Rogers, J. Am. Chem. Soc. 1903, **25.** 299.)

Barium ——, $18BaO, 3P_2O_5, 2V_2O, 60WO_3+144H_2O$.

Easily sol in hot H_2O with decomp (Gibbs, Am. Ch. J. **5.** 391.)

Potassium —— $3K_2O, P_2O_5, V_2O_5, 7WO_3+11H_2O$.

Sol. in H_2O.

$8K_2O, 3P_2O_5, 4V_2O_5, 18WO_3+23H_2O$. Sol. in hot H_2O with decomp. into preceding salt. (Gibbs, Am. Ch. J. **5.** 391.)

Silver ——, $13Ag_2O, 2P_2O_5, 8V_2O_5, 33WO_3+41H_2O$.

Somewhat sol. in H_2O.

Completely sol. in H_2O containing a few drops HNO_3. (Rogers, J. Am. Chem. Soc. 1903, **25.** 302.)

Phosphovanadiovanadicotungstic acid.

Barium phosphovanadiovanadicotungstate, $18BaO, 3P_2O_5, VO_5, VO_2, 60WO_3+150H_2O$.

Sl. sol. in cold, easily sol. in hot H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

Phosphuretted hydrogen.

See **Hydrogen phosphide.**

Platibromonitrous acid.

Potassium platibromonitrite, $K_2Pt(NO_2)_4Br_2$.

Rather sl. sol. in H_2O. (Blomstrand, J. pr. (2) **3.** 214.)

Sol. in about 40 pts. cold, and 20 pts. boiling H_2O. Insol. in alcohol. Sl. sol. in KBr or KNO_2+Aq. (Vèzes, A. ch. (6) **29.** 198.)

$K_2Pt(NO_2)_3Br_3$. Sol. in about 5 pts. warm H_2O with decomp. (Vèzes.)

$K_2Pt(NO_2)_2Br_4$. Sol. in less than 5 pts. H_2O with decomp. (Vèzes.)

Platichloronitrous acid.

Potassium platichloronitrite, $K_2Pt(NO_2)_4Cl_2$.

Rather sl sol. in H_2O. (Blomstrand J. pr. (2) **3.** 214.)

Sol. in 40 pts. cold, and 20 pts. boiling H_2O. Insol. in alcohol Sl. sol. in KCl or KNO_2+Aq. (Vèzes, A. ch. (6) **29.** 183.)

$K_2Pt(NO_2)_3Cl_3$. Very sol. in H_2O. (Vèzes.)

$K_2Pt(NO_2)_2Cl_4+H_2O$. Sol. in H_2O with decomp. (Vèzes.)

Platiiodonitrous acid.

Potassium platiiodonitrite, $K_2Pt(NO_2)_2I_4$.

Sl. sol. in cold, more easily in hot H_2O; decomp. by boiling. (Vèze, A. ch. (6) **29.** 207.)

$K_2Pt(NO_2)I_5$. As above. (Vèzes.)

Platin-.

See also **Plat ino-, plato-, plat-,** *and* **platos-.**

Platin*di*amine compounds.

See **Chloro-, bromo-, hydroxylo-, iodo-, nitrato-, nitrito-, sulphato-, etc., platin*di*amine compounds.**

Platin*tri*amine carbonate,

$Pt(NH_3)_6(CO_3)_2$.

Ppt. Sol. in NaOH+Aq. (Geddes, J. pr. (2) **26.** 257.)

—— **chloride** $Pt(NH_3)_6Cl_4$.

Sol. in hot H_2O (Gerdes.)

—— **chloroplatinate,** $Pt(NH_3)Cl_4, PtCl_4+2H_2O$.

Very sl. sol. in H_2O. (Gerdes.)

—— **nitrate,** $Pt(NH_3)_6(NO_3)_4$.

Easily sol. in H_2O; sl. sol. in HNO_3+Aq. (Gerdes.)

—— **sulphate,** $Pt(NH_3)_6(SO_4)_2+H_2O$.

Nearly insol. in H_2O. (Gerdes.)

*Tetra*platinamine iodide, $Pt_4(NH_3)_8I_{10}$.

(Blomstrand, B. **16.** 1469.)

*Octo*platinamine iodide, $Pt_8(NH_3)_{16}I_{18}$.

(Blomstrand.)

Platinic acid.

Barium platinate, basic (?), $3BaO, 2PtO_2$.

Insol in $HC_2H_3O_2$+Aq; easily sol. in HCl+Aq. (Rousseau.)

Barium platinate, $BaPtO_3$.

(Rousseau, C. R. **109.** 144.)

$+H_2O$. Insol. in dil. HNO_3+Aq; sol. in warm HCl+Aq. (Topsoë, B. **3.** 464.)

$+4H_2O$. Very sl. sol. in H_2O, BaO_2H_2, or NaOH+Aq. Easily sol. in dil. acids, except $HC_2H_3O_2$, in which it is insol. in the cold, but decomp. on heating. (Topsoë, *l. c.*)

Composition is $3BaPtO_3$, $BaCl_2$, $PtCl_2O+4H_2O$ (?). (Johannsen, A. **155.** 204.)

Calcium platinate chloride (?), $2Ca_2Pt_2O_5Cl_2+7H_2O$ (?).

"Herschel's precipitate."

Easily sol. in HCl+Aq, and in HNO_3+Aq, if freshly pptd. (Herschel.)

Very sol. in HNO_3+Aq. (Weiss and Döbereiner, A. **14.** 252.)

Composition is $CaPtO_3$ $PtCl_2O$, $CaO+7H_2O$ (?). (Johannsen, A. **155.** 204.)

Potassium platinate.

Sol. in H_2O. (Berzelius.)

K_2O, PtO_2+3H_2O. Very sol. in H_2O. (Blondel, A. ch. 1905, (8) **6.** 90.)

$K_2Pt(OH)_6$. Sol. in H_2O; insol. in alcohol. (Bellucci, Z. anorg. 1905, **44.** 173.)

Sodium platinate, Na_2O, $3PtO_2+6H_2O$.

Dil. acids dissolve out Na_2O and leave PtO_2. Sol. in HNO_3+Aq. (Döbereiner, Pogg. **28.** 180.)

Na_2O, PtO_2+3H_2O. Sol. in H_2O. (Blondel.)

*Meta*platinic acid, $5PtO_2$, $5H_2O$.

Insol. in H_2O. (Blondel, A. ch. 1905, (8) **6.** 103.)

Sodium *meta*platinate, Na_2O, $5PtO_2+9H_2O$.

Insol. in H_2O. (Blondel.)

Platinimolybdic acid, $4H_2O$, PtO_2, $10MoO_3$.

(Gibbs.)

Ammonium platinimolybdate, $8MoO_3$, $2PtO_2$, $3(NH_4)_2O+12H_2O$.

$4MoO_3$, $2PtO_2$, $2(NH_4)_2O+19H_2O$.

Sol. in hot H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 80–82.)

Potassium platinimolybdate, $60MoO_3$, PtO_2, $10K_2O+40H_2O$.

So . in hot H_2O. (Gibbs.)

Silver platinimolybdate.

Sodium platinimolybdate, $4Na_2O$, PtO_2, $10 MoO_3+29H_2O$.

Sol. in H_2O. (Gibbs, Sill. Am. J. (3) **14.** 61.)

Platinitungstic acid.

Ammonium platinitungstate, $4(NH_4)_2O$, PtO_2, $10WO_3+12H_2O$.

Sol. in H_2O. (Gibbs, B. **10.** 1384.)

Potassium platinitungstate, $4K_2O$, PtO_2, $10WO_3+9H_2O$.

Sol. in H_2O. (Gibbs.)

Sodium platinitungstate, $4Na_2O$, PtO_2, $10WO_3+25H_2O$.

Sol. in H_2O. (Gibbs.)

$5Na_2O$, $7WO_3$, $2PtO_2+35H_2O$. Sol. in H_2O. (Gibbs.)

Is double salt $3Na_2O$, $7WO_3+2Na_2PtO_3$. (Rosenheim, B. **24.** 2397.)

$10WO_3$, PtO_2, $4Na_2O+23H_2O$.
$10WO_3$, PtO_2, $6Na_2O+28H_2O$.
$20WO_3$, PtO_2, $9Na_2O+58H_2O$.
$30WO_3$, $2PtO_2$, $15Na_2O+89H_2O$.
$30WO_3$, PtO_2, $12Na_2O+72H_2O$.

All are sol. in boiling H_2O. (Gibbs, Am. Ch. J. 1895, **17.** 74–80.)

Platino-.

See also Plato—.

Platinochlorophosphoric acid.

See **Chloroplatinophosphoric acid.**

Platinocyanhydric acid, $H_2Pt(CN)_4$.

Deliquescent. Very sol. in H_2O, alcohol, and ether.

Ammonium platinocyanide, $(NH_4)_2Pt(CN)_4+3H_2O$.

Very sol. in H_2O.

$+2H_2O$. Sol. in 1 pt. H_2O, and still more easily in alcohol.

$+H_2O$.

Ammonium hydroxylamine platinocyanide, $NH_4(NH_4O)Pt(CN)_4+3\frac{1}{2}H_2O$.

Sol. in H_2O. (Scholz, M. Ch. **1.** 900.)

Ammonium magnesium platinocyanide, $(NH_4)_2Mg[Pt(CN)_4]_2+6H_2O$.

Barium platinocyanide, $BaPt(CN)_4+4H_2O$.

Sol. in 33 pts. H_2O at 16°, and in much less at 100°. Sol. in alcohol.

Barium potassium platinocyanide, $BaK_2[Pt(CN)_4]_2$.

Sol. in H_2O.

Barium rubidium platinocyanide, $BaRb_2[Pt(CN)_4]_2$.

Sol. in H_2O.

Cadmium platinocyanide, $CdPt(CN)_4$.
Ppt. Sol. in NH_4OH+Aq. (Martius, A. **117.** 376.)
$CdPt(CN)_4$, $2NH_3+H_2O$. (M.)

Calcium platinocyanide, $CaPt(CN)_4+5H_2O$.
Very sol. in H_2O.

Calcium potassium platinocyanide, $CaK_2[Pt(CN)_4]_2$.
Sol. in H_2O.

Cerium platinocyanide, $Ce_2[Pt(CN)_4]_3+18H_2O$.
Sol. in H_2O.

Cobaltous platinocyanide ammonia, $CoPt(CN)_4$, $2NH_3$.
Insol. in H_2O, but sol. in hot NH_4OH+Aq.

Cupric platinocyanide, $CuPt(CN)_4+xH_2O$.
Ppt.

Cupric platinocyanide ammonia, $CuPt(CN)_4$, $2NH_3+H_2O$.
$CuPt(CN)_4$, $4NH_3$. Sol. in H_2O, alcohol, and ether.

Didymium platinocyanide, $Di_2[Pt(CN)_4]_3+18H_2O$.
Efflorescent in dry air. Sol. in H_2O. (Cleve.)

Dysprosium platinocyanide, $Dy_2[Pt(CN)_4]_3+21H_2O$.
Easily sol. in H_2O. (Jantsch, B. 1911, **44.** 1277.)

Erbium platinocyanide, $Er_2[Pt(CN_4)]_3+21H_2O$.
Sol. in H_2O. (Cleve.)

Gadolinium platinocyanide, $2Gd(CN)_3$, $3Pt(CN)_2+18H_2O$.
Sol. in H_2O; decomp. in the air. (Benedicks, Z. anorg. 1900, **22.** 405.)

Glucinum platinocyanide, $GlPt(CN)_4$.
(Toczynski, Dissert. **1871.**)

Hydroxylamine platinocyanide, $(NH_4O)_2Pt(CN)_4+2H_2O$.
Deliquescent. Very sol. in H_2O. (Scholz.)

Hydroxylamine lithium platinocyanide, $(NH_4O)LiPt(CN)_4+3H_2O$.
Sol. in H_2O.

Indium platinocyanide, $In_2[Pt(CN)_4]_3+2H_2O$.
Hydroscopic; sol. in H_2O. (Renz, B. 1901, **34.** 2765.)

Lanthanum platinocyanide, $La_2[Pt(CN)_4]_3+18H_2O$.
Easily sol. in H_2O. (Cleve.)

Magnesium platinocyanide, $MgPt(CN)_4+2H_2O$.
Solubility in H_2O.
100 g. of the sat. solution contain at:

96.4°	100°	
44.33	43.96	g. $MgPt(CN)_4$

(Buxhoevden, Z. anorg. 1897, **15.** 325.)

$+4H_2O$.
Solubility in H_2O.
100 g. of the sat. solution contain at:

42.2°	46.3°	48.7°	55°	
40.21	39.79	40.75	40.02	g. $MgPt(CN)_4$,
58.1°	69°	77.8°	87.4°	
42.01	43.48	44.88	45.52	g. $MgPt(CN)_4$,
90°	93°			
45.59	45.04	g. $MgPt(CN)_4$.		

(Buxhoevden.)

$+7H_2O$. Sol. in 3.4 pts. H_2O at 16°. Easily sol. in alcohol and ether.
Solubility in H_2O.
100 g. of the sat. solution contain at:

—4.12°	+0.5°	5.5°	18.0°		
24.9	26.33	28.07	31.23	g. $MgPt(CN)_4$,	
36.6°	45.0°	46.2°			
38.36	41.32	41.96	g. $MgPt(CN)_4$.		

(Buxhoevden.)

Magnesium potassium platinocyanide, $MgK_2[Pt(CN)_4]_2+7H_2O$.
Sol. in H_2O.

Mercuric platinocyanide, $HgPt(CN)_4$.
Ppt.

Mercuric platinocyanide nitrate, $5HgPt(CN)_4$ $Hg(NO_3)_2+10H_2O$.
Ppt.

Nickel platinocyanide ammonia, $NiPt(CN)_4$, $2NH_3+H_2O$.

Potassium platinocyanide, $K_2Pt(CN)_4+3H_2O$.
Extremely efflorescent. Sl. sol. in cold, easily in hot H_2O. (Willm, B. **19.** 950.)
Sol. in alcohol and ether.

Potassium sodium platinocyanide, $K_2Pt(CN)_4$, $Na_2Pt(CN)_4+6H_2O$.
Sol. in H_2O. (Willm, B. **19.** 950.)

Praseodymium platinocyanide, $2Pr(CN)_3$, $3Pt(CN)_2$.
Sol. in H_2O. (Von Scheele, Z anorg. 1898, **18.** 355.)

Samarium platinocyanide, $Sm_2[Pt(CN_4)]_3$ $+18H_2O$.
Sol. in H_2O. (Cleve.)

Scandium platinocyanide, $Sc_2[Pt(CN)_4]_3$ $+21H_2O$.
Sol. in H_2O and insol. in alcohol; when boiled in alcohol it is dehydrated. (Crookes, Phil. Trans. 1910, **210**. A, 368.)
$+21H_2O$. (Orlow, Ch. Z. 1912, **36**. 1407.)

Silver platinocyanide, $Ag_2Pt(CN)_4$.
Insol. in H_2O. Sol. in NH_4OH+Aq.

Silver platinocyanide ammonia, $Ag_2Pt(CN)_4$, $2NH_3$.
Insol. in H_2O. Sol. in NH_4OH+Aq.

Silver platinocyanide bromide.
See **Bromoplatinocyanide, silver.**

Silver platinocyanide chloride.
See **Chloroplatinocyanide, silver.**

Silver platinocyanide iodide.
See **Iodplatinocyanide, silver.**

Sodium platinocyanide, $Na_2Pt(CN)_4+3H_2O$.
Easily sol. in H_2O. (Willm, Z. anorg. **4**. 298.)
Sol. in alcohol.

Strontium platinocyanide, $SrPt(CN)_4+5H_2O$.
Sol. in H_2O.

Thallous platinocyanide, $Tl_2Pt(CN)_4$.
Nearly insol. in cold, sl. sol. in hot H_2O. (Friswell, Chem. Soc. **24**. 461.)

Thallous platinocyanide carbonate, $2Tl_2Pt(CN)_4$, Tl_2CO_3.
Nearly insol. in cold H_2O. (F.)

Thorium platinocyanide, $Th[Pt(CN)_4]_2+$ $16H_2O$.
Somewhat difficultly sol. in cold, easily in hot H_2O. (Cleve, Sv. V. A. H. Bih. **2**. No. 6.)

Uranyl platinocyanide, $(UO_2)Pt(CN)_4+xH_2O$.
Sol. in H_2O. (Levy, Chem. Soc. 1908, **93**. 1459.)

Ytterbium platinocyanide, $2Yb(CN)_3$, $3Pt(CN)_2+18H_2O$.
Easily sol. in H_2O. (Cleve, Z. anorg. 1902, **32**. 139.)

Yttrium platinocyanide, $Y_2[Pt(CN)_4]_3+$ $21H_2O$.
Easily sol. in H_2O. Insol. in absolute alcohol. (Cleve and Höglund.)

Zinc platinocyanide ammonia, $ZnPt(CN)_4$, $2NH_3+H_2O$.

Platinonitrous acid.
See **Platonitrous acid.**

Platinoplatinicyanhydric acid, $HPt(CN)_4$ $+xH_2O$.
Sol. in H_2O. (Levy, Chem. Soc. 1912, **101**. 1093.)

Platinoselenocyanhydric acid.

Potassium platinoselenocyanide, $K_2Pt(SeCN)_6$.
Sol. in H_2O and alcohol. (Clarke and Dudley, B. 1878, **11**. 1325.)

Platinoselenostannic acid.
See under **Selenostannate, platinum.**

Platinososulphocyanhydric acid, $H_2Pt(SCN)_4$.
Known only in aqueous solution.

Potassium platinososulphocyanide, $K_2Pt(SCN)_4$.
Permanent. Sol. in 2.5 pts. H_2O at 15°, and more readily at higher temp. Very sol. in warm alcohol.

Silver ——, $Ag_2Pt(SCN)_4$.
Insol. in H_2O. Sol. in $KSCN+Aq$, and partly sol. in NH_4OH+Aq.

Platinosulphocyanhydric acid, $H_2Pt(SCN)_6$.
Known only in aqueous, and alcoholic solutions.

Ammonium platinosulphocyanide, $(NH_4)_2Pt(SCN)_6$.
Sol. in H_2O and alcohol.

Barium ——, $BaPt(SCN)_6$.
Sol. in H_2O and alcohol.

Ferrous ——, $FePt(SCN)_6$.
Insol. in H_2O or alcohol. Not attacked by dil. H_2SO_4, HCl, or HNO_3+Aq.

Lead ——, $PbPt(SCN)_6$.
Sl. sol. in cold, decomp. by hot H_2O. Sol. in alcohol.
$PbPt(SCN)_6$, PbO. Insol. in H_2O or alcohol. Sol. in acetic or nitric acids.

Mercurous ——, $Hg_2Pt(SCN)_6$.
Ppt. Insol. in H_2O.

Potassium platinosulphocyanide, $K_2Pt(SCN)_6$.

Sol. in 12 pts. H_2O at 60°. Much more easily in boiling H_2O, and still more easily in hot alcohol.

$+2H_2O$. (Miolati and Bellucci, Gazz. Ch. it. 1900, **30**, II. 592.)

Silver ——, $Ag_2Pt(SCN)_6$.

Insol. in H_2O or $K_2Pt(SCN)_6$+Aq. Sol. in cold NH_4OH+Aq and in KCNS+Aq.

Sodium ——, $Na_2Pt(SCN)_6$.

Sol. in H_2O and alcohol.

Platinosulphostannic acid.

See under **Sulphostannate, platinum.**

Platinosulphurous acid.

See **Platosulphurous acid.**

Platinum, Pt.

Not attacked by H_2O, H_2SO_4, HCl, or HNO_3+Aq. Slowly sol. in aqua regia, or a mixture of HBr and HNO_3, but much less easily than Au.

Precipitated Pt is remarkably sol. in HCl+Aq in presence of air. (Wilm, B. 1881, **14.** 636.)

Pure Pt foil is attacked by fuming HCl under influence of light, but not in the dark. (Berthelot, C. R. 1904, **138.** 1297.)

Dil. HCl+Aq dissolves 10–15% Pt from active Pt black. (Wöhler, B. 1903, **36.** 3482.)

Conc. HNO_3 oxidizes Pt black; Pt sponge, less easily; sheet Pt, slightly. (Wöhler, Dissert. **1901.**)

Pt in presence of Hg is more or less sol. in conc. HNO_3. (Tarugi, Gazz. ch. it. 1903, **33**, II. 171.)

Pt vessels are attacked by evaporating HNO_3 therein. (Jaunek and Meyer, Z. anorg. 1913, **83.** 71.)

Sl. sol. in conc. H_2SO_4 containing small amounts of nitrogen oxides. (Scheurer-Kestner, C. R. **86.** 1082.)

Pt black, pptd. by formic acid, is easily sol. in boiling H_2SO_4. (Deville and Stas, Paris, **1878.**)

Thin sheet Pt is attacked by boiling H_2SO_4 containing K_2SO_4; 1 sq. cm. loses 0.01 g. in 1 hour and velocity of the reaction is not accelerated by addition of HNO_3. Pt black is completely dissolved under the above conditions in 50 hours. (Delépine, C. R. 1905, **141.** 1013.)

Further data on solubility of Pt in H_2SO_4 are given by Delépine. (C. R. 1906, **142.** 631.)

95% H_2SO_4 dissolves 0.04 g. Pt from commercial Pt at 250–260° in 28 hours. (Conroy, J. Soc. Chem. Ind. 1903, **22.** 465.)

See also Quenessen. (Bull. Soc. 1906, (3) **35.** 620.)

0.0038 g. is dissolved by 10 cc. of boiling H_2SO_4. (McCoy, Eighth Inter. Cong. App. Chem. **1912.** 2.)

HCl+HNO_3, so long as they are sufficiently dil. or the temperature is so low that they cannot react on each other, have no action on Pt. Addition of Cl does not bring about reaction, but a few drops of KNO_2 or N_2O_3+Aq bring about an immediate reaction. (Millon.)

Slowly sol. in HI+Aq. (Deville, C. R. **42.** 896.)

Conc. H_3PO_4 attacks Pt when heated in presence of air, but not in its absence. (Hüttner, Z. anorg. 1908, **59.** 216.)

Pt dissolves easily in most acids when they contain H_2O_2. (Fairley, B. 1875, **8.** 1600.)

Slowly sol. in boiling $FeCl_3$+Aq. (Saint-Pierre, C. R. **54.** 1077.)

$FeCl_3$ in acid solution is without influence on Pt. (Marie, C. R. 1908, **146.** 476.)

Pt is completely insol. in KCN+Aq. (Rössler, Z. Chem. **1866.** **175.**)

Pt is attacked by boiling conc. KCN+Aq. (Deville and Debray, C. R. **82.** 241.)

Solubility of Pt in 10% KCN+Aq is very small at ord. temp. (1.4 mg. in 8 days) but is considerably greater in boiling conc. KCN +Aq. (71.5 mg. in 5 hours). (Glaser, Z. Elektrochem. 1903, **9.** 15.)

Pt foil is dissolved in boiling KCN+Aq (0.030 g. for 1 cc. in 1 hour). Insol. in cold KCN+Aq. (Brochet and Petit, C. R. 1904, C. R. **138.** 1255.)

Sol. in $RbCl_4I$+Aq. (Erdmann, Arch. Pharm. 1894, **232.** 30.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Platinum ammonium compounds.

Data published since the first edition of this work have not been included in this edition.

See —

Platosamine comps., $Pt<^{NH_3.R}_{NH_3.R.}$

Plato*semidi*amine comps.,
$Pt<^{NH_3.NH_3.R}_{R.}$

Plato*monodi*amine comps.,
$Pt<^{NH_3.NH_3.R}_{NH_3.R.}$

Plato*di*amine comps., $Pt<^{NH_3.NH_3.R}_{NH_3.NH_3.R.}$

Platoso*semi*amine comps., $Pt<^{NH_3.R}_{R.}$

***Di*plato*di*amine comps.,**
Pt—$NH_3.NH_3$.R
|
Pt—$NH_3.NH_3$.R

Bromoplatinamine comps.,
$Br_2Pt<^{NH_3.R}_{NH_3.R.}$

Chloroplatinamine comps.,
$Cl_2Pt<^{NH_3.R}_{NH_3.R.}$

Chloronitratoplatinamine comps., $Cl(NO_3)Pt<\begin{matrix}NH_3.R\\ NH_3.R.\end{matrix}$

Iodoplatinamine comps., $I_2Pt<\begin{matrix}NH_3.R\\ NH_3.R.\end{matrix}$

Hydroxyloplatinamine comps., $(OH)_2Pt<\begin{matrix}NH_3.R\\ NH_3.R.\end{matrix}$

Nitratoplatinamine comps., $(NO_3)_2Pt<\begin{matrix}NH_3R\\ NH_3.R.\end{matrix}$

Sulphatoplatinamine comps., $SO_4Pt<\begin{matrix}NH_3.R\\ NH_3.R.\end{matrix}$

Bromoplatin*semidi*amine comps., $Br_3PtNH_3.NH_3.R.$

Bromonitritoplatin*semidi*amine comps., $Br_2(NO_2)PtNH_3.NH_3.R.$

Chloroplatin*semidi*amine comps., $Cl_3PtNH_3.NH_3.R.$

Chlorohydroxylonitrito*semidi*amine comps., $Cl(OH)(NO_2)PtNH_3.NH_3.R.$

Chloronitritoplatin*semidi*amine comps., $Cl_2(NO_2)PtNH_3.NH_3.R.$

Iodoplatin*semidi*amine comps., $I_3PtNH_3.NH_3.R.$

Hydroxylo*semidi*amine comps., $(OH)_3PtNH_3.NH_3.R.$

Bromoplatin*monodi*amine comps., $Br_2Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.R.\end{matrix}$

Bromohydroxyloplatin*monodi*amine comps. $Br(OH)Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.R.\end{matrix}$

Chloroplatin*monodi*amine comps., $Cl_2Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.R.\end{matrix}$

Iodonitratoplatin*monodi*amine comps., $I(NO_3)Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.R.\end{matrix}$

Hydroxyloplatin*monodi*amine comps., $(OH)_2Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.R.\end{matrix}$

Bromoplatin*di*amine comps., $Br_2Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.NH_3.R.\end{matrix}$

Bromocarbonatoplatin*di*amine comps., $\begin{matrix}CO_3\\ Br_2\end{matrix}>[Pt(NH_3)R]_2.$

Bromochloroplatin*di*amine comps., $BrClPt(NH_3)_4R_2.$

Bromohydroxyloplatin*di*amine comps., $Br(OH)Pt(NH_3)_4R_2.$

Bromonitratoplatin*di*amine comps., $Br(NO_3)Pt(NH_3)_4R_2.$

Bromosulphatoplatin*di*amine comps., $Br_2(SO_4)[Pt(NH_3)_4R_2]_2.$

Carbonatochloroplatin*di*amine comps., $(CO_3)Cl_2[Pt(NH_3)_4R_2]_2.$

Carbonatonitratoplatin*di*amine comps., $(CO_3)(NO_3)_2[Pt(NH_3)_4R_2]_2.$

Chloroplatin*di*amine comps., $Cl_2Pt(NH_3)_4R_2.$

Chlorohydroxyloplatin*di*amine comps., $Cl(OH)(NH_3)_4R_2.$

Chloroiodoplatin*di*amine comps., $ClIPt(NH_3)_4R_2.$

Chloronitratoplatin*di*amine comps., $Cl(NO_3)Pt(NH_3)_4R_2.$

Hydroxyloplatin*di*amine comps., $(OH)_2Pt(NH_3)_4R_2.$

Hydroxylonitrato*di*amine comps., $(OH)(NO_3)Pt(NH_3)_4R_2.$

Hydroxylosulphato*di*amine comps., $(OH)_2SO_4[Pt(NH_3)_4R_2]_2.$

Iodoplatin*di*amine comps., $I_2Pt(NH_3)_4R_2.$

Iodonitritoplatin*di*amine comps., $I(NO_2)Pt(NH_3)_4R_2.$

Nitratoplatin*di*amine comps., $(NO_3)_2Pt(NH_3)_4R_2.$

Nitritoplatin*di*amine comps., $(NO_2)_2Pt(NH_3)_4R_2.$

Sulphatoplatin*di*amine comps., $(SO_4)Pt(NH_3)_4R_2.$

Iodo*di*platinamine comps.,

$$\begin{matrix}I—Pt<\begin{matrix}NH_3.R\\ NH_3.R\end{matrix}\\ |\\ I—Pt<\begin{matrix}NH_3.R\\ NH_3.R.\end{matrix}\end{matrix}$$

Bromo*di*platin*di*amine comps.,

$$\begin{matrix}Br—Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.NH_3.R\end{matrix}\\ |\\ Br—Pt<\begin{matrix}NH_3.NH_3.R\\ NH_3.NH_3.R.\end{matrix}\end{matrix}$$

Hydroxylo*di*platin*di*amine comps., $(OH)_2Pt_2(NH_3)_8R_4.$

Iodo*di*platin*di*amine comps., $I_2Pt_2(NH_3)_8R_4.$

Nitrato*di*platin*di*amine comps., $(NO_3)_2Pt_2(NH_3)_8R_4.$

Platin*tri*amine comps., $R_2Pt<\begin{matrix}NH_3.NH_3.NH_3.R\\ NH_3.NH_3.NH_3.R.\end{matrix}$

*Tetra*platinamine comps., $Pt_4(NH_3)_8R_{10}$.

*Octo*platinamine comps., $Pt_8(NH_3)_{16}R_{18}$.

Platinum antimonide, $PtSb_2$.

(Christofle, **1863.**)

Platinum arsenide, Pt_3As_2.

(Tivoli, Gazz. ch. it. **14.** 487.)

$PtAs_2$. Min. *Sperrylite.* Sl. attacked by aqua regia. (Wells, Sill. Am. J. (3) **37.** 67.)

Platinum arsenic hydroxide (?), $PtAsOH$.

Insol. in, and slowly decomp. by H_2O and alcohol. Easily decomp. by HCl+Aq; not attacked by HNO_3+Aq. Sol. in aqua regia; not attacked by cold conc. H_2SO_4, but decomp. on heating. (Tivoli, Gazz. ch. it. **14.** 487.)

Platinum potassium azoimide.

Ppt. Explodes violently even in aq. solution. (Curtius, J. pr. 1898, (2) **58.** 304.)

Platinum boride, Pt_2B_2.

Very slowly sol. in aqua regia. (Martius, A. **109.** 79.)

Platinous bromide, $PtBr_2$.

Insol. in H_2O. Sol. in HBr+Aq. Sl sol. in KBr+Aq. (Topsoë, J. B. **1868.** 274.)

Platinic bromide, $PtBr_4$.

Not deliquescent; sol. in H_2O. (Meyer and Züblin, B. **13.** 404.)

Sl. sol. in H_2O. 100 g. $PtBr_4$+Aq sat at 20° contain 0.41 g. $PtBr_4$. (Halberstadt, B. **17.** 2962.)

Easily sol. in HBr+Aq; sl. sol. in $HC_2H_3O_2$+Aq. Sol. in considerable amount in K or NH_4 oxalate+Aq.

Very sl. sol. in alcohol or ether, also in glycerine. (Halberstadt.)

Platinic hydrogen bromide.

See **Bromoplatinic acid.**

Platinous bromide carbonyl.

See **Carbonyl platinous bromide.**

Platinic bromide *with* **MBr.**

See **Bromoplatinate, M.**

Platinum carbide, PtC_2.

Hot aqua regia dissolves out nearly all the Pt. (Zeise, J. pr. **20.** 209.)

Platinum carbon ***di*****sulphide,** $PtCS_2$.

See **Platinum sulphocarbide.**

Platinum ***mono*****chloride,** $PtCl+xH_2O$.

Easily sol. in HCl; mod. sol. in hot dil. H_2SO_4 without decomp. (Sonstadt, Proc. Chem. Soc. 1898, **14.** 179.)

Platinous chloride, $PtCl_2$.

Insol. in H_2O, conc. H_2SO_4, or HNO_3. Sol. in hot HCl+Aq with exclusion of air. (Berzelius.)

Insol. in alcohol or ether; sol. in NH_4OH+Aq. (Raewsky, A. ch. (3) **22.** 280.) Sol. in aqua regia with formation of $PtCl_4$.

Insol. in cold conc. KI+Aq, but sol. when heated. (Lassaigne, A. ch. (2) **51.** 117.)

Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Insol. in acetone. (Fidmann, C. C. **1899,** II. 1014.)

Platinum ***tri*****chloride,** $PtCl_3$.

Sl. sol. in cold, more sol. in hot H_2O.

Partially hydrolyzed by boiling with H_2O. Insol. in cold conc. HCl. Sol. in hot conc. HCl with decomp.

Sol. in KI+Aq. (Wöhler, B. 1909, **42.** 3961.)

Platinic chloride, $PtCl_4$.

Not deliquescent. Very sol. in H_2O. (Pullinger, Chem. Soc. **61.** 420.)

Sp. gr. of aqueous solution containing:

5	10	15	20	25	% $PtCl_4$,
1.046	1.097	1.153	1.214	1.285	
30	35	40	45	50	% $PtCl_4$.
1.362	1.450	1.546	1.666	1.785	

(Precht, Z. anal. **18.** 512.)

Insol. in conc. H_2SO_4. (Dumas.)

Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Sol. in alcohol and ether; sol. in anhydrous acetone. (Zeise, A. **33.** 34.)

Insol. in ether. (Willstätter, B. 1903, **36.** 1830.)

Sl. sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in acetone. (Eidmann, C. C. **1899,** II 1014; Naumann, B. 1904, **37.** 4328.)

$+H_2O$. Sol. in H_2O. (Gutbier and Heinrich, Z. anorg. 1913, **81.** 378.)

$+4H_2O$. Sol. in H_2O. (Pigeon, C. R. 1891, **112.** 792.)

$+5H_2O$. Not deliquescent. Sol. in H_2O or HCl+Aq.

Composition is probably $H_2PtCl_4O+4H_2O$. (Norton, J. pr. **110.** 469.)

$+7H_2O$. Sol. in H_2O. (Pigeon.)

$+8H_2O$. (Blondel, A. Ch. 1905, (8) **6.** 98.)

Platinic thallium chloride, $Tl_3Pt_2Cl_8H_5O_4$.

Ppt.; insol. in H_2O. (Miolati, Z. anorg. 1900, **22.** 460.)

Platinous hydrogen chloride.

See **Chloroplatinous acid.**

Platinic hydrogen chloride.

See **Chloroplatinic acid.**

Platinous chloride *with* **MCl.**

See **Chloroplatinite, M.**

Platinic chloride *with* **MCl.**

See **Chloroplatinate, M.**

Platinous phosphorus chloride.

See **Phosphorus platinous chloride.**

Platinic phosphorus chloride.

See **Phosphorus platinic chloride.**

Platinous chloride carbonyl.

See **Carbonyl platinous chloride.**

Platinum chloride hydroxylamine, $Pt(NH_2OH)_2Cl_2$.

Ppt. Sol. in alcohol and in ether. Decomp. in aq. solution.

$Pt(NH_2OH)_4Cl_2$. Sol. in H_2O. (Uhlenhuth, A. 1900, **311.** 124.)

Platinous chloride sulphocarbamide, $PtCl_2, 4CS(NH_2)_2$.

Sl. sol. in H_2O; very sol. in hot H_2O; decomp. sl. on boiling. (Kurnakow, J. pr. 1894, (2) **50.** 483.)

Platinum chloroiodide, $PtCl_2I_2$.

Very deliquescent. (Kämmerer, A. **148.** 329.)

$PtClI_3$. Insol. in H_2O. Sl. sol. in alcohol. Sol. in KOH+Aq, from which it is pptd. by H_2SO_4. (Mather, Sill. Am. J. **27.** 257.)

Platinum chloronitride, PtNCl.

(Alexander, C. C. **1887.** 1254.)

Platinous cyanide *with* **MCN.**

See **Platinocyanide, M.**

Platinous fluoride, PtF_2(?).

Insol. in H_2O. (Moissan, A. ch. (6) **24.** 287.)

Platinic fluoride, PtF_4.

Deliquescent. Sol. in H_2O with immediate decomp. into PtO_4H_4 and HF. (Moissan, C. R. **109.** 807.)

Platinous hydroxide, PtO_2H_2.

Sol. in HCl, HBr, and H_2SO_3+Aq, but not in other oxygen acids. Decomp. by boiling KOH+Aq. (Thomsen, J. pr. (2) **16.** 344.)

When freshly pptd, is insol. in dil. HNO_3 and H_2SO_4, and in $HC_2H_3O_2$; sol. in conc. HNO_3 and H_2SO_4. Very sol. in H_2SO_3 and HCl. After drying, is insol. in conc. HNO_3 and H_2SO_4. (Wöhler, Z. anorg. 1904, **40.** 424.)

Platinic hydroxide, $Pt(OH)_4$.

Easily sol. in dil. acids and in NaOH+Aq. (Topsoë, J. B. **1870.** 386.)

Nearly insol. in acetic acid. (Döbereiner.)

Insol. in all acids except conc. HCl and aqua regia. (Wöhler, Z. anorg. 1904, **40.** 438.)

$+H_2O$. Ppt. (Prost, Bull. Soc. (2) **44.** 256.)

Insol. in 2N–H_2SO_4 and dil. HNO_3+Aq; mod. sol. in conc. HNO_3, H_2SO_4, 2N–HCl and NaOH+Aq. (Wöhler.)

$+2H_2O$. Easily sol. in dil. acids, even acetic acid, and in NaOH+Aq. (Topsoë.)

Insol. in acetic acid; sl. sol. in 2N–H_2SO_4 and HNO_3; easily sol. in HCl, and NaOH+Aq. (Wöhler.)

Platinoplatinic hydroxide, $Pt_3O_4, 9H_2O$.

Ppt. (Prost, Bull. Soc. (2) **46.** 156.)

$Pt_5O_{11}, 11H_2O$. Ppt. (Prost.)

Platinum hydroxylamine comps.

See—

Plato*di*oxamine comps., $Pt(NH_3O)_4R_2$.
Platosoxamine comps., $Pt(NH_3O)_2R_2$.
Platosoxamine-amine comps., $Pt(NH_3O)_3NH_3R_2$.

Platinous iodide, PtI_2.

Insol. in H_2O, acids, or alcohol. (Lassaigne, A. ch. (2) **51.** 113.)

Difficultly sol. in Na_2SO_3+Aq. (Topsoë.)

Gradually decomp. by hot HI+Aq of 1.038 sp. gr., also by hot KI+Aq, PtI_4 being dissolved out and Pt left behind. Not attacked by conc. H_2SO_4, HCl, or HNO_3+Aq, but gradually decomp. by KOH or NaOH+Aq. (Lassaigne.)

Insol. in acetone. (Eidmann, C. C. **1889,** II. 1014.)

Platinic iodide, PtI_4.

Insol. in H_2O. Sol. in NaOH or Na_2CO_3+Aq, H_2SO_3, or Na_2SO_3+Aq. Sol. in HI+Aq or alkali iodides+Aq. Sol. in alcohol, with partial decomp. Not attacked by acids. (Lassaigne, A. ch. (2) **51.** 122.)

Very sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Sol. in alcohol. (Belluci, C. C. **1902, I.** 625.)

Platinic iodide *with* **MI.**

See **Iodoplatinate, M.**

Platinum nitride chloride, PtNCl.

See **Platinum chloronitride.**

Platinous oxide, PtO.

Sol. in H_2SO_3+Aq. Insol. in other acids. (Döbereiner, Pogg. **28.** 183.)

Sol. in conc. H_2SO_4; easily in conc. HCl+Aq. (Storer's Dict.)

Very sl. sol. in HCl+Aq. Sl. sol. in aqua regia. (Wöhler, B. 1903, **36.** 3482.)

Platinic oxide, PtO_2.

Insol. in acids, even aqua regia. (Wöhler, Dissert, **1901.**)

Platinum *tri*oxide, PtO_3

Unattacked by dil. H_2SO_4, HNO_3 or acetic acid. Sol. with decomp. in dil. and conc. HCl, conc. H_2SO_4 or conc. HNO_3. (Wöhler, B. 1909, **42.** 3329.)

Platinum *sesqui*oxide, $Pt_2O_3+xH_2O$.

Insol. in dil. sol. in conc. H_2SO_4. Sl. sol. in hot dil. HNO_3. Sol. in HCl. Sol. in conc. alkali hydroxides+Aq. (Wöhler, B. 1909, **42.** 3964.)

$+2H_2O$. Insol. in HNO_3 and H_2SO_4. Insol. in alkalies +Aq, also cold dil. HCl+Aq. Sol. in aqua regia. (Dudley, Am. Ch. J. 1902, **28.** 66.)

$+5H_2O$. (Delépine, Bull. Soc. 1910, (4) **7.** 103.)

Platinoplatinic oxide, Pt_3O_4.

Not attacked by long boiling with HCl, HNO_3, or aqua regia. (Jörgensen, J. pr. (2) **16.** 344.)

Does not exist. (Wöhler, Z. anorg. 1904, **40.** 450.)

Platinum oxychloride, $3PtO, PtCl_2$ (?).

Sol. in HCl, and in KOH+Aq. (Kane, Phil. Trans. **1842.** 298.)

$PtCl_2(OH)_2 = H_2PtCl_2O_2$. (Jörgensen, J. pr. (2) **16.** 345.)

$5PtO_2, 2HCl+9H_2O$. Insol. in cold H_2O; decomp. on boiling. Slowly sol. in HCl. (Blondel, A. ch, 1905, (8) **6.** 100.)

Platinum oxysulphide, PtOS.

See **Platinum sulphydroxide.**

Platinum phosphide, PtP_2.

Insol. in HCl+Aq. Sol. in aqua regia. (Schrötter, W. A. B. **1849.** 303.)

PtP_2H_2. Insol. in H_2O, and HCl+Aq. (Cavazzi, Gazz. ch. it. **13.** 324.)

PtP. Insol. in aqua regia. (Clark and Joslin.)

Pt_2P. Sol. in aqua regia. (Clark and Joslin.)

Pt_3P_5. Partially sol. in aqua regia. (Clark and Joslin, C. N **48.** 385.)

Attacked very slowly by aqua regia. Rapidly sol. in molten alkalies. (Granger, C. N. 1898, **77.** 229.)

Completely sol. in aqua regia if the action sufficiently prolonged, though with difficulty. (Granger, C. R. 1896, **123.** 1285.)

Platinum ***di*****selenide,** $PtSe_2$.

As PtS_2. (Minozzi, Chem. Soc. 1909, **96.** (2) 899.)

Platinum ***tri*****selenide,** $PtSe_3$.

Sl. attacked by hot conc. HNO_3; not attacked by cold conc. HCl+Aq; slowly sol. in aqua regia and Cl_2+Aq; insol. in CS_2.

Platinum silicide, Pt_2Si.

Sol. in hot aqua regia. (Vigouroux, C. R. 1896, **123.** 117.)

Pt_3Si_2. (Colson, C. R. **94.** 27.)

Pt_4Si_3. Slowly decomp. by aqua regia. (Guyard, Bull. Soc. (2) **25.** 511.)

PtSi. Insol. in HNO_3, H_2SO_4, HF, and HCl. Completely sol. in aqua regia. (Lebeau and Novitzky, C. R. 1907, **145.** 241.)

Platinum sulphydroxide, $PtOS+H_2O = PtS(OH)_2$.

Decomp. easily into—

$Pt_2S_2O_3H_2 = \frac{PtS}{PtS} O \frac{OH}{OH} = PtOS + \frac{1}{2}H_2O$. H_2O cannot be removed without decomposing the compound. (v. Meyer, J. pr. (2) **15.** 1.)

Platinous sulphide, PtS.

Not attacked by boiling acids, aqua regia, or KOH+Aq. (Böttger, J. pr. **2.** 274.)

Sol. in large excess of $(NH_4)_2S$+Aq.

Platinoplatinic sulphide, Pt_2S_3.

Not attacked by HCl or HNO_3+Aq, and only slowly by aqua regia. (Schneider, Pogg. **138.** 607.)

Platinic sulphide, PtS_2.

Anhydrous. Aqua regia attacks sl., other acids not at all. (Davy.)

Hydrated Insol. in HCl+Aq; sl. sol. in boiling HNO_3+Aq. Sol in aqua regia. (Fresenius.) Sol. in alkali sulphides, hydrates and carbonates+Aq. (Berzelius.) Very sl. sol. in $(NH_4)_2S$+Aq. (Claus.)

Insol. in NH_4Cl, or NH_4NO_3+Aq.

1 pt. $PtCl_4$ in 100 pts. H_2O+25 pts. HCl is not pptd. by H_2S. (Reinsch.)

Difficultly sol. in alkali sulphydroxides+Aq, but more easily in presence of SnS, Sb_2S_3, As_2S_3, or SnS_2. (Ribau, C. R. **85.** 283.)

Platinum sulphide, Pt_5S_6, or *Tetra***platinum sulphoplatinate,** $4PtS, PtS_2$.

Decomp. on moist air, but not attacked by acids. (Schneider, J. pr. (2) **7.** 214.)

Platinum sulphides ***with*** M_2S.

See **Sulphoplatinate, M.**

Platinum sulphocarbide, PtC_2S_2.

Not attacked by hot HCl, HNO_3+Aq, slightly by aqua regia. (Schützenberger, C. R. **111.** 391.)

Platinum telluride, PtTe.

Decomp. by fused oxidizing agents; slowly sol. in conc. HNO_3. (Roessler, Z. anorg. 1897, **15.** 407.)

Platinum ***di*****telluride,** $PtTe_2$.

Insol. in boiling conc. KOH+Aq; slowly sol. in boiling conc. HNO_3; decomp. by fused oxidizing agents. (Roessler.)

Plato-.

See also **Platino-.**

Platoamidosulphonic acid.

Potassium platoamidosulphonate, $K_2Pt(NH_2SO_3)_4+2H_2O$.

Very sl. sol. in cold H_2O; sol. in 10 pts. boiling H_2O. (Ramberg and St. Kahlenberg, B. 1912, **45.** 1514.)

Sodium ——, $Na_2(Pt(NH_2SO_3)_4+4H_2O$.

Very sol. in H_2O. (Ramberg and St. Kahlenberg.)

Plato*di*amine bromide, $Pt[(NH_3)_2Br]_2+3H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **carbonate,** $Pt(N_2H_6)_2CO_3+H_2O$.

Sol. in H_2O. (Peyrone, A. **51.** 14.)

$Pt(N_2H_6CO_3H)_2$. Sl. sol. in, but decomp. by boiling with H_2O into—

—— *sesqui***carbonate.**

More sol. than preceding salt. (Reiset, C. R. **11.** 711.)

—— **chloride,** $Pt[(NH_3)_2Cl]_2+H_2O$.

"Reiset's first chloride." Sol. in 4 pts. H_2O at 16.5°, and in less hot H_2O. Insol. in alcohol or ether. (Reiset, A. ch. (3) **11.** 419.)

As sol. in NH_4Cl+Aq as in H_2O; insol. in absolute alcohol; sl. sol. in dil. alcohol; very sol. in dil. HCl+Aq. (Peyrone, A. ch. (3) **12.** 196.)

—— **cuprous chloride,** $Pt(NH_3)_4Cl_2$, Cu_2Cl_2.

Sol. in H_2O, and pptd. from H_2O solution by alcohol. (Buckton.)

—— **cupric chloride,** $Pt(NH_3)_4Cl_2$, $CuCl_2$.

Sl. sol. in cold, decomp. by hot H_2O into $Pt(NH_3)_4Cl_2$, Cu_2Cl_2. (Buckton, Chem. Soc. **5.** 218.)

Nearly insol. in H_2O; easily sol. in warm HCl+Aq; insol. in alcohol. (Millon and Commaille, C. R. **57.** 822.)

Millon and Commaille's salt is $Cu(NH_3)_4Cl_2$, $PtCl_2$, cuprammonium chloroplatinite.

—— **lead chloride,** $Pt(NH_3)_4Cl_2$, $PbCl_2$.

Sol. in hot, much less in cold H_2O. Insol. in HCl+Aq or alcohol. (Buckton, Chem. Soc. **5.** 213.)

—— **mercuric chloride,** $Pt(NH_3)_4Cl_2$, $HgCl_2$.

Easily sol. in hot H_2O, much less in cold. Insol. in HCl+Aq. (Buckton.)

—— **zinc chloride,** $Pt(NH_3)_4Cl_2$, $ZnCl_2$.

Easily sol. in hot H_2O. Insol. in alcohol. (Buckton.)

Plato*di*amine chloroplatinate, $Pt(NH_3)_4Cl_2$, $PtCl_4$.

Ppt. Insol. in H_2O. (Cossa, Gazz. ch. it. **17.** 1.)

—— **chloroplatinite,** $Pt(NH_3)_4Cl_2$, $PtCl_2$.

(Magnus' green salt.) Insol. in, and not decomp. by H_2O, HCl+Aq, or alcohol. (Magnus.)

Slowly sol. in boiling NH_4OH+Aq and in conc. NH_4 salts+Aq. (Reiset, A. ch. (3) **11.** 427.)

Almost as sol. in $(NH_4)_2CO_3+Aq$ as in NH_4OH+Aq. Sol. in hot $PtCl_4+Aq$. (Reiset.)

Not decomp. by boiling KOH, dil. HCl, or H_2SO_4+Aq, but easily by HNO_3+Aq. (Gros, A. **27.** 245.)

—— **chromate,** $Pt(NH_3)_4CrO_4$.

Scarcely sol. in H_2O. (Cleve.)

—— *di***chromate,** $Pt(NH_3)_4Cr_2O_7$.

Sl. sol. in H_2O. Insol. in alcohol. Sol. in KOH+Aq. (Buckton, Chem. Soc. **5.** 213.)

—— **platinous cyanide,** $Pt(NH_3)_4(CN)_2$, $Pt(CN)_2$.

Sl. sol. in cold, easily in boiling H_2O; sol. in KOH, HCl, and dil. H_2SO_4+Aq without decomp., but conc. H_2SO_4 decomposes.

—— **potassium ferrocyanide,** $Pt(NH_3)_4K_2[Fe(CN)_6]_2+3H_2O$.

—— **hydroxide,** $Pt[(NH_3)_2OH]_2$.

"Reiset's first base." Easily sol. in H_2O. Sl. sol. in alcohol.

—— **iodide,** $Pt[(NH_3)_2I_2]$.

Sl. sol. in cold, more easily in hot H_2O, but slowly decomp. on boiling. (Reiset.)

—— **nitrate,** $Pt[(NH_3)_2NO_3]_2$.

Sol. in about 10 pts. boiling H_2O. Insol. or but sl. sol. in alcohol. (Peyrone, A. ch. (3) **12.** 203.)

—— **nitrate sulphate,** $[Pt(NH_3)_4NO_3]_2SO_4$, $Pt(NH_3)_4SO_4$.

Very easily sol. in H_2O. (Carlgren, Sv. V. A. F. **47.** 310.)

—— **nitrite,** $Pt[(NH_3)_2NO_2]_2+2H_2O$.

Efflorescent. Very sol. in hot or cold H_2O. Insol. in 90% alcohol. (Lang.)

—— **platinous nitrite,** $Pt[(NH_3)_2NO_2]_2$, $Pt(NO_2)_2$.

Scarcely sol. in cold, somewhat more easily in hot H_2O. Not attacked by cold dil. acids. More sol. in NH_4OH+Aq than in H_2O. (Lang.)

Platodiamine phosphate, $Pt(N_2H_6)_2HPO_4 + H_2O$.

Rather difficultly sol. in cold, and very easily in hot H_2O. (Cleve.)

—— **ammonium phosphate,** $Pt[(N_2H_6)PO_4(NH_4)_2]_2$, $4NH_4H_2PO_4 + H_2O$.

Very easily sol. in H_2O with decomp. into—
$Pt(N_2H_6H_2PO_4)_2$, $2NH_4H_2PO_4 + 9H_2O$
Much more sol. in H_2O than the preceding comp. (Cleve.)

—— **sulphate,** $Pt(NH_3)_4SO_4$.

Sol. in 32 pts. H_2O at 16.5°; more easily when heated. (Reiset.)
Sol. in 50–60 pts. boiling H_2O; less in cold H_2O; insol. in alcohol. (Cleve.)

—— **sulphate, acid,** $Pt[(NH_3)_2SO_4H]_2 + H_2O$.

Decomp. by H_2O or alcohol into neutral salt.
$3Pt(NH_3)_4SO_4$, $H_2SO_4 + H_2O$. Sol. in H_2O. (Cleve.)

—— **sulphite,** $Pt(NH_3)_4SO_3$.

Nearly insol. in cold H_2O. (Birnbaum, A. **152.** 143.)
$Pt[(NH_3)_2SO_3H]_2 + 2H_2O$. Ppt. Sol. in $HCl + Aq$. (Cleve.)

—— **platinous sulphite,** $3Pt(NH_3)_4SO_3$, $PtSO_3 + 2H_2O$.

Scarcely sol. in cold H_2O; sol. in 190 pts. H_2O at 100°. Easily sol. in warm $HCl + Aq$ with decomp. (Peyrone.)
$+4H_2O$. (Carlgren, Sv. V. A. F. **47.** 308.)
$2Pt(NH_3)_4SO_3$, $PtSO_3$, H_2SO_3. Insol. in cold H_2O or alcohol. Scarcely sol. in hot H_2O. (Peyrone.)

—— **sulphocyanide,** $Pt(NH_3)_4(CNS)_2 + H_2O$.

Very sol. in H_2O. Solution is decomp. on boiling. (Cleve, Sv. V. A. H. **10, 9.** 7.)

—— **platinous sulphocyanide,** $Pt(NH_3)_4(CNS)_2$, $Pt(CNS)_2$.

Insol. in H_2O and alcohol; sol. in dil. $HCl + Aq$. (Buckton, Chem. Soc. **13.** 122.)

Platomonodiamine chloride, $Pt{(NH_3)_2Cl \atop NH_3Cl}$.

Easily sol. in H_2O. (Cleve.)

Platomonodiamine chloroplatinite

$2Pt{(NH_3)_2Cl \atop NH_3Cl}$, $PtCl_2$.

Moderately sol. in cold, but more easily in hot H_2O. (Cleve.)

—— **nitrate,** $Pt{(NH_3)_2NO_3 \atop NH_3NO_3} + H_2O$.

Easily sol. in H_2O. (Cleve.)

Platomonodiamine sulphate, $Pt{(NH_3)_2 \atop NH_3}SO_4$.

Easily sol. in cold, but much more in hot H_2O.

Platosemidiamine bromide, $Pt < {(NH_3)_2Br \atop Br}$.

Sol. in H_2O. Easily sol. in $NH_4OH + Aq$. (Cleve.)

—— **chloride,** $Pt < {(NH_3)_2Cl \atop Cl}$

(Peyrone's chloride.) Sol. in 387 pts. H_2O at 0°, and 26 pts. at 100° (Cleve); in 33 pts. at 100°. (Peyrone.)
Sol. in $NH_4OH + Aq$; very sl. sol. in HCl or $H_2SO_4 + Aq$; more easily in $HNO_3 + Aq$; sol. in alkali carbonates + Aq. (Peyrone, A. ch. (3) **12.** 193.)

Platosemidiamine chlorosulphurous acid, $Pt < {(NH_3)_2SO_3H \atop Cl}$.

Easily sol. in H_2O. (Cleve.)

Ammonium platosemidiamine chlorosulphite platosemidiamine sulphite,

$Pt < {(NH_3)_2SO_3NH_4 \atop Cl}$, $Pt < {(NH_3)_2SO_3NH_4 \atop SO_3NH_4} + 2H_2O$.
Easily sol. in H_2O. Insol. in alcohol. (Cleve.)

Platosemidiamine cyanide, $Pt(CN)(NH_3)_2CN$.

Easily sol. in H_2O. (Cleve.)

—— **platinous cyanide,** $Pt(CN)(NH_3)_2CN$, $Pt(CN)_2(?)$.

Ppt.

—— **hydroxide,** $Pt < {(NH_3)_2OH \atop OH}$.

Not known.

—— **iodide,** $Pt < {(NH_3)_2I \atop I}$.

Sl. sol. in boiling H_2O. (Cleve.)

—— **nitrate** $Pt{(NH_3)_2NO_3 \atop NO_3}$.

Moderately sol. in H_2O. (Cleve.)

—— **nitrite,** $Pt{(NH_3)_2NO_2 \atop NO_2}$

Very sl. sol. in cold, more easily in hot H_2O.

—— **oxalate,** $Pt(NH_3)_2C_2O_4$.

(Cleve.)
$+2H_2O$. (Cleve.)

—— **sulphate,** $Pt < \frac{(NH_3)_2}{} > SO_4$.

Very sl. sol. even in hot H_2O. (Cleve.)

Plato*semidi*amine sulphocyanide, $Pt(SCN)(NH_3)_2SCN$.
Easily sol. in warm H_2O, but solution soon decomposes.

Plato*semidi*amine sulphurous acid.

Ammonium plato*semidi*amine sulphite, $Pt<\genfrac{}{}{0pt}{}{(NH_3)_2SO_3(NH_4)}{SO_3(NH_4)}$, $(NH_4)_2SO_3$.
Very sol. in H_2O. (Cleve.)

Barium ——, $Pt(SO_3)[(NH_3)_2SO_3]Ba, BaSO_3$.
Ppt. (Cleve.)

Silver ——. $Pt(SO_3Ag)[(NH_3)_2SO_3Ag], Ag_2SO_3$.
Ppt. (Cleve.)

*Di*plato*di*amine chloride, $Pt_2(NH_3)_4Cl_2$.
Insol. in H_2O.

—— hydroxide, $Pt_2(NH_3)_4(OH)_2+H_2O$.
Insol. in H_2O.

—— nitrate, $Pt_2(NH_3)_4(NO_3)_2$.
Insol. in H_2O. (Cleve.)

—— sulphate, $Pt_2(NH_3)_4SO_4$.
Insol. in H_2O. (Cleve.)

Platobromonitrous acid.

Potassium platobromonitrite, $K_2Pt(NO_2)_3Br+2H_2O$.
Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes, A. ch. (6) **29.** 194.)
$K_2Pt(NO_2)_2Br_2+H_2O$. Sol. in 1 pt. cold, and still less hot H_2O. Insol. in alcohol. (Vèzes.)

Platochloronitrous acid.

Potassium chloronitrite, $K_2Pt(NO_2)_3Cl+2H_2O$.
Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes, A. ch. (6) **29.** 178.)
$K_2Pt(NO_2)_2Cl_2$. Sol. in about 3 pts. cold, and 2 pts. boiling H_2O. (Vèzes.)

Platochlorosulphurous acid.
See **Chloroplatosulphurous acid.**

Platoiodonitrous acid, $H_2Pt(NO_2)_2I_2$.
Known only in solution. (Nilson, J. pr. (2) **21.** 172.)

Aluminum platoiodonitrite, $Al_2[Pt(NO_2)_2I_2]_3+27H_2O$.
Easily sol. in H_2O. (Nilson.)

Ammonium ——, $(NH_4)_2Pt(NO_2)_2I_2+2H_2O$.
Sol. in H_2O; decomp. on heating.

Barium platoiodonitrite, $BaPt(NO_2)_2I_2+4H_2O$.
Very sol. in H_2O.

Cadmium ——, $CdPt(NO_2)_2I_2+2H_2O$.
Easily sol. in H_2O.

Cæsium ——, $Cs_2Pt(NO_2)_2I_2+2H_2O$.
Easily sol. in H_2O.

Calcium ——, $CaPt(NO_2)_2I_2+6H_2O$.
Very easily sol. in H_2O.

Cerium ——, $Ce_2[Pt(NO_2)_2I_2]_3+18H_2O$.
Easily sol. in H_2O.

Cobalt ——, $CoPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Didymium ——, $Di_2[Pt(NO_2)_2I_2]_3+24H_2O$.
Sol. in H_2O.

Erbium ——, $Er_2[Pt(NO_2)_2I_2]_3+18\ H_2O$.
Sol. in H_2O.

Ferrous ——, $FePt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Ferric ——, $Fe_2[Pt(NO_2)_2I_2]_3+6H_2O$.
Sol. in H_2O.

Lanthanum ——, $La_2[Pt(NO_2)_2I_2]_3+24H_2O$.
Sol. in H_2O.

Lead ——, basic, $PbPt(NO_2)_2I_2, Pb(OH)_2$.
Insol. in H_2O.

Lithium ——, $Li_2Pt(NO_2)_2I_2+6H_2O$.
Very sol. in H_2O.

Magnesium ——, $MgPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Manganese ——, $MnPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Mercurous ——, basic, $2Hg_2Pt(NO_2)_2I_2, Hg_2O+9H_2O$.
Insol. in H_2O.

Nickel ——, $NiPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Potassium ——, $K_2Pt(NO_2)_2I_2+2H_2O$.
Sol. in H_2O in all proportions.
Very sol. in alcohol.

Rubidium ——, $Rb_2Pt(NO_2)_2I_2+2H_2O$.
Sol. in H_2O.

Silver platoiodonitrite, $Ag_2Pt(NO_2)_2I_2$.
Insol. in H_2O.

Sodium ——, $Na_2Pt(NO_2)_2I_2+4H_2O$.
Very sol. in H_2O.

Strontium ——, $SrPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

Thallium ——, $Tl_2Pt(NO_2)_2I_2$.
Insol. in H_2O.

Yttrium ——, $Y_2[Pt(NO_2)_2I_2]_3+27H_2O$.
Sol. in H_2O.

Zinc ——, $ZnPt(NO_2)_2I_2+8H_2O$.
Sol. in H_2O.

***Tri*platoocto*nitrosylic acid,** $H_4Pt_3O(NO_2)_8$
(Nilson, J. pr. (2) **16.** 241.)

Potassium *tri*platoocto*nitrosylate.
See under **Platonitrite, potassium.**

Platonitrous acid, $H_2Pt(NO_2)_4$.
Sol. in H_2O or alcohol. (Lang. J. pr. **83.** 419.)
Is called "Plato*tetra*nitrosylic acid" by Nilson.

Aluminum platonitrite, $Al_2[Pt(NO_2)_4]_3+14H_2O$.
Sol. in H_2O.
$Al_2(OH)_2[Pt(NO_2)_2]_4O_2+10H_2O$. Sl. sol. in cold, easily in hot H_2O and alcohol. (Nilson, B. **9.** 1727.)

Ammonium platonitrite, $(NH_4)_2Pt(NO_2)_4+2H_2O$.
Moderately sol. in cold H_2O. (Nilson, B. **9.** 1724.)

Barium platonitrite, $BaPt(NO_2)_4+3H_2O$.
Sl. sol. in cold, very sol. in hot H_2O. (Lang.)

Cadmium platonitrite, $CdPt(NO_2)_4+3H_2O$.
Easily sol. in H_2O. (Nilson.)

Cæsium platonitrite, $Cs_2Pt(NO_2)_4$.
Resembles K salt.

Calcium platonitrite, $CaPt(NO_2)_4+5H_2O$.
Very sol. in H_2O. (Nilson.)

Cerium platonitrite, $Ce_2[Pt(NO_2)_4]_3+18H_2O$.
Sol. in H_2O. (Nilson.)

Chromium *di*platonitrite,
$Cr_2(OH)_2[Pt(NO_2)_2]_4O_2+24H_2O$.
Sol. in H_2O. (Nilson.)

Cobalt platonitrite, $CoPt(NO_2)_4+8H_2O$.
Easily sol. in H_2O (Nilson.)

Copper platonitrite, $CuPt(NO_2)_4+3H_2O$.
Sol. in H_2O. (Nilson.)
$3CuPt(NO_2)_4$, $CuO+18H_2O$. Decomp. by H_2O. (Nilson.)

Didymium platonitrite, $Di_2[Pt(NO_2)_4]_3+18H_2O$.
Deliquescent; sol. in H_2O.

Erbium platonitrite, $Er_2[Pt(NO_2)_4]_3+9$, and $21H_2O$
Deliquescent; sol. in H_2O.

Glucinum *di*platonitrite, $Gl[Pt(NO_2)_2]_2O+9H_2O$.
Sl. sol. in cold H_2O.

Indium *di*platonitrite, $In(OH)_2[Pt(NO_2)_2]_4O_2+10H_2O$.
Sl. sol. in H_2O.

Ferric *di*platonitrite, $Fe_2[Pt(NO_2)_2]_6O_3+30H_2O$.
Sl. sol. in cold, easily in hot H_2O.

Lanthanum platonitrite, $La_2[Pt(NO_2)_4]_3+18H_2O$.
Deliquescent; sol. in H_2O.

Lead platonitrite, $PbPt(NO_2)_4+3H_2O$.
Sl. sol. in H_2O. (Nilson.)

Lithium platonitrite, $Li_2Pt(NO_2)_4+3H_2O$.
Sl. deliquescent; easily sol. in H_2O.

Magnesium platonitrite, $MgPt(NO_2)_4+5H_2O$.
Easily sol. in H_2O.

Manganese platonitrite, $MnPt(NO_2)_4+8H_2O$.
Sol. in H_2O.

Mercurous platonitrite, $Hg_2Pt(NO_2)_4$, Hg_2O.
Nearly insol. in H_2O. (Lang, J. pr. **83.** 415.)
$+H_2O$. Nearly insol. in H_2O. (Nilson.)

Nickel platonitrite, $NiPt(NO_2)_4+8H_2O$.
Easily sol. in H_2O. (Nilson.)

Potassium platonitrite, $K_2Pt(NO_2)_4$.
Sol. in 27 pts. H_2O at 15°; more easily sol. in warm H_2O. (Lang, J. pr. **83.** 415.)
$+2H_2O$. Efflorescent. (Lang.)
$K_2H_4Pt_3O(NO_2)_6+3H_2O$. Very sl. sol. in cold (0.01 mol. in 1 l. at 16°), but very easily in hot H_2O. (Vèzes, A. ch. (6) **29.** 162.)
$K_4Pt_3O(NO_2)_8+2H_2O$. Sl. sol. in warm H_2O. (Nilson.)

Potassium platonitrite bromide.

See **Platibromonitrite** *and* **platobromonitrite, potassium.**

Potassium platonitrite chloride.

See **Plati-** *and* **platochloronitrite, potassium.**

Potassium platnitrite hydrogen chloride, $K_2Pt(NO_2)_4$, HCl.

Sol. in H_2O. (Miolati, Att. Linc. Rend. 1896, (5) **5,** II. 358.)

Potassium platonitrite iodide.

See **Plati-** *and* **platoiodonitrite, potassium.**

Potassium platonitrite nitrogen ***di*****oxide,** $K_2Pt(NO_2)_4$, $2NO_2$.

Violently decomp. by H_2O. (Miolati, Atti Linc. Rend. 1896, (5) **5,** II, 356.)

Rubidium platonitrite, $Rb_2(Pt)(NO_2)_4$, and $+2H_2O$.

Very slowly sol. in cold, more easily in warm H_2O. (Nilson.)

Silver platonitrite, $Ag_2Pt(NO_2)_4$.

Very sl. sol. in cold, easily in hot H_2O.

Silver ***di*****platonitrite,** $Ag_2Pt_2(NO_2)_4O$.

Insol. in H_2O. (Nilson.)

Sodium platonitrite, $Na_2Pt(NO_2)_4$.

Easily sol. in H_2O.

Strontium platonitrite, $SrPt(NO_2)_4+3H_2O$.

Somewhat sl. sol. in cold H_2O, but easily sol. in warm H_2O.

Thallium platonitrite, $Tl_2Pt(NO_2)_4$.

Very sl. sol. in H_2O. (Nilson.)

Yttrium platonitrite, $Y_2[Pt(NO_2)_4]_3+9$, or $21H_2O$.

Sol. in H_2O.

Zinc platonitrite, $ZnPt(NO_2)_4+8H_2O$.

Sol. in H_2O.

Plato*di*oxamine chloride, $Pt(NH_3O.NH_3OCl)_2$.

Easily sol. in H_2O. (Alexander, A. **246.** 239.)

—— **chloroplatinite,** $Pt(NH_3O.NH_3OCl)_2$, $PtCl_2$.

Sol. in warm HCl+Aq. Insol. in cold H_2O or alcohol; very sl. sol. in hot H_2O. (Alexander.)

—— **hydroxide,** $Pt(NH_3O.NH_3O)_2(OH)_2$.

Insol. in H_2O or alcohol. Easily sol. in HCl or HNO_3+Aq. Difficultly sol. in hot dil. H_2SO_4+Aq. (Alexander.)

Plato*di*oxamine oxalate, $Pt(NH_3O.NH_3O)_2C_2O_4$.

Insol. in cold H_2O, alcohol, or organic acids. (Alexander.)

—— **phosphate,** $Pt_3(NH_3O.NH_3O)_{12}(PO_4)_2+3H_2O$.

Ppt. (Alexander.)

—— **sulphate,** $Pt(NH_3O.NH_3O)SO_4+H_2O$.

Sl. sol. in H_2O. (Alexander.)

Platosamine bromide, $Pt(NH_3Br)_2$.

Sl. sol. even in hot H_2O. (Cleve.)

—— **chloride,** $Pt(NH_3Cl)_2$.

"Reiset's second chloride." Sol. in 140 pts. H_2O at 100°. (Peyrone, A. **61.** 180.)

Sol. in 130 pts. H_2O at 100°, and 4472 pts. at 0°. (Cleve.)

Easily sol. in NH_4OH+Aq, HNO_3, or aqua regia, with decomp. Sol. in KCN+Aq with evolution of NH_3. (Cleve.)

—— **ammonium chloride,** $Pt(NH_3Cl)_2$, $2NH_4Cl$.

Sl. sol. in cold, easily in hot H_2O; insol. in alcohol; sol. in NH_4OH or $(NH_4)_2CO_3$+Aq. (Grimm, A. **99.** 75.)

Platosamine chlorosulphurous acid, $Pt\frac{NH_3Cl}{NH_3SO_3H}$.

Easily sol. in H_2O without decomp. (Cleve.)

Ammonium platosamine chlorosulphite, $Pt(NH_3Cl)NH_3SO_3NH_4+H_2O$.

Sol. in H_2O. (Peyrone, A. **61.** 180.)

Platosamine cyanide, $Pt(NH_3CN)_2$.

Quite easily sol. in H_2O or NH_4OH+Aq. (Buckton.)

—— **hydroxide,** $Pt(NH_3OH)_2$.

"Reiset's second base." Very sol. in H_2O. (Odling, B. **3.** 685.)

—— **iodide,** $Pt(NH_3I)_2$.

Very sl. sol. in H_2O. Sol. in cold NH_4OH+Aq to form platodiamine iodide. (Cleve.)

—— **nitrate,** $Pt(NH_3NO_3)_2$.

Moderately sol. in hot H_2O. Sol. in NH_4OH+Aq with combination. (Reiset, A. ch. (3) **11.** 26.)

—— **nitrite,** $Pt(NH_3NO_2)_2$.

Very sl. sol. in cold, easily in hot H_2O. Insol. in alcohol. (Lang.)

Platosamine platinous nitrite, $Pt(NH_3NO_2)_2$, $Pt(NO_2)_2$.

Slowly and sl. sol. in cold, more easily sol. in hot H_2O.

Extremely sl. sol. even in conc. acids; more sol. in NH_4OH+Aq than in H_2O. (Lang.)

—— **oxide,** $Pt(NH_3)_2O$.

Insol. in H_2O or NH_4OH+Aq. (Reiset.)

—— **oxalate,** $Pt(NH_3)_2H_2(C_2O_4)_2+2H_2O$.

Ppt. (Cleve.)

—— **sulphate,** $Pt(NH_3)_2SO_4+H_2O$.

Sl. sol. in cold, more easily in hot H_2O.

—— **sulphite,** $Pt(NH_3)_2SO_3+H_2O$.

Easily sol. in H_2O. (Cleve.)

—— **sulphocyanide,** $Pt(NH_3SCN)_2$.

Insol. in H_2O; can be cryst. from alcohol; not attacked by HCl or H_2SO_4+Aq. (Buckton.)

Very sol. in hot H_2O. (Cleve.)

—— **silver sulphocyanide,** $Pt(NH_3)_2Ag_4(SCN)_6$.

(Cleve.)

Platosamine sulphurous acid, $Pt(NH_3SO_3H)_2$.

Exists only in its salts.

See **Platosamine sulphite.**

Ammonium platosamine sulphite, $Pt(NH_3SO_3NH_4)_2$.

Sol. in H_2O. Insol. in alcohol.

Barium platosamine sulphite, $Pt(NH_3)_2(SO_3)_2Ba+3H_2O$.

Ppt. (Cleve.)

Cobalt —— ——, $Pt(NH_3)_2(SO_3)_2Co+6H_2O$.

Very sl. sol. in H_2O. Sol. in HCl+Aq.

Copper —— ——, $Pt(NH_3)_2(SO_3)_2Cu+5H_2O$.

Very sl. sol. in H_2O; sol. in HCl+Aq.

Lead —— ——, $Pt(NH_3)_2(SO_3)_2Pb+H_2O$.

Ppt.

Manganese —— ——, $Pt(NH_3)_2(SO_3)_2Mn+4H_2O$.

Ppt. Sl. sol. in H_2O.

Nickel —— ——, $Pt(NH_3)_2(SO_3)_2Ni+7H_2O$.

Sl. sol. in H_2O.

Sodium platosamine sulphite, $Pt(NH_3SO_3Na)_2+5\frac{1}{2}H_2O$.

Sol. in H_2O. 100 ccm. sat. solution at 20° contains 5.52 g. cryst. salt. (Haberland and Hanekop, A. **245.** 235.)

Silver —— ——, $Pt(NH_3SO_3Ag)_2+H_2O$.

Ppt.

Uranyl —— ——, $Pt(NH_3)_2(SO_3)_2UO_2+H_2O$.

Ppt.

Zinc —— ——, $Pt(NH_3)_2(SO_3)_2Zn+6H_2O$.

Ppt. Very sl. sol. in H_2O. (Cleve.)

Platoso*semi*amine potassium chloride,

$Pt{}^{NH_3Cl}_{Cl}$, $KCl+H_2O$.

Very sol. in H_2O; insol. in alcohol. (Cossa, B. **23.** 2507.)

Platosoxamine chloride, $Pt{}^{NH_3OCl}_{NH_3OCl}$.

Sol. in H_2O. Much less sol. in H_2O than plato*di*oxamine chloride. (Alexander, A. **246.** 239.)

Platosoxamine amine chloride,

$Pt{}^{NH_3O.NH_3Cl}_{NH_3.NH_3OCl}$.

Easily sol. in H_2O. Insol. in alcohol and conc. HCl+Aq. (Alexander, A. **246.** 239.)

—— **chloroplatinite,** $Pt{}^{NH_3O.NH_3Cl}_{NH_3.NH_3OCl}$, $PtCl_2$

Ppt.

Platosulphurous acid.

Ammonium platosulphite, $(NH_4)_6Pt(SO_3)_4+3H_2O$.

Sol. in H_2O. (Birnbaum, A. **139.** 170.)

$(NH_4)_2Pt(SO_3)_2+H_2O$. Sol. in H_2O. (Liebig, Pogg. **17.** 108.)

Ammonium platosulphite chloride, $(NH_4)_2Pt(SO_3)_2$, $2NH_4Cl$.

Sol. in H_2O. (Birnbaum.)

$PtClSO_3H$, $2NH_4Cl$. Deliquescent; sol. in H_2O. (Birnbaum, A. **152.** 143.)

See also **Chloroplatosulphite, ammonium.**

Potassium platosulphite, $K_6Pt(SO_3)_4+4H_2O$.

Sl. sol. in cold, easily in hot H_2O. Much more sol. than the Na salt. (Birnbaum, A. **139.** 168.)

$+3H_2O$. (Lang, J. pr. **83.** 415.)

$6K_2O$, $2PtO$, $10SO_2$. Sl. sol. in H_2O. (Claus, J. B. **1847–48.** 453.)

Does not exist. (Lang.)

$K_2Pt(SO_3)_2$. Sol. in H_2O.

Silver platosulphite, $Ag_6Pt(SO_3)_4$.

Ppt. Very sol. in cold NH_4OH+Aq. (Lang. J, pr. **83.** 415.)

Sodium platosulphite, $Na_6Pt(SO_3)_4$.

Very sl. sol. in cold, somewhat more easily in hot H_2O. Not decomp. by boiling KOH or NaOH+Aq. Gradually sol. in $(NH_4)_2S$ or K_2S+Aq. Insol. in NaCl+Aq or alcohol. (Litton and Schnedermann, A. **42.** 316.)

+1½H_2O.

+7H_2O.

$Na_2Pt(SO_3H)_4$. Moderately sol. in H_2O. (Litton and Schnedermann.)

Platothiosulphuric acid.

Sodium platothiosulphate, $Na_6Pt(S_2O_3)_4$+10H_2O.

Very sol. in H_2O (Schottländer, A. **140.** 200.)

PtS_2O_3, $4Na_2S_2O_3+10H_2O$.

PtS_2O_3, $6Na_2S_2O_3+19H_2O$.

$2Pt_2S_2O_3$, $7Na_2S_2O_3+18H_2O$. (Jochum, C. C. **1885.** 642.)

Plumbic acid.

Barium plumbate, Ba_2PbO_4.

Insol. in H_2O. Sol. in HCl+Aq with evolution of Cl. Sol. in acids in presence of a reducing substance. (Kassner, Arch. Pharm. **228.** 109.)

Calcium plumbate.

Insol. in H_2O. HNO_3+Aq dissolves out CaO. (Crum, A. **55.** 218.)

Ca_2PbO_4. Properties as Ba_2PbO_4. (Kassner, Arch. Pharm. **228.** 109.)

+4H_2O. Easily decomp. by HNO_3. (Kassner, Arch. Pharm. 1894, **232.** 378.)

Calcium hydrogen plumbate, $H_2CaPb_2O_6$.

Fairly stable; slowly sol. in HNO_3 in the cold. (Kassner.)

Calcium lead ***ortho*****plumbate,** $CaPbPbO_4$.

Insol. in H_2O. Sol. in HCl. HNO_3, acetic and other acids cause a separation of PbO_2. (Kassner, Arch. Pharm. 1903, **241.** 147.)

Copper ***meta*****plumbate,** $CuPbO_3$.

Decomp. by acids. Insol. in NH_4OH+Aq. Acetic acid dissolves Cu. (Hoehnel, Arch. Pharm. 1896, **234.** 399.)

Lead ***meta*****plumbate,** $PbPbO_3$.

Identical with lead sesquioxide. (Hoehnel, Arch. Pharm. 1896, **234.** 399.)

Manganese ***meta*****plumbate.**

Decomp. by acids. (Hoehnel, Arch. Pharm. 1896, **234.** 399.)

Potassium plumbate, $K_2PbO_3+3H_2O$.

Very deliquescent. Decomp. by pure H_2O into PbO_2 and KOH. Sol. in KOH+Aq without decomp. (Fremy, J. Pharm. (3) **3.** 32.)

Silver ***meta*****plumbate,** Ag_2PbO_3.

Ppt. (Grützner, Arch. Pharm. 1895, **233.** 518.)

Sodium plumbate.

Sol. in H_2O with decomposition. Sl. sol. in alkalies+Aq. (Fremy, A. ch. (3) **12.** 490.)

Sodium ***meta*****plumbate,** $Na_2PbO_3+4H_2O$.

Decomp. by H_2O; insol. in alcohol. (Hoehnel, Arch. Pharm. 1894, **232.** 224.)

Strontium plumbate, Sr_2PbO_4.

Properties as Ba_2PbO_4. (Kassner, Arch. Pharm. **228.** 109.)

Zinc ***meta*****plumbate,** $ZnPbO_3+2H_2O$.

Decomp. by dil. acids; insol. in H_2O. (Hoehnel, Arch. Pharm. 1896, **234.** 398.)

Plumbous acid.

Calcium plumbite.

Sl. sol. in H_2O. (Karsten, Scher. J. **5.** 575.)

Potassium plumbite, PbO, xK_2O.

Known only in solution.

Silver plumbite, Ag_2PbO_2.

Insol. in H_2O, NH_4OH+Aq and KOH+Aq; sol. in HNO_3 and acetic acid; and in conc. H_2SO_4, HI, and HF. (Bullnheimer, B. 1898, **31.** 1288.)

+2H_2O. Insol. in H_2O. Decomp. on air. (Kratwig, B. **15.** 264.)

Sodium plumbite.

Known only in solution.

Potassium, K_2.

Violently decomposes H_2O or alcohol. Insol. in hydrocarbons. Sol. with violent action in acids.

Solubility in fused KOH at t°.

t°	G. K sol. in 100 g. fused KOH
480	7.8–8.9
600	3 –4
650	2 –2.7
700	0.5–1.3

(Hevesy, Z. Elektrochem. 1909, **15.** 534.)

Sol. in liquid NH_3. (Seely, C. N. **23.** 169); (Franklin, Am. Ch. J. 1898, **20.** 829.)

1 gram atom of K dissolves in 4.74 mol.

liquid NH_3 at 0°; in 4.79 mol. at —50°; in 4.82 mol. at —100°. (Ruff, B. 1906, **39.** 839.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Slowly sol in ethylene diamine. Insol. in ethyl amine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, **29.** 1561.)

Potassium acetylide, K_2C_2.

(Moissan, C. R. 1898, **127.** 917.)

Potassium acetylide acetylene, K_2C_2, C_2H_2.

(Moissan, C. R. 1898, **127.** 915.)

Potassium amalgams.

Hg_4K, Hg_6K, Hg K, $Hg_{10}K$, $Hg_{12}K$ and $Hg_{18}K$. (Guntz, C. R. 1900, **131.** 183.)

$Hg_{14}K$. Stable up to 0°. Can be cryst. from Hg without decomp. below 0°.

$Hg_{12}K$. Stable from 0° to 71° or 73°. Can be cryst. from Hg without decomp. at any temp. between these limits.

$Hg_{10}K$. Stable from 71° or 73-75°. Can be cryst. from Hg without decomp. at any temp. between these limits. (Kerp, Z. anorg. 1900, **25.** 68.)

Potassium amide, KH_2N.

Decomp. by water or alcohol. Insol. in hydrocarbons.

Potassium ammonickelate, $Ni_2N_3K_5$, $6NH_3$.

Decomp. by H_2O. Sl. sol. in liquid NH_3. (Bohart, J. phys. Chem. 1915, **19.** 559.)

Potassium ammonoargentate, AgNHK, NH_3 or $AgNH_2$, KNH_2.

Ppt., decomp. in the air. Decomp. by H_2O or by liquid NH_3 solutions of acids. (Franklin, J. Am. Chem. Soc. 1915, **37.** 855.)

Potassium ammonobarate, BaNK, $2NH_3$.

Hydrolyzed by H_2O. Insol. in liquid NH_3. Decomp. and dissolved in a solution of NH_4NO_3 in liquid NH_3. (Franklin, J. Am. Chem. Soc. 1915, **37.** 2297.)

Potassium ammonocadmiate, $Cd(NHK)_2$, $2NH_3$.

Ppt. (Franklin, Am. Ch. J. 1912, **47.** 310.)

$Cd(NHK)_2$, $2NH_3$. Decomp. by H_2O. Insol. in liquid NH_3. (Bohart, J. phys. Chem. 1915, **19.** 542.)

Potassium ammonocalciate, CaNK, $2NH_3$.

Hydrolyzed by H_2O. Readily sol. in a solution of NH_4NO_3 in liquid NH_3. (Franklin, J. Am. Chem. Soc. 1915, **37.** 2300.)

Potassium ammonocuprite, $CuNK_2$, $3NH_3$.

Very sol. in liquid NH_3.

$CuNK_2$, $2NH_3$.

$CuNK_2$, NH_3. (Franklin, J. Am. Chem. Soc. 1912, **34.** 1503.)

$CuNK_2$, $2\frac{1}{2}NH_3$. Ppt. (Franklin, Am. Ch. J. 1912, **47.** 311.)

Potassium ammonomagnesate, $Mg(NHK)_2$. $2NH_3$.

Sl. sol. in liquid NH_3. Rapidly hydrolyzed by H_2O. (Franklin, J. Am. Chem. Soc. 1913, **35.** 1463.)

Potassium ammonoplumbite, PbNK, $2\frac{1}{2}NH_3$.

Completely hydrolyzed by action of water vapor Violently decomp. by H_2O or dil. acids. Sol. in liquid NH_3. (Franklin, J. phys. Chem. 1911, **15.** 519.)

Potassium ammonostannate, $Sn(NK)_2$, $4NH_3$.

Decomp. by H_2O. Readily sol. in HCl+Aq. Sl. sol. in liquid NH_3. Readily sol. in a solution of NH_4I in liquid NH_3. (Fitzgerald, J. Am. Chem. Soc. 1907, **29.** 1696.)

Potassium ammonostrontiate, SrNK, $2NH_3$.

Hydrolyzed vigorously by H_2O. Sol. in solutions of NH_4NO_3 in liquid NH_3. Insol. in liquid NH_3. (Franklin, J. Am. Chem. Soc. 1915, **37.** 2299.)

Potassium ammonothallate, $TlNK_2$, $4NH_3$.

Sensitive to action of air or moisture. Violently decomp. by H_2O or dil. acids. Moderately sol. in liquid NH_3 at 20°, more sol. at higher temp. and much less sol. at lower temp. Decomp. by liquid NH_3 solutions of acids. (Franklin, J. phys. Chem. 1912, **16.** 689.)

Potassium ammonotitanate, (N) TiNHK.

Vigorously hydrolyzed by H_2O. Insol. in liquid NH_3 solutions of either potassium amide or NH_4Br. (Franklin, J. Am. Chem. Soc. 1912, **34.** 1500.)

Potassium ammonozincate, $Zn(NHK)_2$, $2NH_3$.

Decomp. by water. Sl. sol. in liquid NH_3. (Fitzgerald, J. Am. Chem. Soc. 1907, **29.** 663.)

Decomp. by H_2O. Sol. in dilute acids. Sl. sol. in liquid NH_3. Sol. in solutions of ammonium salts in liquid NH_3. (Franklin, Z. anorg. 1907, **55.** 195.)

Potassium arsenide, K_3As.

(Hugot, C. R. 1899, **129.** 604.)

K_2As_4. (Hugot.)

Potassium arsenide, ammonia, AsK_3, NH_3.

Nearly insol. in liquid NH_3. (Hugot.)

K_2As_4, NH_3. (Hugot.)

Potassium azoimide, KN_3.

Stable in aq. solution.

46.5 pts. are sol. in 100 pts. H_2O at 10.5°.
48.9 " " " " 100 " H_2O " 15.5.
49.6 " " " " 100 " H_2O " 17.
0.1375 " " " " 100 " abs. alcohol at 16°.

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 280.)

Potassium bromide, KBr.

Solubility of KBr in 100 pts. H_2O at t°.

t°	Pts. KBr	t°	Pts. KBr
0	53.48	60	85.35
20	64.52	80	93.46
40	74.63	100	102.0

(Kremers, Pogg. **97.** 151.)

Solubility of KBr in 100 pts. H_2O at t°.

t°	Pts. KBr	t°	Pts. KBr
—13.4	46.17	43.15	77.0
— 6.2	49.57	45.45	77.73
0	53.32	50.5	80.33
+3.4	55.60	54.8	82.78
5.2	56.63	60.15	85.37
12.65	61.03	66.75	88.22
13.0	61.17	71.45	90.69
13.3	61.45	74.85	92.25
18.3	64.11	86.5	97.28
26.05	68.31	97.9	102.9
30.0	70.35	110.0	110.3
37.9	74.46	...	...

Solubility is represented by a straight line of the formula 54.43+0.5128t. (Coppet, A. ch. (5) **30.** 416.)

100 pts. KBr+Aq sat. at 15–16° contain 39.06 pts. KBr. (v. Hauer, J. pr. **98.** 137.)

Solubility of KBr in 100 pts. H_2O at high temp.

t°	Pts. KBr
140	120.9
181	145.6

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Sat. solution boils at 112°. (Kremers.)

Sat. KBr+Aq contains at:

—12°	—10°	+3°	32°	39°
31.0	31.5	35.7	41.6	47.7% KBr,
55°	77°	140°	173°	220°
45.5	48.7	54.1	58.5	61.6% KBr.

(Étard, A. ch. 1894, (7) **2.** 539.)

If solubility S=pts. KBr in 100 pts. solution, S=34.5+0.2420t from 0° to 40°, S=41.5+0.1378t from 30° to 120°. (Étard, C. R. **98.** 1432.)

Solubility of KBr in 100 g. H_2O at t°.

t°	G. KBr.	t°	G. KBr.
10.5	62.1	−11	44.9
10	60.7	−10.5	41.8
3.5	55.5	−10	39.7
0	52.6	− 8.5	35.7
−5	50.1	− 8	31.2
−8	47.5	− 6.5	25.0
−11.5	45.3	...	...

(Meusser, Z. anorg. 1905, **44.** 80.)

68.74 g. KBr are sol. in 100 g. H_2O at 25°. (Amadori and Pampanini, Rend. Ac. Linc. 1911, V, **20.** 473.)

Sp. gr. of KBr+Aq at 19°.

% KBr	Sp. gr.	% KBr	Sp. gr.
5	1.037	30	1.256
10	1.075	35	1.309
15	1.116	40	1.366
20	1.159	45	1.432
25	1.207	..	...

(Gerlach, Z. anal. **8.** 285.)

Sp. gr. of KBr+Aq at 15° containing:

5	10	20	30	36% KBr.
1.0357	1.074	1.1583	1.2553	1.3198

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr of KBr+Aq at t°.

G. KBr dissolved in 100 g. H_2O	G. KBr in 100 g. of the solution	t°	Sp. gr.
4.166	4	14.5	1.0291
11.111	10	15.7	1.0753
25.000	20	16.5	1.1625
42.867	30	16.0	1.2580

(de Lannoy, Z. phys. Ch. 1895, **18.** 460.)

KBr+Aq containing 6.99%KBr has sp. gr. 20°/20° = 1.0521. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

Sp. gr. of KBr+Aq at 20.5°.

Normality of KBr+Aq.	G. KBr in 100 g. of solution	Sp. gr. t°/4°
4.29	37.97	1.3449
3.01	28.83	1.2407
2.00	20.49	1.1629
1.00	11.03	1.0815

(Oppenheimer, Z. phys. Ch. 1898, **27.** 452.)

Solubility of $KBr+NH_4Br$ at 25°.

% KBr	% NH_4Br	Sp. gr
55.81	0.0	1.3756
55.42	0.64	1.3745
53.65	2.46	1.3733
51.68	5.13	1.3721
44.12	15.29	1.3711
34.73	26.22	1.3715
26.23	34.76	1.3753
26.03	38.14	1.3753
23.22	41.78	1.3766
22.23	43.25	1.3777
17.99	48.08	1.3766
0.0	57.73	1.3763

(Fock, Z. Kryst. Min. 1897, **28**. 357.)

Solubility in KNO_3+Aq.

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol. KNO_3	Mol. KBr	Mol. KNO_3	Mol. KBr
0.0	4.332	0.0	4.761
0.362	4.156	0.131	4.72
0.706	4.093	0.527	4.61
1.235	3.939	0.721	4.54
...	...	1.090	4.475
...	...	1.170	4.44
...	...	1.504	4.375

(Touren, C. R. 1900, **130**. 911.)

See also under KNO_3.

100 pts. KBr+KCl+Aq sat. at 15–16° contain 37.55 pts. of the two salts; 10.0 pts. KBr+KI+Aq sat. at 15–16° contain 57.96 pts. of the two salts; 100 pts. KBr+KCl+KI+Aq sat. at 15–16° contain 57.88 pts. of the three salts. (v. Hauer, J. pr. **98**. 137.

Solubility of KBr+KCl in H_2O at 25°.

% KBr	% KCl	Sp. gr.
55.81	0.00	1.3756
53.15	2.34	1.3700
50.36	4.66	1.3648
45.46	8.26	1.3544
37.96	13.66	1.3320
32.48	16.69	1.3119
21.80	21.39	1.2689
14.07	25.09	1.2455
4.75	29.17	1.1977
0.00	31.13	1.1756

(Fock, Z. Kryst. Min. 1897, **28**. 357.)

Solubility of KBr+KCl in H_2O at t°.

t°	Sat. solution contains		
	% KCl	% KBr	% total salt
−14	10.7	18.8	29.5
−13.7	...	...	29.4
−13.5	...	...	29.5
−7	10.7	19.8	30.5
+5.2	...	...	34.4
+6	11.3	22.6	33.9
10	11.0	23.7	34.7
21	10.8	...	35.3
26	11.2	25.5	36.7
30	...	...	39.4
32	11.9	26.6	38.5
39	...	...	39.8
47	11.0	30.8	41.8
52	11.0	31.2	42.2
55	11.9	29.9	41.8
71	12.0	31.7	43.7
73	11.8	32.9	44.7
102	12.8	35.8	48.6
152	13.2	40.6	53.8
160	12.5	42.3	54.8
168	...	...	55.0
225	14.7	45.0	59.7

(Étard, A. ch. 1894, (7) **3**. 281.)

Solubility of KBr+KCl in H_2O at 25°.

G. per 100 g. H_2O.	
KBr	KCl
68.47	0.0
62.26	5.43
58.50	8.46
52.45	12.48
45.42	17.17
38.70	21.23
26.62	25.88
12.94	31.02
0.0	36.12

(Amadori and Pampanini, Att. Acc. Linc. 1911, **20**, II. 475.)

Solubility in KCl+Aq at 25.2°.

1 litre of the solution contains	
Mol. KCl	Mol. KBr
0.0	4.761
0.67	4.22
0.81	4.15
1.35	3.70
1.48	3.54
1.61	3.42
1.70	3.34
2.46	2.50
3.775	0.525

(Touren, C. R. 1900, **130**. 1252.)

See also under KCl.

By repeatedly heating KBr+Aq sat. at 15–16° with KI and cooling to 15°, nearly all the KBr can be separated. (v. Hauer.)

100 pts. H_2O sat. with KBr at 16° dissolve 13.15 pts. KI, but on addition of more KI, KBr is pptd. (van Melckebeke, C. C. **1872.** 586.)

Solubility in KI+Aq at t°.

t°	Sat. solution contains		
	% KBr	% KI	% total salt
−22	8.3	42.6	50.9
−19	9.5	42.8	52.3
−6	9.3	44.7	54.0
−1.5	[illegible]	...	55.3
+3	10.3	45.9	56.2
13.6	10.1	46.2	55.9
25	10.8	48.0	58.8
44.2	11.1	50.1	61.2
51	12.1	50.0	62.1
66	10.8	53.1	63.9
70	11.6	51.9	63.5
80	12.3	52.5	64.8
93	13.0	53.7	66.7
116	13.2	54.6	67.8
125	13.7	54.8	68.5
150	15.1	55.1	70.2
175	16.0	57.2	73.2
175	...	...	72.7
195	16.7	56.5	73.2
220	17.6	57.0	74.6

(Étard, A. ch. 1894, (7) **3.** 279.)

Solubility of KBr+KI in H_2O at 25°.

G. per 100 g. H_2O.	
KBr	KCl
53.21	35.92
42.32	66.63
34.14	95.36
30.08	119.59
29.62	119
22.15	127.10
21.88	127.31
18.54	130.61
0.0	149.26

(Amadori and Pampanini, Att. Acc. Linc. 1911, **20,** II. 475.)

Solubility of KBr in KOH+Aq.

G. per 1000 g. H_2O		G. per 1000 g. H_2O	
KOH	KBr	KOH	KBr
36.4	558.4	277.6	248.1
113.5	433.6	434.7	137.1
177.2	358.1	579.6	64.8
231.1	281.2	806.9	33.4

(Ditte, C. R. 1897, **124.** 30.)

Sol. in Br_2 at 15°. (Walden, Z. anorg. 1900, **25.** 220.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in liquid NH_3. 45 pts. are sol. in 100 pts. liquid NH_3 at —50°. (Joannis, C. R. 1905, **140.** 1244.)

Attacked by liquid NO_2 with liberation of Br_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Sol. in SO_3. (Walden, Z. anorg. 1900, **25.** 217.)

Sol. in $SO_2Cl(OH)$. (Walden, Z. anorg. 1902, **29.** 382.)

Difficultly sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $SbCl_3$. (Walden, Z. anorg. 1900, **25.** 220.)

Sol. in liquid SO_2. (Walden, Z. anorg. 1902, **30.** 160.)

Hydrazine dissolves 56.4 pts. KBr at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)

Sl. sol. in alcohol. (Ballard.)

Sol. in 200 pts. cold, and 16 pts. boiling 80% alcohol.

Sol. in 180 pts. 90% alcohol. (Hager.)

Sol. in 750 pts. abs. alcohol at 15°. (Eder, Dingl. **221.** 89.)

100 pts. absolute methyl alcohol dissolve 1.51 pts. at 25°; 100 pts. absolute ethyl alcohol dissolve 0.13 pt. at 25°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility of KBr in methyl alcohol+Aq at 25°.

P = % by wt. of alcohol in alcohol+Aq.
S = Sp. gr. of alcohol+Aq sat. with KBr.
L = millimols KBr in 100 ccm. of the solution.

P	S 25°/4°	L
0	1.3797	471
10.6	1.300	389
30.8	1.159	252
47.1	1.058	162
64.0	0.9801	87
78.1	0.8906	44
98.9	0.8411	23
100	0.8047	14.2

(Herz and Anders, Z. anorg. 1907, **55.** 273.)

100 g. KBr+CH_3OH contain 0.2 g. KBr at the critical temp. (Centnerszwer, Z. phys. Ch 1910, **72.** 437.)

Solubility of KBr in ethyl alcohol+Aq.

Wt. % alcohol	Temp. =30° G. KBr. per 100 g. Solution	Temp. =30° G. KBr. per 100 g. Solvent	Temp. =40° G. KBr per 100 g. Solution	Temp. =40° G. KBr per 100 g. Solvent
0	41.62	71.30	43.40	76.65
5	38.98	67.25	40.85	72.70
10	36.33	63.40	38.37	69.00
20	31.09	56.40	33.27	62.30
30	25.98	50.15	28.32	56.45
40	21.24	44.95	23.22	50.46
50	16.27	38.85	18.11	44.25
60	11.50	32.50	13.02	37.40
70	6.90	24.70	7.98	28.90
80	3.09	15.95	3.65	18.95
90	0.87	8.80	1.03	10.45

(Taylor, J. phys. Ch. 1896, **1.** 724.)

At room temp., 1 pt. KBr by weight is sol. in:

52 pts. methyl alcohol, D^{15} 0.7990.
350 " ethyl " D^{15} 0.8100.
1818 " propyl " D^{15} 0.8160

(Rohland, Z. anorg. 1898, **18.** 325.)

Solubility of KBr in ethyl alcohol at 0°.

Conc. of alcohol in mol. g. per l. H_2O	G. KBr in 1 l. H_2O	Mol. solubility
—	536.75	4.51
¼	529.25	4.45
½	502.85	4.22
1	491.75	4.13
2	455.25	3.82

(Armstrong and Eyre, Proc. R. Soc. 1910, [A] **84.** 127.)

100 g. methyl alcohol dissolve 2.17 g. KBr at 25°.
100 g. ethyl alcohol dissolve 0.142 g. KBr at 25°.
100 g. propyl alcohol dissolve 0.035 g. KBr at 25°.
100 g. isoamyl alcohol dissolve 0.003 g. KBr at 25°.
(Turner and Bissett, Chem. Soc. 1913, **103.** 1909.)

0.055 g. is sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 276.)
Sol. in 5000 pts. ether (sp. gr. 0.729 at 15°.) (Eder, *l. c.*)
Sol. in 1700 pts. alcohol-ether (1 : 1) at 15°. (Eder, *l. c.*)
100 pts. acetone dissolve 0.023 pt. KBr at 25°. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Solubility of KBr in acetone+Aq at 25°.
A=cc. acetone in 100 cc. acetone+Aq.
KBr=millimols KBr in 100 cc. of the solution.

A	KBr	Sp. gr.
0	481.3	1.3793
20	366	1.2688
30	310.5	1.2118
40	259.0	1.1558
50	202.9	1.0918
60	144.9	1.0275
70	95.3	0.9591
80	46.5	0.89415
90	10.1	0.8340

(Herz and Knoch, Z. anorg. 1905, **45.** 262.)

Solubility of KBr in glycerine+Aq at 25°.
G=g. glycerine in 100 g. glycerine+Aq.
KBr=millimols KBr in 100 cc. of the solution.

G	KBr	Sp. gr.
0	481.3	1.3793
13.28	444.3	1.3704
25.98	404.0	1.3655
45.36	340.5	1.3594
54.23	310.4	1.3580
83.84	219.25	1.3603
100	172.65	1.3691

(Herz and Knoch, Z. anorg. 1905, **45.** 267.)

100 g. 95% formic acid dissolve 23.2 g. KBr at 18.5°. (Aschan, Chem. Ztg. 1913, **37.** 1117.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
100 ccm. of a sat. solution of KBr in furfurol at 25° contain 0.139 pts. by wt. KBr. (Walden, Z. phys. Ch. 1906, **55.** 713.)
Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Potassium rhodium bromide.
See **Bromorhodite, potassium.**

Potassium ruthenium *tri*bromide.
See **Bromoruthenite, potassium.**

Potassium ruthenium *tetra*bromide.
See **Bromoruthenate, potassium.**

Potassium selenium bromide.
See **Bromoselenate, potassium.**

Potassium tellurium bromide.
See **Bromotellurate, potassium.**

Potassium thallic bromide, KBr, $TlBr_3+2H_2O$.
Sol. in H_2O.
3KBr, $2TlBr_3+3H_2O$. Sol. in H_2O. (Rammelsberg.)

Potassium thorium bromide.
Sol. in H_2O. (Berzelius.)

Potassium tin (stannous) bromide, KBr, $SnBr_2+H_2O$.
Sol. in H_2O. (Benas, C. C. **1884.** 958.) Can be recryst. from HBr or KBr+Aq. (Richardson, Am. Ch. J. **14.** 95.)
2KBr, $SnBr_2+2H_2O$. Cannot be recryst. from HBr+Aq. (Richardson.)

Potassium tin (stannic) bromide, 2KBr, $SnBr_4$.
See **Bromostannate, potassium.**

Potassium uranous bromide, $KUBr_6$.
Very sol. in H_2O. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Potassium uranyl bromide, 2KBr, $UO_2Br_2+2H_2O$.
Very easily sol. in H_2O. (Sendtner.)

Potassium zinc bromide, KBr, $ZnBr_2+2H_2O$.
Not hygroscopic. (Ephraim, Z. anorg. 1908, **59.** 60.)
2KBr, $ZnBr_2+2H_2O$. Not hygroscopic. (Ephraim.)

Potassium bromide ammonia, KBr, $4NH_3$.
(Joannis, C. R. 1905, **140.** 1244.)

Potassium bromide ruthenium ***di*****hydronitrosochloride,** $(NO)Ru_2H_2Cl_3$, 2HCl, 3KBr.
Ppt. Sl. sol. in H_2O. (Brizard, A. ch. 1900, (7) **21.** 359.)

Potassium bromoiodide, KBr_2I.
Decomp. rapidly on air. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

Potassium carbonyl, $K_2C_2O_2$.
Decomp. by H_2O with explosion. (Joannis, C. R. **116.** 158.)

Potassium chloride, KCl.
Sol. in H_2O with absorption of heat.
30 pts. KCl+100 pts. H_2O at 13.2° lower the temp. 12.6°. (Rüdorff, B. **2.** 68.)
100 pts. H_2O dissolve 29.31 pts. KCl at 0°. (Gay-Lussac); 28.5 pts. KCl at 0° (Mulder; Gerardin.)

The saturated solution contains 58.5%, and boils at 107.6° (Mulder); contains 59.40%, and boils at 108.3° (Legrand); contains 59.26%, and boils at 109.6° (Gay-Lussac); boils at 110°. (Kremers.)
Sol. in 3.016 pts. H_2O at 15° (Gerlach); in 3.03 pts. at 17.5°, or 100 pts. H_2O at 17.5° dissolve 33 pts KCl. (Schiff.)

100 pts. H_2O at t° dissolve pts. KCl:

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
0	29.21	52.39	43.59	109.60	59.26
19.35	34.53	79.58	50.93	....	....

(Gay-Lussac, A. ch. (2) **11.** 308.)

100 pts. H_2O dissolve 34.6 pts. KCl at 11.8°; 34.9 pts. at 13.8°; 35 pts. at 15.6°. (Kopp.)
100 pts. H_2O at 17.5° dissolve 33.24 pts. KCl, and sp. gr. of solution is 1.635. (Karsten.)
100 pts. H_2O at 12° dissolve 32 pts., and at 100°, 59.4 pts. (Otto-Graham.)
Sol. in 3 pts. H_2O at ord. temp., and 3 pts. boiling H_2O (Bergmann); in 3.33 pts. hot or cold H_2O (Fourcroy); in 3 pts. at 15°, and 1.68 pts. at 110° (M. R. and P.)
Sol. in 3.5 pts. H_2O at 0°, and in less than 1 pt. hot H_2O (Schubarth); 100 pts. H_2O at 17.5° dissolve 30.7-33.0 pts. KCl (Ure's Dict.).
100 pts. H_2O dissolve 35.405 pts. KCl at 15°, and solution has sp. gr. =1.1809. (Michel and Krafft, A. ch. (3) 41. 478.)

100 pts. H_2O dissolve at:

18°	30°	40°	57°
33.6	37.8	40.1	45.0 pts. KCl.

(Gerardin, A. ch. (4) **5.** 139.)

100 pts. H_2O dissolve 33.06–32.08 pts. KCl at 15.6° and sp. gr. of solution = 1.171. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
0	28.5	17	33.9	34	38.5
1	28.7	18	34.2	35	38.7
2	29.0	19	34.4	36	39.0
3	29.3	20	34.7	37	39.3
4	29.5	21	35.0	38	39.6
5	30.0	22	35.3	39	39.9
6	30.5	23	35.5	40	40.1
7	31.0	24	35.8	41	40.3
8	31.5	25	36.1	42	40.6
9	31.7	26	36.4	43	40.9
10	32.0	27	36.6	44	41.2
11	32.3	28	36.9	45	41.5
12	32.5	29	37.2	46	41.7
13	32.8	30	37.4	47	42.0
14	33.1	31	37.7	48	42.3
15	33.4	32	38.0	49	42.5
16	33.6	33	38.2	50	42.8

Solubility in 100 pts., etc.—*Continued.*

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
51	43.1	71	48.5	91	54.1
52	43.4	72	48.8	92	54.4
53	43.6	73	49.1	93	54.6
54	43.9	74	49.4	94	54.9
55	44.2	75	49.6	95	55.2
56	44.4	76	49.9	96	55.5
57	44.7	77	50.2	97	55.7
58	44.9	78	50.5	98	56.0
59	45.2	79	50.8	99	56.3
60	45.5	80	51.0	100	56.6
61	45.8	81	51.3	101	56.9
62	46.1	82	51.5	102	57.2
63	46.3	83	51.8	103	57.4
64	46.6	84	52.1	104	57.7
65	46.9	85	52.4	105	58.0
66	47.2	86	52.6	106	58.2
67	47.5	87	52.9	107	58.5
68	47.7	88	53.2	107.65	58.5
69	48.0	89	53.5	...	..
70	48.3	90	53.8	..	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864**. 41.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
−11°	24.46	25.7	36.10	64.95	47.17
−6.4	25.78	29.25	37.31	71.65	48.76
0	27.9	38.0	39.71	74.25	49.27
+3.9	29.37	41.45	40.67	80.75	51.24
9.4	30.84	46.15	42.34	86.6	52.53
11.4	32.19	48.8	42.86	91.4	53.49
14.95	32.66	55.1	44.51	...	...
19.0	34.32	60.55	45.90	...	...

(Coppet, A. ch. (5) **30**. 414.)

Solubility is represented by a straight line, of which the formula is 28.51+0.2837t. (Coppet.)

100 pts. H_2O dissolve 29.33 pts. KCl at 4°, 45.5 pts. at 60°. (Andreae, J. pr. (2) **29**. 456.)

100 pts. H_2O dissolve at:

0°	100°	130°	180°
29.2	56.5	66	78 pts. KCl.

(Tilden and Shenstone, Lond, R. Soc. Proc. **35**. 345.)

Solubility of KCl in 100 pts. H_2O at high temp.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
125	59.6	147	70.8	180	77.5
133	69.3	175	75.2	...	...

(Tilden and Shenstone, Phil. Trans. **1884**. 23.)

If solubility S=pts. KCl in 100 pts. solution, S=20.5+0.1445t from —90° to 110°. (Étard, C. R. **98**. 1432.)

Sat. KCl+Aq contains at:

142°	150°	175°	180°
38.6	38.8	41.[illegible]	41.8% KCl.
190°	200°	242°	732° (mpt.)
43.2	42.9	47.6	100% KCl.

(Étard, A. ch. 1894, (7) **2**. 256.)

100 g. H_2O dissolve 0.488 gram-equivalent KCl at 25°. (van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, **49**. 315.)

Solubility of KCl in H_2O at t°.

G. KCl per 100 G. H_2O.		
t°	KCl	Sp. gr.
0.70	28.29	1.1540
19.55	34.37	1.1738
32.80	38.32	1.1839
59.85	45.84	1.1980
74.80	49.58	1.2032
89.45	53.38	1.2069
108.0*	58.11	1.2118

* B.-pt. of sat. solution.

(Berkeley, Phil. Trans. Roy. Soc. 1904, **203**, A. 189.)

Solubility of KCl in 100 g. H_2O at t°.

t°	g. KCl	t°	g. KCl
+18.5	33.3	−4.5	25.9
11.5	31.2	−9	23.9
10	30.8	−8.5	21.5
7.5	29.8	−8	20.0
2.5	28.4	−7	17.5
0	27.5	−6	15.7
−1	27.2	−5.5	14.3

(Meusser, Z. anorg. 1905, **44**. 80.)

Sat. KCl+Aq at 25° contains 26.46% KCl. (Foote, Am. Ch. J. 1906, **35**. 238.)

28.01 g. KCl are contained in 100 g. solution sat. at 30°. (de Waal, Dissert. **1910**.)

36.12 g. KCl are sol. in 100 g. H_2O at 25°. (Amadori and Pampanini, Rend. Acc. Linc. 1911, V. **20**. 473.)

4.272 g. mol. are contained in 1 l. solution sat. at 25°. (Herz. Z. anorg. 1911, **73**. 274.)

Solubility of KBr at 6°=23.06%; 28.4°=26.91%; 62.6°=31.57°. (Süss, Z. Krist. 1912, **51**. 262.)

Solubility at 22°=25.68%. (Brönstedt, Z. phys. Ch. 1912, **80**. 208.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
8.2	8.99	9.75	10.39 mol. KCl.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37**. 18.)

KCl+Aq sat. at 16° has sp. gr.=1.077. (Stolba, J. pr. **97**. 503.)

Sp. gr. of KCl+Aq at 17.5°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1.0062	9	1.0586	17	1.1152
2	1.0125	10	1.0655	18	1.1225
3	1.0189	11	1.0725	19	1.1298
4	1.0254	12	1.0795	20	1.1372
5	1.0319	13	1.0866	21	1.1446
6	1.0385	14	1.0937	22	1.1521
7	1.0451	15	1.1008	23	1.1596
8	1.0518	16	1.1080	24	1.1673

(Schiff, A. **110**. 76.)

Sp. gr. of KCl+Aq at 19.5°.

% KCl	Sp. gr.	% KCl	Sp. gr.
5.98	1.0382	21.31	1.1436
11.27	1.0733	25.133	1.1720
16.27	1.1075	...	...

(Kremers, Pogg. **95**. 119.)

Sp. gr. of KCl+Aq at 15°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1.00650	10	1.06580	19	1.12894
2	1.01300	11	1.07271	20	1.13608
3	1.01950	12	1.07962	21	1.14348
4	1.02600	13	1.08654	22	1.15088
5	1.03250	14	1.09345	23	1.15828
6	1.03916	15	1.10036	24	1.16568
7	1.04582	16	1.10750	24.9*	1.17234
8	1.05248	17	1.11465	...	...
9	1.05914	18	1.12179	...	...

* Mother liquor.

(Gerlach, Z. anal. **8**. 281.)

Sp. gr. of KCl+Aq at 20°, containing mols. KCl to 100 mols. H_2O.

Mols. KCl	Sp. gr.	Mols. KCl	Sp. gr.
0.5	1.01310	4.0	1.09415
1.0	1.02568	5.0	1.11445
2.0	1.04959	...	...

(Nicol, Phil. Mag. (5) **16**. 122.)

Sp. gr. of KCl+Aq at 18°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
5	1.0308	15	1.0978	25	1.1408
10	1.0638	20	1.1335	..	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of KCl+Aq at 0°. S=pts. salt in 100 pts. of solution; S_1=mols. salt in 100 mols. solution.

S	S_1	Sp. gr.
20.7840	5.954	1.1489
17.7214	4.940	1.1258
14.4707	3.922	1.1018
11.0757	2.918	1.0769
7.5440	1.931	1.0521
4.4968	1.123	1.0308

(Charpy, A. ch. (6) **29**. 23.)

Sp. gr. of KCl+Aq at 25°.

Concentration of KCl+Aq	Sp. gr.
1-normal	1.0466
1/2- "	1.0235
1/4- "	1.0117
1/8- "	1.0059

(Wagner, Z. phys. Ch. 1890, **5**. 36.)

KCl+Aq containing 5.05% KCl has sp. gr. 20°/20°=1.0327.

KCl+Aq containing 20.55% KCl has sp. gr. 20°/20°=1.1393.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19**. 272.)

Sp. gr. of KCl+Aq.

g. KCl in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.7140	1.000464
1.5042	1.000975
3.0724	1.001991
8.3165	1.005391

(Dijken, Z. phys. Ch. 1897, **24**. 109.)

Sp. gr. of KCl+Aq at 20.1°, when p=per cent strength of solution; d=observed density, and w=volume conc. in g. per cc. $\left(\frac{pd}{100}\right)=w$

p	d	w
36.43	1.853	0.43171
31.12	1.1554	0.35954
24.79	1.1215	0.27887
18.06	1.0866	0.19610
13.17	1.0617	0.13980
8.412	1.0386	0.08736
6.610	1.0297	0.06806
4.419	1.0193	0.4505
3.456	1.0148	0.03507
1.197	1.0040	0.01202

(Barnes, J. phys. Ch. 1898, **2**. 544.)

Sp. gr. of KCl+Aq at t°.

t°	Normality of KCl+Aq.	g. KCl in 100 g. of solution	Sp. gr. t°/4°
20.5	3.74	23.93	1.1617
"	2.65	17.66	1.1166
"	1.87	12.82	1.0829
"	0.93	6.64	1.0424

(Oppenheimer, Z. phys. Ch. 1898, **27**. 450.)

Sp. gr. of KCl+Aq at 18°/4°.

g. KCl in 100 g. of solution	Sp. gr.
0.24963	1.0003
0.12459	0.9995
0.08342	0.99929
0.062343	0.99912

(Jahn, Z. phys. Ch. 1900, **33**. 559.)

KCl+Aq containing 1 pt. KCl in 58.923 pts. H_2O at 17° has sp. gr. = 1.0096. (Hittorf, Z. phys. Ch. 1902, **39**. 628.)

Sp. gr. 20°/4° of a normal solution of KCl = 1.04443. (Haigh, J. Am. Chem. Soc. 1912, **34**. 1151.)

Sp. gr. of sat. KCl+Aq at t°.

t°	g. KCl sol. in 100 g. H_2O	Sp. gr.
—10°	24.98	1.139
0	28.50	1.156
10	31.23	1.168
20	34.11	1.177
30	37.28	1.183
40	40.12	1.190
50	42.86	1.195
60	45.48	1.199
70	48.30	1.203

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, **44**. 1565.)

Sp. gr. of dil. KCl+Aq at 20.004°.

Conc. = g. equiv. KCl per l. at 20.004°. Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,004,8
0.0002	1.000,009,7
0.0005	1.000,024,2
0.0010	1.000,048,5
0.0026	1.000,097,1
0.0050	1.000,242,6
0.0100	1.000,483,6

(Lamb and Lee, J. Am. Chem. Soc., 1913, **35**. 1687.)

KCl+Aq containing 10% KCl boils at 101.1°; containing 20%, at 103.4°. (Gerlach.)

Sat. KCl+Aq containing 52.7 pts. KCl to 100 pts. H_2O forms a crust at 107.7°; highest temp. observed, 108.5°. (Gerlach, Z. anal. **26**. 426.)

B.-pt. of KCl+Aq containing pts. KCl to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26**. 438); L = according to Legrand (A. ch. (2) **59**. 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	4.9	4.7	105°	36.2	37.8
101.0	9.2	9.0	105.5	39.3	41.0
101.5	13.1	13.2	106	42.4	44.2
102	16.7	17.1	106.5	45.5	47.4
102.5	20.1	20.9	107	48.4	50.5
103	23.4	24.5	107.5	51.5	53.7
103.5	26.7	28.0	108	54.5	56.9
104	29.9	31.4	108.3	...	59.4
104.5	33.1	34.6	108.5	57.4	...

Precipitated from aqueous solution by HCl+Aq. Much less sol. in very dil. HCl+Aq than in H_2O. (Fresenius.)

Nearly insol. in conc. HCl+Aq.

100 cc. sat. HCl+Aq dissolve 1.9 g. KCl at 17°. (Ditte, A. ch. 1881, (5) **24**. 226.)

Solubility of KCl in HCl+Aq at 0°.

G. per 100 cc. of solution	
HCl	KCl
0.0	25.73
1.42	22.69
2.41	20.84
2.59	20.51
4.05	17.71
8.39	11.93
12.40	7.46
14.95	5.60
23.88	1.49
54.20	1.52

(Engel, A. ch. 1888, (6) **33**. 377.)

Solubility of KCl in HCl+Aq.

t°	Concentration of HCl g. mol. per 1000 g. H_2O	Wt. KCl per 1000 g. H_2O	Mol. solubility
0	0	283.55	3.81
"	¼	267.25	3.59
"	½	250.00	3.36
"	1	214.25	2.88
25	0	359.25	4.82
"	¼	341.55	4.59
"	½	324.30	4.35
"	1	289.60	3.89

(Armstrong and Eyre, Proc. R. Soc. 1910 (A) **84**. 127.)

100 g. sat. HCl+Aq dissolve 1.9 g. KCl at 20°. (Stoltzenberg, B. 1912, **45**. 2248.)

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm.	Millimols KCl in 10 ccm.
...	42.72
5.66	37.49
10.20	33.79
15.90	28.68
20.94	24.74
32.52	17.39

(Herz, Z. anorg. 1912, **73**. 275.)

Solubility of KCl in HBr+Aq at 25°.

Millimols HBr in 10 ccm.	Millimols KCl in 10 ccm.
...	42.72
6.61	37.80
34.15	19.57

(Herz, Z. anorg. 1912, **73**. 275.)

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl. When action has ceased, the solution at 18.75° contains 31.6% of the mixed salt; or 100 pts. H_2O dissolve 46.1 pts. of the mixed salt, viz. 16.27 pts. KCl and 29.83 pts. NH_4Cl. (Karsten.)

Solubility of KCl in NH_4Cl+Aq at 25°.

Dissolved in 1000 mols H_2O	
Mols KCl	Mols NH_4Cl
74.2	23.8
67.9	32.5
61.4	52.2
55.5	65.9
50.2	74.4
43.0	96.3
37.6	110.0
37.0	107.5
37.5	109.4
22.6	118.2

(Biltz, Z. anorg. 1911, **71**. 174.)

See also NH_4Cl.

Sol. in sat. $BaCl_2$+Aq with pptn. of $BaCl_2$ until a state of equilibrium is reached, when 100 pts. H_2O at 16.8° dissolve 45.9 pts. mixed salts, viz. 18.2 pts. $BaCl_2$ and 27.7 pts. KCl.

See also $BaCl_2$.

Solubility of KCl in $MgCl_2$+Aq of given percentage composition.

t°	30%	21.2%	15%	11%
10	1.9%	5.3%	9.9%	14.3%
20	2.6	6.5	11.3	15.9
30	3.4	7.6	12.7	17.5
40	4.2	8.8	14.2	19.0
50	5.0	10.0	15.6	20.5
60	5.8	11.2	17.0	21.9
70	6.5	12.4	18.3	23.2
80	7.3	13.6	19.5	24.5
90	8.1	14.7	20.8	25.8
100	8.9	15.9	22.1	27.1

(Precht and Wittgen, B. **14**. 1667.)

Solubility of KCl+NaCl in 20% $MgCl_2$+Aq.

t°	% KCl	% NaCl	t°	% KCl	% NaCl
10	4.2	5.7	60	8.9	6.3
20	5.1	5.8	70	9.9	6.4
30	6.0	5.9	80	10.9	6.6
40	6.9	6.0	90	11.9	6.7
50	7.9	6.1	100	13.0	6.9

(P. and W.)

Sol. in sat. KNO_3+Aq with pptn. of KNO_3.

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol. KCl	Mol. KNO_3	Mol. KCl	Mol. KNO_3
3.865	0.0	4.18	0.0
3.810	0.204	4.11	0.136
3.782	0.318	4.07	0.318
3.710	0.615	3.93	0.902
3.667	0.818	3.85	1.212
3.629	0.910	3.81	1.397
3.597	1.176	3.70	1.805
3.582	1.220	...	....

(Touren, C. R. 1900, **130**. 909.)

Solubility of KCl in KNO_3+Aq.

t°	Concentration of KNO_3 in g. mol. per 1000 g. H_2O	Wt. KCl in 1000 g. H_2O	Mol. solubility
0	0	283.55	3.81
"	¼	284.25	3.81
"	½	283.60	3.81
"	1	287.60	3.86
25	0	364.15	4.89
"	¼	355.00	4.90
"	½	361.65	4.86
"	1	358.80	4.81
"	1½	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. 1910 [A], **84**. 127.)

See also KNO_3.

Sol. in sat. $NaNO_3$+Aq without causing pptn. (*See* $NaNO_3$.)

Sol. in sat. $Ba(NO_3)_2$+Aq without causing pptn.

Solubility in KBr+Aq at 25.2°.

1 litre of the solution contains	
Mol. KBr	Mol. KCl
0.0	4.18
0.49	3.85
0.85	3.58
1.31	3.19
1.78	2.91
2.25	2.58
2.69	2.33

(Touren, C. R. 1900, **130**. 1252.)

See also KBr.

100 pts. H_2O dissolve 133.2 pts. KI and 10.4 pts. KCl at 21.5°, no matter how prepared. (Rüdorff, B. **6**. 484.)

100 pts. KCl+Aq sat. at 15–16° contain 25.26–25.37 pts. KCl. 100 pts. KCl+Ki+Aq sat. at 15–16° contain 57.80 pts. of the two salts. KCl is pptd. by KI. (v. Hauer, J. pr. **98**. 137.)

Solubility in KI+Aq at t°.

t°	Sat. solution contains		
	% KCl	% KI	% total salt
0	4.8	50.8	56.6
8	5.1	51.1	56.2
18	...	...	57.9
30	4.2	54.6	58.8
41	4.7	55.0	59.7
49	5.7	56.0	61.7
60	...	...	62.5
75	4.4	59.5	63.9
82	5.0	59.6	64.6
96	...	...	66.2
102	...	...	66.8
140	...	63.3	...
155	7.6	64.8	72.4
182	8.7	65.4	74.1
190	8.6	66.0	74.6
245	10.0	66.5	76.5

(Étard, A. ch. 1894, (7) **3**. 281.)

Solubility of KCl+KI in H_2O at 25°.

G. per 100 g. H_2O			
KCl	KI	KCl	KI
0	149.26	19.64	68.22
4.06	144.03	23.75	43.89
7.63	137.79	29.56	23.83
11.36	132.60	31.38	14.83
11.74	133.90	33.68	7.00
15.10	105.91	36.12	0.00

(Amadori and Pampanini, Att. Acc. Linc. 1911, **20**, II. 475.)

Solubility of KCl in KOH+Aq at 0°.

G. per 100 cc. solution	
KCl	KOH
26.83	0.0
23.44	1.33
21.39	2.64
17.39	5.56
13.89	8.46
10.91	11.23
8.64	13.83
6.78	16.43
4.74	19.72

(Engel, Bull. Soc. 1891, (3) **6**. 16.)

Solubility in KOH+Aq at 20°.

G. KOH in 1 litre	G. KCl in 1 litre	Sp. gr.	Degrees Baumé
10	293	1.185	22.5
20	285	1.185	22.5
30	276	1.190	23.0
40	265	1.192	23.0
50	255	1.195	23.5
60	245	1.200	24.0
70	236	1.200	24.0
80	226	1.205	24.5
90	219	1.205	24.5
100	211	1.210	25.0
110	205	1.210	25.0
120	199	1.215	25.5
130	192	1.215	25.5
140	185	1.220	26.0
150	178	1.225	26.5
160	171	1.225	26.5
170	165	1.230	27.0
180	159	1.235	27.5
190	153	1.240	28.0
200	148	1.245	28.5
210	142	1.250	29.0
220	137	1.255	29.5
230	133	1.260	30.0
240	128	1.265	30.5
250	124	1.270	30.8
260	120	1.275	31.3
270	115	1.280	31.7
280	112	1.285	32.0
290	108	1.290	32.5
300	104	1.295	33.0
310	100	1.300	33.5
320	96	1.305	34.0
330	93	1.310	34.2
340	89	1.315	34.6
350	85	1.320	35.0
360	81	1.325	35.5
370	78	1.330	36.0
380	74	1.335	36.3
390	71	1.340	36.7
400	68	1.345	37.1
410	64	1.350	37.5

Solubility in KOH+Aq at 20°.—*Continued.*

G. KOH in 1 litre	G. KCl in 1 litre	Sp. gr.	Degrees Baumé
420	61	1.355	38.0
430	58	1.360	38.5
440	55	1.365	38.9
450	53	1.370	39.2
460	50	1.375	39.5
470	47	1.380	40.0
480	44	1.385	40.2
490	42	1.390	40.6
500	40	1.397	41.0
510	38	1.405	41.5
520	35	1.410	42.0
530	33	1.415	42.3
540	31	1.420	42.6
550	29	1.425	43.0
560	27	1.430	43.5
570	25	1.435	43.7
580	24	1.440	44.0
590	23	1.445	44.3
600	22	1.450	44.6
610	21	1.455	45.0
620	20	1.460	45.5
630	18	1.465	45.9
640	17	1.470	46.2
650	16	1.475	46.5
660	15	1.480	46.8
670	15	1.485	47.0
680	15	1.490	47.5
690	15	1.495	47.9
700	14	1.500	48.2
710	14	1.505	48.5
720	13	1.510	48.8
730	13	1.515	49.1
740	13	1.520	49.5
750	13	1.525	49.7
760	12	1.530	50.0
770	12	1.535	50.3
780	12	1.540	50.6
790	11	1.545	51.0
800	11	1.550	51.3
810	10	1.560	51.5
820	10	1.565	51.8
830	9	1.570	52.2
840	9	1.575	52.6
850	9	1.580	53.0

(Winteler, Z. Elektrochem, 1900, **7**. 360.)

KCl+NaCl.

100 pts. KCl+NaCl+Aq sat. at 13–16° contain 30.18 pts. of the two salts. (v. Hauer.)

100 pts. H_2O dissolve 13.92 pts. KCl and 30.65 pts. NaCl at 15.6°, and solution has sp. gr. = 1.233. (Page and Keightley.)

100 pts. H_2O dissolve 10.11 pts. KCl, 32.15 pts. NaCl, and 4.69 pts. K_2SO_4, and solution has sp. gr. = 1.250. (P. and K.)

100 pts. H_2O dissolve 29.9 pts. NaCl and 15.7 pts. KCl at 18.8°. (Rüdorff.)

Solubility of KCl+NaCl in H_2O at t°. 100 pts. H_2O dissolve pts. KCl and pts. NaCl.

t°	Pts. KCl	Pts. NaCl	t°	Pts. KCl	Pts. NaCl
10	12.5	29.7	60	24.6	27.2
20	14.7	29.2	70	27.3	26.8
30	17.2	28.7	80	30.0	26.4
40	19.5	28.2	90	32.9	26.1
50	22.0	27.7	100	34.7	25.8

(Precht and Wittgen, B. **14**. 1667.)

100 pts. H_2O dissolve 13.99 pts. KCl+30.54 pts. NaCl = 44.53 pts. mixed salts at 20°. (Nicol, Phil. Mag. (5) **31**. 385.)

Solubility of KCl in NaCl+Aq at 20°.

G. per 100 g. H_2O	
NaCl	KCl
0.0	34.52
6.5	29.37
13.0	4.71
19.5	0.42

(Nicol, Phil. Mag. 1891, **31**. 369.)

Solubility of KCl+NaCl at t°.

t°	G. per 100 g. H_2O	
	KCl	NaCl
25	15.8	14.5
"	29.0	31.3
80	30.0	25.2
"	26.4	34.0

(Soch, J. phys. Ch. 1898, **2**. 46.)

Solubility of KCl+NaCl at ?

G. salts in 100 g. H_2O		
NaCl	KCl	Solid phase
9.89	28.34	KCl
18.35	22.75	"
29.88	16.28	KCl+NaCl
31.57	10.91	NaCl
33.17	5.65	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, **2**. 245.)

100 g. H_2O sat. with NaCl dissolve 0.216 gram-equivalent KCl at 25°.

100 g. H_2O sat. with K_2SO_4 dissolve 0.466 gram-equivalent KCl at 25°. (Euler, Z. phys. Ch. 1904, **49**. 315.)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91°. Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Chem. Soc. 1915, **108**. (2) 13.)

Solubility of KCl+NaCl in HCl+Aq at 25°.

% HCl	% NaCl	% KCl
0	19.95	10.90
8.61	10.65	7.58
17.16	3.56	3.80
20.65	2.03	2.86
32.78	0.18	1.27

(Hicks, J. Am. Chem. Soc. 1915, **37**. 846.)
See also under NaCl.

$KCl+SrCl_2$.
100 pts. H_2O dissolve 11.2 pts. KCl and 48.6 pts. $SrCl_2$ at 14.5°. (v. Hauer.)

If $SrCl_2$+Aq. sat. at 14.5 is sat. with KCl at same temp., 100 pts. H_2O dissolve:

KCl	33.2	11.2	...
$SrCl_2$	...	48.6	50.7
		59.8	

(Mulder, Scheik. Verhandel. **1864**.)

$KCl+(NH_4)_2SO_4$.
Sat. solution of $KCl+(NH_4)_2SO_4$ at b.-pt. when cooled to 14° has different composition from sat. solution of $(NH_4)Cl$ and K_2SO_4, and its composition is changed by warming it with either KCl or $(NH_4)_2SO_4$. (Rüdorff.)

$KCl+K_2SO_4$.
100 pts. H_2O contain the following amounts salt at 18.75°: (1) sat. with KCl alone; (2) sat. first with KCl then with K_2SO_4; (3) sat. with K_2SO_4 and KCl together; (4) sat. first with K_2SO_4 then with KCl; (5) sat. with K_2SO_4 alone.

	1	2	3	4	5
KCl	34.5	32.96	33.12	33.12	...
K_2SO_4	...	1.79	1.75	1.83	10.8

(Karsten.)

100 pts. H_2O sat. with both K_2SO_4 and KCl contain the following amounts.

	At 14.8°		
KCl	33.5	28.2	...
K_2SO_4	...	2.0	10.3

	At 15.8°		
KCl	33.6	27.9	...
K_2SO_4	...	2.3	10.4

	At 16.1°		
KCl	33.6	27.1	...
K_2SO_4	...	3.3	10.4

(Kopp, A. **34**. 264.)

Sat. K_2SO_4+Aq dissolves KCl only with pptn. of K_2SO_4, but sat. KCl+Aq dissolves some K_2SO_4 without any separation. (Karsten.)

Solubility of $KCl+K_2SO_4$: 100 pts. H_2O dissolve at t°.

t°	Pts. KCl	Pts. K_2SO_4	t°	Pts. KCl	Pts. K_2SO_4
10	30.9	1.32	60	43.8	1.94
20	33.4	1.43	70	46.5	2.06
30	36.1	1.57	80	49.2	2.21
40	38.7	1.68	90	52.0	2.38
50	41.3	1.82	100	54.5	2.53

(Precht and Wittgen.)

100 g. H_2O dissolve 34.76 g. KCl+2.93 g. K_2SO_4 at 25°. (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1898, **27**. 75.)
Sol. in 20% $KC_2H_3O_2$+Aq. (Stromeyer.)
Quickly attacked by liquid NO_2 in the presence of traces of moisture, with evolution of Cl_2. (Frankland, Chem. Soc. 1901, **79**. 1361.)
Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20**. 829.)
Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46**. 2.)
100 g. hydrazine dissolves 8.5 pts. KCl at 12.5–13°. (de Bruyn, R. t. c. 1899, **18**. 297.)
100 g. anhyd. hydroxylamine dissolve 12.3 g. KCl at 17–18°. (de Bruyn, Z. phys. Ch. 1892, **10**. 782.)

100 pts. alcohol of 0.900 sp. gr. dissolve 4.62 pts.; 0.872, 1.66 pts.; 0.834, 0.38 pt.; 0.817, 0.00 pt. KCl. (Kirwan.)
Sol. in 48 pts. boliing alcohol. (Wenzel.)
Insol. in absolute alcohol containing LiCl. (Mitscherlich.)

At 15°, 100 pts. alcohol of p percentage by volume (S=sp. gr.) dissolve pts. KCl as follows:

p	10	20	30	40
S	0.984	0.972	0.958	0.940
KCl	19.8	14.7	10.7	7.7

p	50	60	80
S	0.918	0.896	0.848
KCl	5.0	2.8	0.45

(Schiff, A. **118**. 365.)

100 pts. of a mixture of 40% alcohol with 60% H_2O dissolve 9.2 pts. KCl at 15°. (Schiff.)
Insol. in absolute alcohol or in 96% alcohol at 15° or below. At 20°, 100 pts. of the latter dissolve 0.04 pt.; at 25°, 0.06 pt.; at 30°, 0.20 pt. KCl. Dilute alcohol dissolves less KCl than the contained H_2O would dissolve by itself.

Solubility in dil. alcohol. D = sp. gr. of alcohol; S = solubility in 100 pts. alcohol at t°.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
t°	S	t°	S	t°	S	t°	S
0	23.2	4	20.9	4	16.4	3	12.2
4	24.8	20	25.5	21	20.3	5	12.7
22	29.4	27	26.6	28	22.0	16	15.4
25	30.2	30	27.5	43	25.6	20	16.1
34	32.8	37	29.0	..	...	25	17.3
52	37.5	60	35.2	..	...	34	19.0

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8244	
t°	S	t°	S	t°	S	t°	S
10	8.8	2	4.2	12	2.87	4	0.00
11	9.0	7	5.1	31	4.35	15	0.00
17	10.3	16	6.4	47	4.88	20	0.04
30	12.5	30	8.5	65	5.65	25	0.06
40	13.9	38	9.6	..	...	32	0.20
60	16.7	57	11.3	..	...	..	...

(Gerardin, A. ch. (4) **5.** 140.)

Solubility of KCl in dil. alcohol at 14.5°

Sp. gr.	100 ccm. contain		
	Alcohol	Water	KCl
1.1720	...	88.10	29.10
1.1542	2.79	85.78	26.85
1.1365	4.98	84.00	24.67
1.1075	10.56	79.63	20.56
1.1085	15.57	75.24	17.24
1.0545	20.66	70.52	14.27
1.0455	24.25	67.05	13.25
0.9695	40.42	50.18	6.35
0.9315	48.73	40.60	3.82
0.8448	68.63	15.55	0.30

(Bodländer, Z. phys. Ch. **7.** 316.)

Solubility of KCl in ethyl alcohol.

(G. KCl per 100 g. alcohol+Aq.)

Wt. % alcohol	at 30°	at 40°	Wt. % alcohol	at 30°	at 40°
0	38.9	41.8	43.1	11.1	13.1
5.28	33.9	35.9	55.9	6.8	8.2
9.43	30.2	33.3	65.9	3.6	4.1
16.9	24.9	27.6	78.1	1.3	1.6
25.1	19.2	21.8	86.2	0.4	0.5
34.1	15.6	17.2	...	...	...

(Bathrick, J. phys. Ch. 1896, **1.** 160.)

Solubility of KCl in ethyl alcohol at 0°.

Concentration of alcohol Mol. g. alcohol per 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
...	285.15	3.80
0.25	277.95	3.73
0.50	271.10	3.64
1.00	265.50	3.45
3.00	208.80	2.81

(Armstrong and Eyre, Proc. Roy. Soc. 1910, (A) **84.** 127.)

Solubility of KCl in ethyl alcohol +Aq at 25°.

Wt. % alcohol	G. KCl per 100 cc. sat. solution	Wt. % alcohol	G. KCl per 100 cc. sat. solution
0	31.18	60	4.18
10	23.93	70	2.27
20	17.89	80	0.93
30	13.27	90	0.31
40	9.40	100	0.08
50	6.26		

(McIntosh, J. phys. Ch. 1903, **7.** 350.)

100 pts. absolute methyl alcohol dissolve 0.5 pt. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.034 pt. at 18.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. 40% wood alcohol dissolve 9.2 pts. KCl. (Schiff.)

Solubility of KCl in methyl alcohol+Aq at 25°.

P = % by wt. of alcohol in alcohol+Aq.
S = Sp. gr. alcohol+Aq sat. with KCl.
L = millimols KCl in 100 ccm. of the solution.

P	S 25°/4°	L
0	1.1782	417.4
10.6	1.125	329
30.8	1.033	183
47.1	0.9679	102
64.0	0.9064	46.1
78.1	0.8607	20.6
98.9	0.8242	9.9
100	0.7937	5.7

(Herz and Anders, Z. anorg. 1907, **55.** 273.)

Solubility of KCl in methyl alcohol.

t°	Concentration of alcohol. Mol. g. alcohol per 1000 g. H_2O	Solubility 1 in 1000 g. H_2O	Molecular solubility
0	...	283.55	3.81
"	0.25	280.00	3.76
"	0.50	276.35	3.71
"	1.00	267.85	3.60
"	3.00	238.10	3.18
25	...	364.15	4.89
"	0.25	361.90	4.86
"	0.50	357.10	4.79
"	1.00	348.70	4.67
"	3.00	324.15	4.35

(Armstrong and Eyre, Proc. Roy. Soc. 1910 (A) **84**. 127.)

At room temp. 1 pt. by weight is sol. in:
200 pts. methyl alcohol, D^{15} 0.7990.
750 " ethyl " D^{15} 0.3035.
Insol. in propyl alcohol. (Rohland, Z. anorg. 1899, **18**. 325.)
100 g. methyl alcohol dissolve 0.53 g. KCl at 25°.
100 g. ethyl alcohol dissolve 0.022 g. KCl at 25°.
100 g. propyl alcohol dissolve 0.004 g. KCl at 25°.
100 g. isoamyl alcohol dissolve 0.0008 g. KCl at 25°.
(Turner and Bissett, Chem. Soc. 1913, **103**. 1909.)

Insol. in propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14**. 276.)

Solubility of KCl in propyl alcohol.

t°	Concentration of alcohol. Mol. g. per 1000 g. H_2O	Solubility in 1000 g. H_2O	Molecular solubility
0	...	283.55	3.81
"	0.25	274 10	3.68
"	0.50	265.45	3.56
"	1.00	248.0	3.33
25	...	365.10	4.90
"	0.25	355.40	4.77
"	0.50	347.70	4.67
"	1.00	331.50	4.45

(Armstrong and Eyre, Proc. Roy. Soc. 1910, (A) **84**. 127.)

Insol. in fusel-oil. (Gooch, Am. Ch. J. **9**. 53.)
Very sl. sol. in mixture of equal pts. absolute alcohol and ether. (Berzelius.)

500 mg. KCl treated with 10 g. of above mixture yield only 0.3 mg. to the liquid. (Lawrence Smith, Am. J. Sci. **16**. **56**.)
Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6**. 184; Eidmann, C. C. **1899**, II. 1014.)

Solubility of KCl in acetone+Aq at t.°

t°	% acetone	100 g. of the solution contain		
		G. H_2O	G. acetone	G.KCl
30	0	72.73	0.00	27.27
	5	71.15	3.74	25.11
	9.09	69.62	6 96	23.42
	20	64.88	16.22	18.90
	30	59.49	25.45	15.06
	40	53.17	35.52	11.31
	50	45.98	45.98	8.04
	60	37.97	56.91	5.12
	70	29.22	68.18	2.60
	80	19.82	79.43	0.76
	90	9.98	89.88	0.13
	100	0.00	100.00	0.00
40	0	71.31	0.00	28 69
	5	69.62	3.67	26.72
	9.09	67.88	6.79	25.33
	15	65.15	11.51	32.34
	20	62.97	15.75	21.28
	80	19.81	79.34	0.58
	85	14.94	84.66	0.40
	90	10.00	89.84	0.16
	95	4.97	94.96	0.07
	100	0.00	100.00	0.00

Since there is but one liquid phase here, these figures represent the solubility of KCl in acetone+Aq at 30° and 40°.

(Snell, J. phys. Chem. 1898, **2**. 484.)

The addition of KCl to mixtures of acetone and H_2O will cause a division into two layers. The following table gives the temp. at which sat. solutions of KCl in acetone+Aq of varying concentrations separate into two layers and also the compositions of the sat. solutions of KCl in acetone+Aq.

% acetone	Temp. of division	100 g. of solution contain		
		G. H_2O	G. acetone	G. KCl
26	46.5°	...	...	...
30	40.0	59.36	25.44	15.20
40	34.2	53.21	35.47	11.32
50	32.6	45.97	45.97	8.06
60	33.3	37.86	56.80	5.34
70	35.5	29.09	68.25	2.66
75	39.0	...	...	...
80	45.6	19.80	79.20	1.00

(Snell.)

The following table gives the compositions of the solutions of KCl in acetone+Aq at the points at which the solution just divides into two layers. Temp.=40°.

100 g. of the solution contain		
G. H_2O	G. acetone	G. KCl
56.68	28.63	14.68
53.05	35.67	11.29
50.34	39.82	9.83
47.60	43.83	8.58
44.35	48.36	7.29
42.68	50.75	6.57
38.53	56.26	5.21
36.59	58.84	4.57
32.37	64.18	3.45
30.62	66.43	2.95
28.12	69.45	2.44

(Snell.)

The addition of KCl to aqueous acetone causes the separation of the liquid into two layers. The following table gives the composition of these layers at 40°.

Upper layer contains per 100 g. of solution		
G. H_2O	G. acetone	G. KCl
55.20	31.82	12.99
54.27	36.69	12.03
53.27	35.44	11.29
51.69	37.76	10.55
51.23	48.50	10.27
50.34	39.88	9.77
49.08	41.67	9.26
48.02	43.18	8.79
47.62	43.73	8.64
46.49	45.34	8.17
45.65	46.52	7.83
45.64	46.57	7.79
58.99	25.24	15.77

Lower layer contains per 100 g. of solution		
G. H_2O	G. acetone	G. KCl
28.14	69.42	2.44
29.45	67.83	2.72
30.96	65.97	3.07
31.83	64.83	3.33
32.64	63.79	3.56
34.07	62.01	3.92
35.27	60.49	4.24
37.44	57.67	4.89
38.00	56.96	5.04
38.68	56.17	5.25
39.98	54.36	5.66
40.41	53.78	5.81
23.66	74.91	1.43

(Snell.)

Solubility in acetone+Aq at 20°.

A = ccm. acetone in 100 ccm. acetone+Aq.
KCl = millimols KCl in 100 ccm. of the solution.

A	KCl
0	410.5
10	351.7
20	286.6
30	223.7
40	166.5
50	115.4
60	71.2
70	38.5
80	12.9
90	2.0
100	...

(Herz and Knoch, Z. anorg. 1904, **41.** 317.)

Solubility of KCl in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq.
KCl = millimols KCl in 100 cc. of the solution.

G	KCl	Sp. gr.
0	424.5	1.1800
13.28	383.4	1.1848
25.98	339.3	1.1935
45.36	271.4	1.2106
54.23	238.5	1.2189
83.84	149.0	1.2590
100	110.6	1.2860

(Herz and Knoch, Z. anorg. 1905, **45**, 267.)

Insol. in CS_2. (Baeyer; Arctowski, Z. anorg. 1894, **6.** 257.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Solubility of KCl in organic compounds +Aq at 25°.

Compound	G. comp. per l. H_2O	G. KCl per 100 g. sat. solution
Water	....	26.89
Acetaldehyde	11.01	27.05
Paraldehyde	11.07	26.42
Glycerol	13.01	25.58
Glycol	15.51	26.43
"	62.05	25.26
Mannitol	45.53	24.86
"	136.59	24.46

(Armstrong and Eyre, Proc. Roy. Soc. 1913, A, **88.** 234.)

Solubility in pyridine+Aq at 10°.

Solvent		100 g. of the solution contain g. KCl
H_2O	Pyridine	
100	0	23.73
90	10	19.76
80	20	16.37
70	30	13.19
60	40	10.05
50	50	6.34
40	60	3.335
30	70	1 245
20	80	0.24
10	90	0.039
0	100	...

(Schroeder, J. pr. 1908, (2) **77.** 268.)

Insol. in anhydrous pyridine and in 97% pyridine+Aq.

Very sl. sol. in 95% pyridine+Aq.

Sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

100 ccm. of a sat. solution of KCl in furfurol at 25° contain 0.085 pts. by wt. KCl. (Walden, Z. phys. Ch. 1906, **55.** 713.)

100 g. H_2O dissolve 246.5 g. sugar+44.8 g. KCl at 31.25°; 100 g. sat. solution contain 62.28 g. sugar+11.33 g. KCl. (Köhler, Z. Ver. Zuckerind, 1897, **47.** 447.)

Solubility in glucose+Aq at 25°.

Concentration of glucose in 9. mol. per 1000 g H_2O	Solubility in 1000 g. H_2O	Molecular solubility
....	362.70	4.86
0.25	366 10	4.91
0.50	369.85	4.96
1.0	376.25	5.04
3.0	402.25	5.39

(Armstrong and Eyre, Proc. Roy. Soc. 1910, **84.** 127.)

Potassium manganic chloride, K_2MnCl_5.

Sol. in H_2O; less sol. in NH_4Cl+Aq; unstable. (Neuman, M. 1894, **15.** 492.)

Potassium rhodium chloride.

See **Chlororhodite, potassium.**

Potassium ruthenium ***sesqui*****chloride.**

See **Chlororuthenite, potassium.**

Potassium ruthenium ***tetra*****chloride.**

See **Chlororuthenate, potassium.**

Potassium tellurium chloride.

See **Chlorotellurate, potassium.**

Potassium thallic chloride, 3KCl, $TlCl_3$+$2H_2O$.

Sol. in H_2O. Not decomp. by boiling H_2O. (Rammelsberg.)

Potassium thorium chloride, KCl, $2ThCl_4$+$18H_2O$.

Deliquescent; sol. in H_2O and alcohol. (Berzelius.)

Potassium tin (stannous) chloride (Potassium chlorostannite), KCl, $SnCl_2$+H_2O.

Decomp. by H_2O; sol. in hot HCl or KCl+Aq. (Remsen and Richardson, Am. Ch. J. **14.** 90.)

2KCl, $SnCl_2$+H_2O. Partially decomp. by dissolving in H_2O. (Rammelsberg, Pogg. **94.** 507.)

+$2H_2O$. Very sol. in hot, and but slightly in cold HCl+Aq or KCl+Aq. (Remsen and Richardson.)

4KCl, $SnCl_2$+$3H_2O$. (Poggiale, C. R. **20.** 1182.)

Does not exist. (Remsen and Richardson.)

Potassium tin (stannic) chloride, 2KCl, $SnCl_4$.

See **Chlorostannate, potassium.**

Potassium tungsten chloride, $K_2(OH)WCl_5$.

Decomp. by moisture. Insol. in organic solvents. (Olsson, B. 1913, **46.** 581.)

$K_3W_2Cl_9$. Sol. in H_2O. Nearly insol. in most organic solvents. (Olsson.)

Potassium uranium chloride, UCl_4, 2KCl.

Very hydroscopic; sol. in H_2O with decomp.; sol. in acetic acid. Decomp. by alcohol. Nearly insol. in ether. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Potassium uranyl chloride, $K_2(UO_2)Cl_4$.

Very sol. in H_2O. Moderately sol. in dil. alcohol. (Aloy, Dissert. **1901.**)

+$2H_2O$. Very sol. in H_2O and alcohol. (Arfvedson.)

Sol. in H_2O, with decomp. and separation of KCl, unless H_2O is acidulated with HCl. (Peligot, A. ch. (3) **5.** 37.)

Solubility in H_2O at t°.

t°	100 pts. of the solution contain			Solid phase
	Pts. UO_2	Pts. Cl	Pts. K	
0.8	38.57	13.59	3.86	UO_2Cl_2, 2KCl, $2H_2O$ +KCl
14.9	33.71	13.51	...	"
17.5	37.36	14.50	5.27	"
25.0	35.01	15.26	...	"
41.5	35.27	15.92	7.39	"
50.0	34.18	16.56	...	"
60.0	34.19	17.25	9.14	UO_2Cl_2, 2KCl, $2H_2O$
71.5	33.55	17.44	9.28	"
78.5	35.26	18.24	9.95	"

(Rimbach, B. 1904, **37.** 463.)

Potassium uranyl chloride is decomp. by H_2O at temp. below 60°. Above 60°, it is sol. in H_2O without decomp.

Potassium vanadium chloride, $VK_2Cl_5+H_2O$.

Difficultly sol. in H_2O and alcohol. (Stähler, B. 1904, **37.** 4412.)

Potassium yttrium chloride.

Sol. in H_2O with evolution of heat.

Potassium zinc chloride, 2KCl, $ZnCl_2$.

Very deliquescent. Sol. in 1 pt. cold, and in all proportions of hot H_2O. (Pierre, A. ch. (3) **16.** 248.)

$+H_2O$. Not very deliquescent. Can be recryst. (Ephraim, Z. anorg. 1908, **59.** 58.)

KCl, $ZnCl_2+2H_2O$. Not deliquescent. Cannot be recryst. without decomp. (Ephraim.)

Potassium chloroiodide, KCl_2I.

Very unstable. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

KCl_4I. Sol. in H_2O with decomp. Ether dissolves out ICl_3. (Filhol, J. Pharm. **25.** 433.)

Potassium fluoride, KF or K_2F_2.

Very deliquescent. Very sol. in H_2O. Sl. sol. in HF+Aq. Easily sol. in conc. $KC_2H_3O_2$ +Aq. Insol. in alcohol. (Berzelius.) Sol. in dilute alcohol. (Stromeyer, A. **100.** 83.)

Sp. gr. of aqueous solution of KF at 18° containing—

5	10	20	30	40%	KF.
1.041	1.084	1.117	1.272	1.378	

(Kohlrausch, W. Ann. **1879.** 1.)

Solubility in HF+Aq at 21°.
(G. per 100 g. H_2O.)

HF	KF	HF	KF
0.0	96.3	13.95	31.4
1.21	72.0	15.98	33.4
1.61	61.0	17.69	35.6
3.73	40.4	20.68	38.4
4.03	32.5	28.60	46.9
6.05	30.4	41.98	61.8
9.25	29.9	53.71	74.8
11.36	29.6	74.20	105.0
12.50	30.5	119.20	169.5

(Ditte, C. R. 1896, **123.** 1282.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Very sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

KF will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of KF, acetone and H_2O just become homogeneous at 20°.

100 g. of the solution contain:

G. KF	G. H_2O	G. acetone	G. KF	G. H_2O	G. acetone
5.75	58.91	35.34	0.61	31.95	67.44
5.00	56.28	38.72	0.50	29.92	69.58
3.84	52.25	43.91	28.42	69.76	1.82
3.06	49.05	47.89	25.74	71.24	3.02
2.61	46.84	50.55	22.35	72.99	4.66
2.22	44.79	52.99	20.28	73.80	5.90
14.95	73.66	11.39	18.71	74.10	7.19
11.46	70.77	17.77	16.31	73.97	9.72
9.17	67.30	23.53	12.40	72.01	15.59
7.72	64.01	28.27	33.86	65.73	0.397
7.07	62.03	30.90	29.97	68.54	1.50
6.43	60.50	33.07	22.05	73.41	4.54
1.38	40.55	58.06	17.82	74.01	8.16
0.979	36.42	62.60	14.34	73.29	12.37
0.693	32.69	66.61	44.24	55.52	0.240
0.57	31.50	67.93	33.34	65.66	1.00
0.89	35.74	63.36	29.86	68.54	1.60
0.75	33.84	65.41	24.38	72.16	3.45

At the first quadruple point where the hydrate, acetone, water and vapor are in equilibrium the upper layer contains 98% acetone, while the lower layer contains in 100 g., 46.3 g. KF. A sat. solution of KF will thus dehydrate acetone to the extent of 98%.

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, **36.** 1115.)

Similar data are given for KF in ethyl and propyl alcohol by Frankforter and Frary. (J. phys. Ch. 1913, **17.** 402.)

$+2H_2O$. Very deliquescent. (Guntz, A. ch. (6) **3.** 20.)

Sat. aq. solution at 18° contains 45.3% KF (de Forcrand, C. R. 1911, **152.** 1210.)

Sp. gr. of solution sat. at 18° = 1.502, and contains 48% KF. (Mylius and Funk, B. 1897, **30.** 1718.)

$+4H_2O$. Not deliquescent. (de Forcrand, C. R. 1911, **152.** 1075.)

Sat. aq. solution at 18° contains 35.96% KF. (de Forcrand, C. R. 1911, **152.** 1210.)

Potassium hydrogen fluoride, KF, HF = KHF_2.

Easily sol. in H_2O. Sl. sol. in H_2O containing HF. Easily sol. in conc. $KC_2H_3O_2$+Aq. Sol. in dil. alcohol, but insol. in absolute alcohol.

KF, 2HF. Deliquescent. Decomp. by H_2O with absorption of heat. (Moissan, C. R. **106.** 547.)

KF, 3HF. As above. (Moissan.)

Potassium manganic fluoride.
See **Fluomanganate, potassium.**

Potassium scandium fluoride, K_3ScF_6.
Sol. in H_2O. Decomp. by acids. (R. J Meyer, Z. anorg. 1914, **86.** 275.)

Potassium silicon fluoride.
See **Fluosilicate, potassium.**

Potassium tantalum fluoride.
See **Fluotantalate, potassium.**

Potassium tellurium fluoride, KF, TeF_4.
Decomp. by H_2O. (Högbom, Bull. Soc. (2) **35.** 60.)

Potassium thallic fluoride, $2TlF_3$, KF.
Decomp. by moisture. Insol. in HF. (Gewecke, A. 1909, **366.** 226.)

Potassium thorium fluoride, 2KF, ThF_4+4H_2O.
Nearly insol. in H_2O. Sol. in HF+Aq.
KF, ThF_4. Precipitate. (Chydenius.)

Potassium tin (stannous) fluoride, 2KF, $3SnF_2+H_2O$.
Sol. in H_2O. (Wagner, B. **19.** 896.)

Potassium tin (stannic) fluoride.
See **Fluostannate, potassium.**

Potassium titanium ***tetra*****fluoride.**
See **Fluotitanate, potassium.**

Potassium titanium ***sesqui*****fluoride,** 4KF, Ti_2F_6.
Precipitate. Very sl. sol. in H_2O. Sol. in dil. acids. (Piccini, C. R. **97.** 1064.)
See also **Fluo*****sesqui*****titanate, potassium.**

Potassium titanyl fluoride.
See **Fluoxypertitanate, potassium.**

Potassium tungstyl fluoride.
See **Fluoxytungstate, potassium.**

Potassium uranium fluoride, KF, UF_4.
Insol. in H_2O and dil. acids. Difficultly sol. in conc. HCl+Aq. Sol. in conc. H_2SO_4. (Bolton, J. B. **1866.** 212.)

Potassium uranyl fluoride.
See **Fluoxyuranate, potassium.**

Potassium vanadium ***sesqui*****fluoride.**
See **Fluovanadate, potassium.**

Potassium vanadium ***tetra*****fluoride** (?).
Easily sol. in H_2O. Insol. in alcohol. (Berzelius.)

Potassium zinc fluoride, KF, ZnF_2.
Sol. in H_2O. (R. Wagner.)
2KF, ZnF_2. Sol. in H_2O. (Berzelius.)

Potassium zirconium fluoride.
See **Fluozirconate, potassium.**

Potassium fluoride hydrogen peroxide, KF, H_2O_2.
Not hydroscopic. Very sol. in H_2O. Is not decomp. at 70° and only partially so at 110° (Tanatar, Z. anorg. 1901, **28.** 255.)

Potassium fluoride vanadic acid.
See **Fluoxyvanadate, potassium.**

Potassium hydride, KH.
Decomp. by H_2O. Insol. in oil of turpentine, benzene, ether and CS_2. (Moissan, C. R. 1902, **134.** 18.)

Potassium hydrosulphide, KSH.
Very deliquescent, and sol. in H_2O with gradual decomp. Crystallizes with $\frac{1}{2}H_2O$. Sol. in alcohol.

Potassium hydroxide, KOH.
Very deliquescent, and sol. in H_2O with evolution of much heat. 100 pts. KOH, exposed over H_2O at 16–20° take up 460 pts. H_2O in 56 days. (Mulder.)

1 pt. KOH dissolves in 0.5 pt. cold H_2O (Lowitz); in 0.47 pt. cold H_2O (Bineau, C. R. **41.** 509); in 1 pt. H_2O. (Abl.)

Solubility of KOH in H_2O at t°.

t°	G. KOH per 100 g. H_2O	G. KOH per 100 g. solution	Solid phase
—22	3.7	3.6	Ice
—20.7	22.5	18.4	"
—65.2	44.5	30.8	"
—36.2	36.2	26.6	$KOH.4H_2O$
—32.7	77.94	43.8	"
—33	80	44.4	$KOH.4H_2O+KOH.2H_2O$
—23.2	85	45.9	$KOH.2H_2O$
0	97	49.2	"
10	103	50.7	"
15	107	51.7	"
20	112	52.8	"
30	126	55.76	"
32.5	135	57.44	$KOH.2H_2O+KOH.H_2O$
50	140	58.33	$KOH.H_2O$
100	178	64.03	"
125	213	68.06	"
143	311.7	75.73	"

(Pickering, Chem. Soc. 1893, **63.** 908.)

100 pts. KOH are sol. in 93.4 pts. H_2O at 15° or 100 pts. H_2O dissolve 107 pts. KOH at 15°. Sp. gr. = 1.5355 at 15°.

All higher values found in solubility tables are incorrect. (Ferchland, Z. anorg. 1902, **30.** 133.)

100 g. sat. aq. solution at 15° contain 50.48 g. KOH. (de Forcrand, C. R. 1909, **149.** 719.)

Sat. KOH+Aq boils at 157.7° (Griffiths); 340°. (Gerlach).

B.-pt. of KOH+Aq containing pts. KOH to 100 pts. H_2O.

B.-pt.	Pts. KOH	B.-pt.	Pts. KOH
105°	20.5	215°	210.5
110	34.5	220	219.8
115	46.25	225	230.0
120	57.5	230	240.9
125	67.5	235	251.9
130	76.8	240	263.1
135	85.0	245	274.4
140	92.5	250	285.7
145	99.8	255	298.5
150	106.5	260	312.5
155	114.05	265	328.0
160	121.7	270	343.5
165	129.35	275	359.0
170	137.0	280	375.0
175	144.8	285	391.0
180	152.6	290	408.2
185	160.4	295	425.5
190	168.2	300	444.4
195	176.5	310	484.0
200	185.0	320	526.3
205	193.5	330	571.5
210	202.0	340	623.6

(Gerlach, Z. anal. **26.** 464.)

Sp. gr. and b-pt. of KOH+Aq according to Dalton.

% K_2O	Sp. gr.	B.-pt.	% K_2O	Sp. gr.	B.-pt.
4.7	1.06	100.56°	36.8	1.44	123.89°
9.5	1.11	101.11	39.6	1.47	129.44
13.0	1 15	101.66	42 9	1 52	135.56
16.2	1.19	103.33	46.7	1.60	143.33
19 5	1.23	104.44	51.2	1.68	160 00
23 4	1 28	106.66	56.8	1.78	188 22
26.3	1.33	109 44	63.6	1.88	215.56
29.4	1.36	112.22	72.4	2.00	315 56
32.4	1.39	115.56	84.0	2.2	red heat
34.4	1.42	118.89	100	2.4	..

Sp. gr. of KOH+Aq at 15°.

% K_2O	Sp. gr.	% K_2O	Sp. gr.	% K_2O	Sp. gr.
0.568	1.0050	10 750	1.1059	20.935	1.2268
1.697	1.0153	11.882	1.1182	21.500	1.2342
2.829	1.0560	13 013	1.1308	22.632	1.2493
3.961	1.0369	14 145	1.1437	23.764	1.2648
5.002	1.0478	15.277	1.1568	24.895	1.2805
6.224	1.0589	16.408	1.1702	26.027	1.2966
7.355	1.0703	17.540	1.1839	27.158	1.3131
8.487	1.0819	18.671	1.1979	28.290	1.3300
9.619	1.0938	19.803	1.2122	..	..

(Zimmerman, N. J. Pharm. **18, 2.** 5.

Sp. gr. of KOH + Aq.

% K_2O	Sp. gr.	% K_2O	Sp. gr.	% K_2O	Sp. gr.
2.44	1.02	23.14	1.22	37.97	1.42
4.77	1.04	24.77	1.24	40.17	1.44
7.02	1.06	26.34	1.26	42.31	1.46
9 20	1.08	27.86	1.28	44.40	1.48
11.28	1.10	29.34	1.30	46.45	1.50
13.30	1.12	30.74	1.32	48.46	1.52
15.38	1.14	32.14	1.34	50.09	1.54
17.40	1.16	33.46	1.36	51.58	1.56
19.34	1.18	34.74	1.38	53.06	1.58
21.25	1.20	35.99	1.40	..	..

(Richter.)

Sp. gr. of KOH+Aq at 15°. a = sp. gr. if % is K_2O; b = sp. gr. if % is KOH.

%	a	b	%	a	b
1	1.010	1.009	31	1.370	1.300
2	1.020	1.017	32	1.385	1.311
3	1.030	1.025	33	1.403	1.324
4	1.039	1.033	34	1.418	1.336
5	1.048	1.041	35	1.431	1.349
6	1.058	1.049	36	1.445	1.361
7	1.068	1.058	37	1 460	1.374
8	1.078	1.065	38	1.475	1.387
9	1.089	1.074	39	1.490	1.400
10	1.099	1.083	40	1.504	1.411
11	1.110	1.092	41	1.522	1.425
12	1.121	1.110	42	1.539	1.438
13	1.132	1.111	43	1.564	1.450
14	1.143	1.119	44	1.570	1.462
15	1.154	1.128	45	1.584	1.472
16	1.166	1.137	46	1.600	1.488
17	1.178	1.146	47	1.615	1.499
18	1.190	1.155	48	1.630	1.511
19	1.202	1.166	49	1.645	1.527
20	1.215	1.177	50	1.660	1.539
21	1.230	1.188	51	1.676	1.552
22	1.242	1.198	52	1.690	1.565
23	1.256	1.209	53	1.705	1.578
24	1.270	1.220	54	1.720	1.590
25	1.285	1.230	55	1.733	1.604
26	1.300	1.241	56	1.746	1.618
27	1.312	1.252	57	1.762	1.630
28	1.326	1.264	58	1.780	1.641
29	1.340	1.278	59	1.795	1.655
30	1.355	1.288	60	1.810	1.667

(Calculated by Gerlach, Z. anal. **8.** 279, after Zimmermann, N. J. Pharm. **18, 2.** 5, and Schiff, A. **107.** 300.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
4.2	1.0382	21.0	1.2008
8.4	1.0776	25.2	1.2439
12.6	1.1177	29.4	1.2880
16.8	1.1588	...	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
10	1.077	50	1.539
20	1.175	60	1.667
30	1.288	70	1.790
40	1.411	.	...

(Gerlach, Z. anal. **27**. 275, calculated from Schiff, A. **107**. 300.)

Sp. gr. of K_2O+Aq at 15°.

% K_2O	Sp. gr.	% K_2O	Sp. gr.
5	1.054	30	1.358
10	1 111	35	1.428
15	1.171	40	1.500
20	1.231	45	1.576
25	1.294	..	...

(Hager, Adjumenta varia, Leipsic, **1876**.)

Sp. gr. of KOH+Aq at 20° containing 2 mols. KOH to 100 mols. H_2O = 1.05325. (Nicol, Phil. Mag. (5) **16**. 122.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.	% KOH	Sp. gr.
52	1.53822	34	1.33313	16	1.14925
51	1.52622	33	1.32236	15	1.13955
50	1.51430	32	1.31166	14	1.12991
49	1.50245	31	1.30102	13	1.12031
48	1.49067	30	1.29046	12	1.11076
47	1.47896	29	1.27997	11	1 10127
46	1.46733	28	1.26954	10	1.09183
45	1.45577	27	1.25918	9	1.08240
44	1.44429	26	1.24888	8	1.07302
43	1.43289	25	1.23866	7	1.06371
42	1.42150	24	1.22849	6	1.05443
41	1.41025	23	1.21838	5	1.04517
40	1.39906	22	1.20834	4	1.03593
39	1.38793	21	1.19837	3	1.02671
38	1.37686	20	1.18839	2	1.01752
37	1.36586	19	1.17855	1	1.00834
36	1.35485	18	1.16875	0	0.99918
35	1.34396	17	1.15898	..	...

(Pickering, Phil. Mag. 1894, (5) **37**. 375.)

Sp. gr. of N solution at 18°/4° = 1.0481. (Loomis, W. Ann. 1896, **60**. 550.)

Sp. gr. of KOH+Aq.

% KOH	6.87	12.10
Sp. gr. 20°/20°	1.0601	1.1025

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19**. 272.)

KOH+Aq containing equal pts. of KOH and H_2O freezes at —54°. (Guyton-Morveau, Gm.-K. **2, 1**. 18.)

KOH is completely miscible with NaOH and with RbOH in both the liquid and the solid states. (Hevesy, Z. phys Ch. 1910, **73**. 667.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20**. 828.)

Abundantly sol. in strong alcohol or wood-spirit.

See below under KOH+$2H_2O$.

Readily sol. in glycerine.

Sol. in not less than 25 pts. of ether. (Boullay.) Sol. in much more than 25 pts. of ether. (Connell.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**. 3790); ethyl acetate. (Naumann, B. 1904, **37**. 3601.)

Insol. in acetone. Readily sol. in fusel oil.

Insol. in acetone and in methylal. (Eidmann, C. C. **1899**, II. 1014.)

Sol. in aqueous solution of mannite. (Favre, A. ch. (3) **11**. 76.)

The composition of the hydrates formed by KOH at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by KOH and of the conductivity and sp. gr. of KOH+Aq. (Jones, Am. Ch. J. 1905, **34**. 337.)

+H_2O.

+$2H_2O$. Very deliquescent, and sol. in H_2O with absorption of much heat.

100 g. sat. solution in H_2O at 30° contain 55.75 g. anhyd. KOH. (de Waal, Dissert. **1910**.)

Solubility of KOH+$2H_2O$ in alcohol+Aq at 30°.

% KOH	% alcohol	% H_2O
55.75	0	44.25
54.81	0.43	44.76
...	...	...*
...	...	...
31.0	57.50	11.50
28.99	65.07	5.94
27.67	69.92	2.41
27.20	73.01	negative
26.25	81.98	"

*Separates into two layers.

(de Waal, Dissert, **1910**.)

+$4H_2O$.

Potassium hydrogen titanium *di*imide, Ti(NH)NK.

Decomp. by H_2O and alcohol. Insol. in all ord. indifferent organic solvents. (Ruff, B. 1912, **45.** 1371.)

Potassium iodide, KI.

Deliquescent only in very moist air. Very sol. in H_2O with absorption of heat.

The temp. of H_2O can be lowered 24° by dissolving KI. (Baup.)

140 pts. KI dissolved in 100 pts. H_2O at 10.8° lower the temp. 22.5°. (Rüdorff, Pogg. **136.** 276.)

100 pts. H_2O dissolve 126.6 pts. KI at 0° (Kremers); 127.8 pts. KI at 0° (Mulder); 127.9 pts. KI at 0°. (Gerardin.)

By boiling, 100 pts. H_2O dissolve 221 pts. KI at 120° (Baup); 222.2 pts. KI at 120° (Gay-Lussac); 222.6 pts. KI at 118.4° (Mulder); 223.58 pts. KI at 117° (Legrand); 223.6 pts. KI at 117°. (Gerardin.)

Between these temps. the solubility increases proportional to temp.

Sol. in 0.735 pt. H_2O at 12.5°; in 0.709 pt. H_2O at 16°; in 0.7 pt. H_2O at 18°; in 0.45 pt. H_2O at 120°. (Graham-Otto.)

100 pts. KI+Aq sat. at 15-16° contain 58.07 pts. KI. (v. Hauer, J. pr. **98,** 137.)

100 pts. H_2O at 12.5° dissolve 136 pts.; at 16°, 141 pts. KI. (Baup.)

100 pts. H_2O at 18° dissolve 143 pts. KI; at 120°, 271 pts. (Gay-Lussac.)

Sol. in 0.79 pt. H_2O at 0°; in 0.70 pt. H_2O at 20°; in 0.63 pt. H_2O at 48°; in 0.57 pt. H_2O at 60°; in 0.53 pt. H_2O at 80°; in 0.51 pt. H_2O at 100°. (Kremers, Pogg. **97.** 15.)

Sol. in 0.71 pt. H_2O at 15°. (Eder, Dingl. **221.** 89.)

Solubility of KI in 100 pts. H_2O at t°.

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
0	127.9	19	143.4	38	159
1	128.7	20	144.2	39	160
2	129.6	21	145.1	40	160
3	130.4	22	145.9	41	161
4	131.2	23	146.7	42	162
5	132.1	24	147.5	43	163
6	132.9	25	148.3	44	164
7	133.7	26	149.1	45	164
8	134.5	27	149.9	46	165
9	135.3	28	150.7	47	166
10	136.1	29	151.5	48	167
11	137.0	30	152.3	49	168
12	137.8	31	153	50	168
13	138.6	32	154	51	169
14	139.4	33	155	52	170
15	140.2	34	156	53	171
16	141.0	35	156	54	172
17	141.8	36	157	55	172
18	142.6	37	158	56	173

Solubility of KI in 100 pts., etc.—*Continued.*

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
57	174	78	191	99	208
58	175	79	192	100	209
59	175	80	192	101	210
60	176	81	193	102	211
61	177	82	194	103	212
62	178	83	195	104	213
63	179	84	196	105	213
64	180	85	197	106	214
65	180	86	197	107	215
66	181	87	198	108	216
67	182	88	199	109	217
68	183	89	200	110	218
69	184	90	201	111	219
70	184	91	202	112	220
71	185	92	202	113	220
72	186	93	203	114	221
73	187	94	204	115	222
74	188	95	205	116	223
75	188	96	206	117	223.6
76	189	97	207	...	...
77	190	98	208	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 63.)

Solubility of KI in 100 pts. H_2O at t°.

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
−22.65	107.2	21.05	143.3	71.1	183.5
−22.35	106.6	25.6	146.6	74.75	185.6
−16.8	111.1	29.1	149.6	81.6	192.0
−11.35	116.3	37.3	156.7	86.35	194.6
−5.9	120.4	42.3	160.3	93.5	200.3
0	126.1	45.75	163.6	100.7	205.6
+3.25	130.1	51.8	167.6	110.2	216.1
9.55	134.0	55.05	169.1	113.7	218.8
12.75	137.1	60.55	173.4	...	...
12.9	137.9	65.0	178.3	...	...

(Coppet, A. ch. (5) **30.** 417.)

Solubility is represented by a straight line of the formula 126.23+0.8088t. (Coppet.)

Solubility of KI in 100 pts. H_2O at high temp.

t°	Pts. KI	t°	Pts. KI
124	233.9	144	264.6
133	249.3	175	310.4

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

If solubility S = pts. KI in 100 pts. solution, S = 55.8+0.122t from 0° to 165°. (Étard, C. R. **98.** 1432.)

Sat. KI+Aq contains % KI at t°.

t°	% KI	t°	% KI
−21	50.7	78	64.8
−21	51.0	96	66.9
−21	51.2	150	70.6
−19	52.2	151	70.9
−15	53.2	175	71.6
−9	54.5	176	72.7
0	56.9	190	73.8
+21	59.3	193	74.5
44	60.8	213	75.7
72	64.3	...	...

(Étard, A. ch. 1894, (7) **2,** 542.)

Solubility of KI in 100 g. H_2O at t°.

t°	g. KI	t°	g. KI.
−1	122.2	−11.5	64.7
−5	119.8	−9.5	51.5
−4	117.4	−7	42.6
−10	115.1	−6	34.4
−14	75.8	−5	25.7

(Meusser, Z. anorg. 1905, **44.** 80.)

102.70 pts. by weight are contained in 100 cc. KI+Aq sat. at 25°, or 59.54 pts. in 100 g. of solution; sp. gr. = 1.7254.

94.05 pts. by weight are contained in 100 cc. KI+Aq sat. at 0°, or 56.34 pts. in 100 g. of solution; sp. gr. = 1.6699. (Walden, Z. phys. Ch. 1906, **55.** 715.)

Solubility of KI in H_2O at low temperatures.

t°	% KI	Solid phase	t°	% KI	Solid phase
−12.5	38	Ice	−22	52.1	KI
−15	41.2	"	−20	52.6	"
−17.5	44.6	"	−15	53.5	"
−20	48	"	−10	54.5	"
−22.5	51.2	"	−5	55.4	"
−23.2	51.9	" +KI	0	56.4	"

(Kremann and Kershbaum, Z. anorg. 1907, **56.** 218.)

149.26 g. KI dissolve in 100 g. H_2O at 25°. (Amadori and Pampanini, Rend. Acc. Linc. 1911, V, **20.** 473.)

60.39 g. in 100 g. KI+Aq sat. at 25°. (Parsons and Whittemore, J. Am. Chem. Soc. 1911, **33.** 1934.)

56.1 g. in 100 g. KI+Aq sat. at 0°; 60.35 g. in 100 g. KI+Aq sat. at 30°. (Van Dam and Donk, Chem. Weekbl. 1911, **8.** 848.)

Sp. gr. of KI+Aq at 21°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
1	1.0075	21	1.1807	41	1.4224
2	1.0151	22	1.1911	42	1.4371
3	1.0227	23	1.2016	43	1.4520
4	1.0305	24	1.2122	44	1.4671
5	1.0384	25	1.2229	45	1.4825
6	1.0464	26	1.2336	46	1.4982
7	1.0545	27	1.2445	47	1.5142
8	1.0627	28	1.2556	48	1.5305
9	1.0710	29	1.2699	49	1.5471
10	1.0793	30	1.2784	50	1.5640
11	1.0877	31	1.2899	51	1.5810
12	1.0962	32	1.3017	52	1.5984
13	1.1048	33	1.3138	53	1.6162
14	1.1136	34	1.3262	54	1.6343
15	1.1226	35	1.3389	55	1.6528
16	1.1318	36	1.3519	56	1.6717
17	1.1412	37	1.3653	57	1.6911
18	1.1508	38	1.3791	58	1.7109
19	1.1605	39	1.3933	59	1.7311
20	1.1705	40	1.4079	60	1.7517

(Schiff, A. **110.** 75.)

Sp. gr. of KI+Aq. S = according to Schiff (A. **108.** 340) at 21°; K = according to Kremers (Pogg. **96.** 62), interpolated by Gerlach (Z. anal. **8.** 285.)

	5	10	15	20	25	30% KI,
S	1.038	1.079	1.123	1.171	...	1.279
K	1.038	1.078	1.120	1.166	1.218	1.271

	35	40	45	50	55	60% KI.
S	...	...	1.483	...	...	...
K	1.331	1.396	1.469	1.546	1.636	1.734

Sp. gr. of KI+Aq at 18°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
5	1.0363	30	1.273	55	1.630
10	1.0762	40	1.3966	..	...
20	1.1679	50	1.545	..	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of KI+Aq at 18°.

% KI	Sp. gr.
1.044	1.0062
5.0	1.0363

(Grotrian, W. Ann. 1883, **18.** 191.)

Sp. gr. at 16°/4° of KI+Aq containing 32.4875% KI = 1.30238. (Schönrock, Z. phys. Ch. 1893, **11.** 781.)

KI+Aq containing 9.35% KI has sp. gr. 20°/20° = 1.0726.

KI+Aq containing 11.35% KI has sp. gr. 20°/20° = 1.0892. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

B.-pt. of KI+Aq containing pts. KI to 100 pts. H_2O.

B.-pt.	Pts. KI	B.-pt.	Pts. KI	B.-pt.	Pts. KI
101°	15	108°	111.5	115	185°
102	30	109	123	116	195
103	45	110	134	117	205
104	60	111	145	118	215
105	74	112	155	118.5	220
106	87	113	165	...	...
107	99.5	114	175	...	...

(Gerlach, Z. anal. **26.** 439.)

Sat. KI+Aq boils at 119°. (Kremers.)

Sat. KI+Aq forms a crust at 117.5°, and contains 210 pts. KI to 100 pts. H_2O; highest temp. observed, 118.5°. (Gerlach, Z. anal. **26.** 426.)

Solubility of KI in I_2+Aq at 25°.

KI mol./l.	I g.-atoms/l.
6.15	0.00
6.23	3.64
6.40	11.11
6.36	13.16
6.33	13.2
6.24	17.03

(Abegg, Z. anorg. 1906, **50.** 428.)

Solubility of $KI+I_2$ in H_2O at 25°.

% KI	% I	Solid phase	% KI	% I	Solid phase
29.45	64.34	$KI+KI_3$	25.88	68.79	KI_7+I_2
28.91	63.88	"	25.57	69.01	"
26.84	66.54	KI_3+KI_7	27.86	66.56	KI_3
27.18	67.14	"	27.27	66.91	"
27.14	66.60	"	26.95	67.17	KI_7
			25.71	67.91	"

(Foote and Chalker, Am. Ch. J. 1908, **39.** 564.)

See also under Iodine.

KI+Aq sat. at 14.5° containing 139.8 pts. KI to 100 pts. H_2O dissolves 1.0 pt. K_2SO_4 with separation of 2.2 pts. KI, so that solution contains 137.6 pts. KI and 1.0 pt. K_2SO_4 to 100 pts. H_2O. (Mulder, Rotterdam, **1864.**)

100 pts. H_2O dissolve 86.3 pts. KI and 2.1 pts. Na_2SO_4 at 14.5°. (Mulder, J. B. **1866.** 67.)

Sol. in $AsCl_3$, $SnCl_4$ and $POCl_3$. (Walden, Z. anorg. 1900, **25.** 214.)

Attacked by dry liquid NO_2 with liberation of I_2. (Frankland, Chem. Soc. 1901, **79.** 1361.

Sol. in liquid SO_2. (Walden, B. 1899, **32.** 2864.)

Solubility in SO_2 decreases with rise of temp. (Walden, Z. phys. Ch. 1903, **42.** 456.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Hydrazine dissolves 135.7 pts. KI at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)

100 pts. alcohol of 0.85 sp. gr. dissolve 18 pts. KI at 12.5°. 100 pts. absolute alcohol dissolve 2.5 pts. KI at 13.5°. Much more sol. in hot alcohol. (Baup.)

100 pts. alcohol of D sp. gr. at 0° dissolve at 18°—

D	0.9904	0.9851	0.9726	0.9665	0.9528
	130.5	119.4	100.1	89.9	76.9 pts. KI,

D	0.9390	0.9088	0.8464	0.8322
	66.4	48.2	11.4	6.2 pts. KI.

That is, aqueous alcohol dissolves approximately the same amount of KI that the water present in the alcohol would dissolve, and it is therefore probable that KI is insol. in strictly absolute alcohol. (Gerardin.)

Solubility in 100 pts. alcohol of 0.9496 sp. gr. at:

8°	13°	25°	46°	55°	62°
67.4	69.2	75.1	84.7	87.5	90.2 pts. KI.

(Gerardin, A. ch. (4) **5.** 155.)

Sol. in 68.3 pts. absolute alcohol (Eder, Dingl. **221.** 89); in 370 pts. ether (sp. gr. 0.729), (Eder, *l. c.*); in 120 pts. alcohol-ether (1 : 1), (Eder, *l. c.*)

Sol. in 10–12 pts. 90% alcohol, and 40 pts. absolute alcohol. (Hager, Comm. **1883.**)

100 pts. absolute methyl alcohol dissolve 16.5 pts. at 20.5°; 100 pts. absolute ethyl alcohol dissolve 1.75 pts. at 20.5°. (de Bruyn, Z. phys. Ch. **10.** 783.)

Solubility of KI in methyl alcohol+Aq at 25°.

P = % by wt. of alcohol in alcohol+Aq.
S = Sp. gr. of alcohol+Aq sat. with KI.
L = millimols KI in 100 ccm. of the solution.

P	S 25°/4°	L
0	1.7213	620
10.6	1.634	555
30.8	1.460	431
47.1	1.325	335
64.0	1.185	243
78.1	1.066	169
98.9	0.9700	113
100	0.9018	80

(Herz and Anders, Z. anorg. 1907, **55.** 274.)

Solubility of KI in CH_3OH.

G = g. KI in 100 g. of the solution.
t_1 = temp. of complete solution.
t_2 = temp. at which salt begins to separate out.

G	t_1	t_2
8.64	...	266°
12.95	0°	...
14.2	20	...
14.6	...	262
14.97	25	..
19.2	85	256
26.8	115	242
28.9	144	229
29.6	188	196
33.0	...	...

(Centnerszwer, Z. phys. Ch. 1910, **72.** 432.)

Solubility of KI in methyl alcohol at t°.

t°	g. KI in 100 g. alcohol	t°	g. KI in 100 g. alcohol
15	14.50	180	30.7
30	16.20	200	29.1
50	18.9	220	27.5
80	22.5	240	24.8
100	25.0	245	22.6
120	27.2	247	21.0
140	29.2	250	13.8
160	30.6	252.5*	7.6

*Critical temp. of solution.

(Tyrer, Chem. Soc. 1910, **97.** 626.)

At room temp. 1 pt. KI by weight is sol. in
6 pts. methyl alcohol D^{15} 0.7990.
16 " ethyl " D^{15} 0.8322.
219 " propyl " D^{15} 0.8160.

(Rohland, Z. anorg. 1898, **18.** 325.)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. KI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution at 25°.

P	G	S 25°/4°
0.00	0.155	0.8015
4.37	0.191	0.8041
10.40	0.225	0.8071
41.02	0.494	0.8295
80.69	1.013	0.8794
84.77	1.072	0.8795
91.25	1.184	0.8908
100.00	1.316	0.9018

(Herz and Kuhn, Z. anorg. 1908, 60. 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. KI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	1.316	0.9018
11.11	1.096	0.8823
23.8	0.854	0.8629
65.2	0.262	0.8187
91.8	0.060	0.8045
93.75	0.058	0.8041
100	0.043	0.8041

(Herz and Kuhn.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. KI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.155	0.8015
8.1	0.146	0.7983
17.85	0.137	0.7991
56.6	0.075	0.7988
88.6	0.052	0.8022
91.2	0.049	0.8027
95.2	0.044	0.8029
100	0.043	0.8041

(Herz and Kuhn.)

100 g. methyl alcohol dissolve 18.04 g. KI at 25°.
100 g. ethyl alcohol dissolve 2.16 g. KI at 25°.
100 g. propyl alcohol dissolve 0.43 g. KI at 25°.
100 g. isoamyl alcohol dissolve 0.09 g. KI at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

0.455 g. is sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 276.)

Alcoholic solution can be mixed with ½ vol. ether without pptn.

100 g. 95% formic acid dissolve 38.2 g. KI at 18.5°. (Aschan, Chem. Ztg. 1913, 37. 1113.)

Solubility in organic solvents at t°.

C = pts. by wt. of KI in 100 ccm. of the sat. solution.

L = no. of litres which at the saturation temp. hold in solution 1 mol. KI.

S = sp. gr. of the solution at t°, referred to H_2O at t°.

p = pts. by wt. of KI in 100 g. of the solution.

Solvent	t°	C	L	S	p
Water	25°	102.70	0.162	1.7254	59.54
"	0°	94.05	0.177	1.6699	56.32
Methyl alcohol	25°	13.48	1.231	0 9003	14.97
"	25°	14.26	...		
"	0°	11.61	1.430	0.8964	12.95
Ethyl alcohol	25°	1 520	10.92	0 7908	1 922
"	0°	1.197	13.87	0 8085	1.479
Glycol	25°	45.85	0.362	1.3888	33.01
"	25°	47.23	0.351	..	.
"	0°	43.28	0.383	1 3954	31 03
Acetonitrile	25°	1 551	10.70	..	.
"	25°	1.590	10.44	0 7936	2 003
"	0°	1.852	9.00	0 8198	2 259
Propionitrile	25°	0.316	52.53	0 7821	0.404
"	25°	0 355	46 76	.	
"	0°	0.344	48 26	0 8005	0 429
"	0°	0.412	40.29	..	.
Benzonitrile	25°	0 051	325 5	1.0076	0 050
Nitromethane	25°	0 349	47.56	1.1367	0 307
"	25°	0.289	57.44	.	
"	0°	0 366	45 36	1 1627	0 315
"	0°	0.314	52.87	.	.
Nitrobenzene	25°	0.0019	87.40	..	.
Acetone	25°	1.038	16.0	0.7968	1.302
"	0°	1.732	9.58	0.8227	2.105
Furfurol	25°	5 93	2 80	1 2014	4 94
"	0°	15.10	1.10	..	.
Benzaldehyde	25°	0.343	48.4	1.0446	0 328
Salicylaldehyde	25°	0.549	30.24	1 1373	0.483
"	0°	1.257	13 21	1 1501	1 093
Anisaldehyde	25°	0.720	23.06	1.1180	0 644
"	0°	1.520	10.92	1.1223	1 355
Ethyl acetate	25°	0.0013	12.80	.	.
Methyl cyan-acetate	25°	2.459	6.75	1.1358	2 165
"	0°	3 256	5.10	1.1521	2 827
Ethyl cyan-acetate	25°	0.888	18.7	1.0579	0.839
"	25°	1.090	15.23	1.0678	1.021

(Walden, Z. phys. Ch. 1906, **55.** 715.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Sol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, **11.** 538.)

100 pts. acetone dissolve 2.930 pts. KI at 25°. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Sol. in acetone, insol. in methylal. (Eidmann, C. C. **1899.** II. 1014.)

3.08 pts. sol. in 100 pts. acetone at −2.5°.
2.38 " " " 100 " " " +22°.
1.21 " " " 100 " " " 56°.

0.26 " " " 100 " pyridine " 10°.
0.11 " " " 100 " " " 119°.

(Laszczynski, B. 1894, **27.** 2287.)

Freely sol. in glycerine. Insol. in acetic acid. (Berthemot.)

Sol. in 3 pts. glycerine; insol. in olive oil. (Cap and Garot.)

100 g. glycerol dissolve 40 g. KI at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Potassium *tri*iodide, KI_3.

Very deliquescent; very sol. in H_2O and alcohol. (Johnson, Chem. Soc. **1877,** **1.** 249.)

Solution of I in KI contains this salt (see KI). Decomp. by heat or shaking with CS_2, ether, chloroform. Sol. in alcohol, from which CS_2 does not remove I. (Jörgensen, J. pr. (2) **2.** 247.)

Potassium *per*iodide.

Solubility determinations show that the compds. KI_3 and KI_7 are the only periodides of potassium which form solids at 25°. *See under* KI+I. (Foote and Chalker, Am. Ch. J. 1908, **39.** 566.)

KI_7. *See above.*

Potassium mercuric iodide ammonia, K_2HgI_4, $2NH_3$.

(Peters, Z. anorg. 1912, **77.** 188.)

Potassium silver iodide, KI, AgI.

Sol. in KI+Aq. Sol. in hot alcohol. (Boullay, A. ch. **34.** 377.)

2KI, AgI, Sol. in KI+Aq. Decomp. by H_2O (Boullay.)

Hygroscopic. (Hellwig, Z. anorg. 1900, **25.** 180.)

3KI, AgI. Decomp. by H_2O. (Ditte, C. R. **93,** 415.)

KI, 2AgI. Sol. in methylethylketone. (Marsh, Chem. Soc. 1913, **103.** 783.)

Potassium silver *poly*iodide, AgK_3I_{12}, $3KI+5H_2O$.

Very deliquescent. (Johnson, Chem. Soc. **33.** 183.)

Potassium tellurium iodide.

See **Iodotellurate, potassium.**

Potassium thallic iodide, KI, TlI_3.

Decomp. by H_2O. Can be crystallized from alcohol. (Willm.)

3KI, $2TlI_3+3H_2O$. Partially decomp. by H_2O. (Rammelsberg.)

Potassium (tin) stannous) iodide, KI, $SnI_2+1\frac{1}{2}H_2O$.

When treated with a small quantity of H_2O, KI dissolves out; but when more H_2O is added, the substance is completely dissolved. More sol. in warm than cold alcohol. (Boullay.)

Potassium zinc iodide, KI, ZnI_2.

Very deliquescent. (Rammelsberg, Pogg. **43.** 665.)

$K_2ZnI_4+2H_2O$. Hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 382.)

Potassium iodide sulphur dioxide, KI, SO_2.

(Péchard, C. R. 1900, **130.** 1188.)

$KI, 4SO_2$. (Walden, Z. phys. Ch. 1903, **42.** 439.)

$KI, 14SO_2$. (Walden.)

Potassium nitride, K_3N.

Decomp. violently by H_2O. (H. Davy.)

Potassium ruthenium ***di*****hydronitrosobromide,** $Ru_2H_2NOBr_3, 2HBr, 3KBr$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 362.)

Potassium ruthenium nitrosochloride, $Ru_2H_2NOCl_3, 3KCl, 2HCl$.

Sl. sol. in H_2O. (Brizard, C. R. 1899, **129.** 216.)

Potassium ***sub*****oxide.**

Decomposes H_2O.

Does not exist. (Lupton, Chem. Soc. **1876, 2.** 565.)

Potassium oxide, K_2O.

Very sol. in H_2O with much heat.

See **Potassium hydroxide.**

Potassium ***di*****oxide,** K_2O_2.

Deliquescent. Sol. in H_2O.

Forms compound $K_2O_2, 2H_2O_2$. (Schöne, A. **193.** 241.)

Potassium ***per*****oxide,** K_2O_4.

Deliquescent. Very sol. with decomp. in H_2O.

Potassium silicon oxyfluoride, $SiF_2(OK)_2$ and $SiO(F)OK$.

(Schiff and Bechi, A. Suppl. **4.** 33.)

Potassium tantalum oxyfluoride, $K_4Ta_4O_5F_{14}$.

Insol. in boiling water. Easily sol. in HF+Aq. (Marignac, A. ch. (4) **9.** 268.)

Potassium phosphide, KP_3.

Decomp. by H_2O. (Joannis, C. C. **1894,** II. 834.)

KP_5. Easily decomp. by H_2O. (Hugot, C. R. 1895, **121.** 208.)

Potassium hydrogen phosphide, PH_2K.

Decomp. by H_2O. (Joannis, C. R. 1894, **119.** 558.)

Potassium phosphoselenide, $KSeP=K_2Se, P_2Se$.

Sol. in cold H_2O with rapid decomp. Sol. in alcohol with slight decomp. (Hahn, J. pr. **93.** 430.)

Potassium phospho***tri*****selenide,** $2K_2Se, P_2Se_3$.

Deliquescent. Decomp. violently with H_2O. Sol. in alcohol or ether, or in a mixture of the two, with slight decomp., but decomp. gradually on the air. (Hahn, J. pr. **93.** 430.)

Potassium phospho***penta*****selenide,** $K_4P_2Se_7=2K_2Se, P_2Se_5$.

Deliquescent; immediately decomp. by H_2O, alcohol, or ether. (Hahn.)

Potassium phosphosulphide, $4K_2S_2, P_2S_3$.

Deliquescent. Sol. in H_2O with decomp.

Potassium selenide, K_2Se.

Sol. in H_2O with subsequent decomp. on the air.

Insol. in liquid NH_3; sol. in air free H_2O to a colorless liquid. (Hugot, C. R. 1899, **129.** 299.)

$+2H_2O$. Sol. in H_2O with decomp. (Clever, Z. anorg. 1895, **10.** 143.)

$+9$, 14, or $19H_2O$. (Fabre, C. R. **102.** 613.)

Potassium ***tetra*****selenide,** K_2Se_4.

Easily sol. in H_2O. Decomp. on standing.

Sol. in liquid NH_3. (Hugot, C. R. 1899, **129.** 299.)

Potassium ***mono*****sulphide,** K_2S.

Deliquescent. Sol. in H_2O and alcohol. H_2O solution decomp. on air.

Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 81.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+5H_2O$. (Schöne, Pogg. **131.** 380.)

All potassium sulphides are sol. in glycerine; insol. in ether and ethyl acetate.

Potassium ***di*****sulphide,** K_2S_2.

Sol. in H_2O and alcohol, with gradual decomp.

Potassium ***tri*****sulphide,** K_2S_3.

Sol. in H_2O and alcohol, with gradual decomp. on the air.

Potassium ***tetra*****sulphide,** K_2S_4.

Sol. in H_2O and alcohol.

$+2H_2O$. Sol. in H_2O. Sl. sol. in alcohol.

$+8H_2O$. Sol. in H_2O. Alcohol takes out water. (Schöne.)

Potassium ***penta*****sulphide,** K_2S_5.

Sol. in H_2O and alcohol.

Potassium palladium sulphide.
See **Sulphopalladate, potassium.**

Potassium platinum sulphide.
See **Sulphoplatinate, potassium.**

Potassium silver sulphide,
$4Ag_2S$, K_2S+2H_2O.
Decomp. by H_2O. (Ditte, C. R. 1895, **120.** 91.)

Potassium rhodium sulphide, $3K_2S$, Rh_2S_3.
Decomp. by H_2O. (Leidié.)

Potassium tellurium sulphide.
See **Sulphotellurate, potassium.**

Potassium thallium sulphide, K_2S, Tl_2S_3.
Not decomposed by H_2O, or hot NH_4OH, or $KOH+Aq$. Decomp. by HCl or moderately conc. H_2SO_4+Aq. Hot HNO_3+Aq decomp. with separation of S. (Schneider, J. pr. **110.** 168.)

Potassium tin (stannic) sulphide.
See **Sulphostannate, potassium.**

Potassium zinc sulphide, K_2S, 3ZnS.
Not attacked by H_2O, but easily decomp. by the most dil. acids. (Schneider, J. pr. (2) **8.** 29.)

Potassium telluride, K_2Te.
Sol. in H_2O. (Demarçay, Bull. Soc. (2) **40.** 99.)
Sol. in H_2O and liquid NH_3. (Hugot, C. R. 1899, **129.** 388.)

Praseocobaltic chloride,
$Co(NH_3)_4Cl_3+H_2O$.
Easily sol. in H_2O.
Dil. $HCl+Aq$ dissolves traces; conc. $HCl+Aq$ dissolves more. Sol. in NH_4OH+Aq with decomp. Sol. in conc. H_2SO_4 without decomp. Sl. sol. in dil. H_2SO_4+Aq. (Rose.)

—— **mercuric chloride,** $Co(NH_3)_4Cl_3$, $HgCl_2$.
Sl. sol. in cold H_2O; insol. in $HgCl_2+Aq$. (Vortmann, B. **15.** 1892.)

—— **chloride** ***di*****chromate,**
$[CoCl_2(NH_3)_4]_2Cr_2O_7+H_2O$.
Scarcely sol. in cold, easily sol. in warm H_2O. (Vortmann, B. **15.** 1897.)

Praseocobaltic chloride nitrate,
$CoCl_2(NH_3)_4NO_3+H_2O$.
Much less sol. in H_2O than the chloride. Precipitated from aqueous solution by dil. HNO_3+Aq. (Vortmann, B. **15.** 1896.)

Praseodymicotungstic acid.

Ammonium praseodymicotungstate,
$2(NH_4)_2O$, Pr_2O_3, $16WO_3+16H_2O$.
Very sl. sol. in H_2O. Decomp. by acids and alkalies. (E. F. Smith, J. Am. Chem. Soc. 1904, **26.** 1478.)

Barium praseodymicotungstate, 4BaO, Pr_2O_3, $16WO_3+7H_2O$.
Ppt. Insol. in H_2O.
6BaO, Pr_2O_3, $16WO_3+9H_2O$. Ppt. (E. F. Smith.)

Silver praseodymicotungstate, $4Ag_2O$, Pr_2O_3, $16WO_3+8H_2O$.
Insol. in H_2O. (E. F. Smith.)

Praseodymium, Pr.

Praseodymium bromide, $PrBr_3+6H_2O$.
Very sol. in H_2O; sol. in HBr. (von Schule, Z. anorg. 1898, **18.** 353.)

Praseodymium carbide, PrC_2.
Decomp. by H_2O; insol. in conc. HNO_3, decomp. by dil. HNO_3. (Moissan, C. R. 1900, **131.** 597.)

Praseodymium chloride, $PrCl_3$.
Very sol. in H_2O. Insol. in PCl_3 or $SnCl_4$. Sol. in alcohol. Insol. in ether and most organic solvents. (Matignon, C. R. 1902, **134.** 427.)
2.14 g. $PrCl_3$ dissolve in 100 g. pyridine at 15°. (Matignon, Int. Cong. App. Chem. 1909, **2.** 53.)
$+H_2O$.
$+3H_2O$.
$+7H_2O$. 100 g. H_2O dissolve 334.2 g. $PrCl_3+7H_2O$ or 103.9 g. of the anhydrous salt at 13°. The aqueous solution sat. at 14° has a sp. gr. 16°/16° = 1.687. At 100°, the solubility in H_2O is unlimited. (Matignon, A. ch. 1906, (8) **8.** 388.)
Sol. in conc. HCl. (von Schule, Z. anorg. 1898, **18.** 352.)
100 pts. of a solution of the salt in $HCl+Aq$ contain at 13°, 41.05 pts. of anhydrous salt and 7.25 pts. HCl. Sp. gr. of this solution at 16° = 1.574. (Matignon, A. ch. 1906, (8) **8.** 388.)

Praseodymium hydride, PrH_3 (?).
(Muthmann, A. 1904, **331.** 59.)

Praseodymium hydroxide.
Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, **26.** 49.)

Praseodymium nitride, PrN.
Decomp. in moist air with evolution of NH_3. (Muthmann, A. 1904, **331.** 59.)

Praseodymium oxide, Pr_2O_3.

Easily sol. in H_2O. (v. Welsbach, M. **6.** 477.)

Decomp. by heating in the air. (Scheele, Z. anorg. 1898, **17.** 322.)

Praseodymium *monoper***oxide,** $Pr(OH)_2.H_2O$.

(Melikoff, Chem. Soc. 1902, **82.** (2) 140.)

Praseodymium *super***oxide,** $Pr(OH)_2(OOH)$.

Ppt. (Melikoff, C. C. **1902,** I. 172.)

Praseodymium *trisuper***oxide,** $Pr(OOH)_3$.

Ppt. (Melikoff.)

Praseodymium *per***oxide,** Pr_4O_7.

Sol. in acids with evolution of O. (v. Welsbach.)

Praseodymium oxysulphide, Pr_2SO_2.

(Biltz, Z. anorg. 1911, **71.** 436.)

Praseodymium *di***sulphide,** PrS_2.

Decomp. by heat. (Biltz, Z. anorg 1911, **71.** 437.)

Purpureocobaltic salts.

For other purpureocobaltic salts, *see*—

Chloropurpureocobaltic salts.
Bromopurpureocobaltic salts.
Nitratopurpureocobaltic salts.
Sulphatopurpureocobaltic salts.

Purpureocobaltic cobalticyanide, $Co(NH_3)_5Co(CN)_6+1\frac{1}{2}H_2O$.

Insol. in H_2O.

—— **ferricyanide,** $Co(NH_3)_5Fe(CN)_6$.

Insol. in cold H_2O. Probably belongs to roseo series.

—— **mercuric hydroxychloride,** $CoN_5H_{11}(HgCl)_3(HgOH)Cl_3$.

Ppt. (Vortmann and Morgulis, B. **22.** 2645.)

$CoN_5H_{11}(HgOH)_4Cl_3$. Ppt. (V. and M.)

—— **mercuriodide, basic,** $CoN_5H_{11}(HgI_2)_2(HgOH)_3I_3$.

Ppt. Sl. sol. in acids. Sol. in KI+Aq. (Vortmann and Borsbach, B. **23.** 2804.)

—— **molybdate,** $Co_2O_3(NH_3)_{10}$, $7MoO_3+3H_2O$ (?).

Insol. in H_2O or dil. $HC_2H_3O_2$+Aq. (Carnot, C. R. **109.** 109.)

—— **sulphate.**

See **Sulphatopurpureocobaltic salts.**

—— **tungstate,** $Co(NH_3)_5O(WO_4)$.

Scarcely sol. in cold or hot H_2O. (Gibbs.)

$Co_2O_3(NH_3)_{10}$, $10WO_3+9H_2O$ (?). Insol. in H_2O, or dil. $HC_2H_3O_2$+Aq, or NH_4OH+Aq. (Carnot, C. R. **109.** 147.)

Purpureocobaltic vanadate, $Co_2O_3(NH_3)_{10}$, $5V_2O_5+9H_2O$ (?).

Ppt. Insol. in H_2O (Carnot, C. R. **109.** 147.)

Purpureocobaltic octamine salts.

See **Octamine cobaltic purpureo salts.**

Pyrosulphuric acid, $H_2S_2O_7$.

See **Disulphuric acid.**

Radium, Ra.

Radium A.

More sol than Radium B and C in all solvents; sol. even in organic solvents, especially CS_2. (Ramstedt, Le Radium, 1913, **10.** 159.)

Radium B.

More quickly sol. than Radium C in H_2O and acids; less quickly sol. in alkaline solutions; very sl. sol. in organic solvents. (Ramstedt, Le Radium, 1913, 10. 159.)

Radium C.

Sol. in common acids, less so in alkaline solutions and in H_2O, only very sl. sol. in organic solvents. (Ramstedt, Le Radium, 1913, **10.** 159; Chem. Soc. 1913, **104.** (2) 659.)

Radium bromide.

Less sol. in H_2O than corresponding Ba comp. (Curie, Dissert. **1903.**)

Radium chloride.

Less sol. in H_2O than corresponding Ba comp. (Curie, Dissert. **1903.**)

Radium emanation.

Coefficient of absorption for H_2O = 0.245 at 3°; 0.23 at 20°; 0.17 at 40°; 0.135 at 60°; 0.12 at 70°; 0.12 at 80°. (Hofmann, Phys. Zeit. 1905, **6.** 339.)

Solubility in H_2O at t°.

Coefficient of solubility = conc. of the emanation in the liquid: conc. of the emanation in the gas.

t°	Coefficient of solubility
0	0.506
4.3	0.424
5.7	0.398
10.0	0.340
14.0	0.303
17.6	0.280
20.0	0.245
26.8	0.206
31.6	0.193
39.1	0.160

Coefficient of solubility in sea-water of sp. gr. at 14° = 1.022 is 0.255.

(Boyle, Phil. Mag. 1911, (6) **22.** 850.)

Solubility in H_2O.

Temp.	0.5°	17.5°	35°	41°	51°
Sol.	0.526	0.283	0.183	0.161	0.138
Temp.	60°	74°	79°	82°	91°
Sol.	0.127	0.112	0.111	0.111	0.108

(Kofler, M. 1913, **34.** 389.)

Coefficient of solubility of radium emanation at 14° in various solvents.

Ethyl alcohol	7.34
Amyl alcohol	9.31
Toluene	13.7
Sea water	0.255
Mercury	0

(Boyle, Phil. Mag. 1911, (6) **22.** 851.)

Coefficient of solubility emanation of radium in various solvents at t°.

Solvents	t = 18°	t = 0°	t = −18°
Ethyl acetate	7.35	9.41	13.6
Acetone	6.30	7.99	10.8
Absolute alcohol	6.17	8.28	11.4
Aniline	3.80	4.43	...
Benzene	12.82	16.54 at 3°	...
Chloroform	15.08	20.5	28.5
Cylclohexane	18.04 at 80°	...	...
Water	0.285	0.52	...
Ether	15.08	20.09	29.1
Glycerine	0.21	...	...
Hexane	16.56	23.4	35.2
Paraffine oil	9.2	12.6	...
Carbon-bisulphide	23.14	33.4	50.3
Toluene	13.24	18.4	27
Xylene	12.75	...	...

(Ramstedt, Le Radium, 1911, **8.** 255.)

Solubility in various oils, etc., at t°.

Rape oil		Poppy seed oil		Oil of turpentine	
t°	Solubility	t°	Solubility	t°	Solubility
−3	51.2	−5	50.5	−21	42.5
10	35.3	16	30.2	0	23.1
20	26.1	40	19.1	18	16.6
100	6.2	65	12.4	50	7.5
200	3.3	90	8.4	6.5	4.08

Solubility in 10% dammar resin in oil of turpentine = 16.7 at 18°.

Solubility in 5% colophony in amyl alcohol = 11.2 at 20°.

Solubility in amyl alcohol = 10.6 at 18°.

Solubility in 20% colophony in amyl alcohol = 11.1 at 20°.

(Curie, Thesis. **1910.**)

Coefficient of absorption for petroleum =
22.70 at −21°.
12.87 at +3°.
9.55 at 20°.
8.13 at 40°.
7.01 at 60°.

(Hofmann, Phys. Zeit. 1905, **6.** 339.)

Rhodicyanhydric acid, $H_3Rh(CN)_6$.

Not known in the free state.

Potassium rhodicyanide, $K_3Rh(CN)_6$.

Sol. in H_2O. Easily decomp. by acids.

Very sol. in H_2O. (Leidié, C. R. 1900, **130.** 89.)

Rhodium, Rh.

Insol. in all acids, including aqua regia.

Rhodium "sponge" is sol. in HNO_3+Aq, and somewhat in HCl+Aq when exposed to air.

Rhodium ammonia compounds.

See—

Bromopurpureorhodium comps., $BrRh(NH_3)_5X_2$.

Chloropurpureorhodium comps., $ClRh(NH_3)_5X_2$.

Iodopurpureorhodium comps., $IRh(NH_3)_5X_2$.

Luteorhodium comps., $Rh(NH_3)_6X_3$.

Nitratopurpureorhodium comps., $(NO_3)Rh(NH_3)_5X_2$.

Roseorhodium comps., $Rh(NH_3)_5(OH_2)X_3$.

Xanthorhodium comps., $(NO_2)Rh(NH_3)_5X_2$.

Rhodium *tri*bromide, $RhBr_3+2H_2O$.

Very sol. in H_2O. (Goloubkine, Chem. Soc. 1911, **100.** (2) 45.)

Rhodium rubidium bromide.

See **Bromorhodite, rubidium.**

Rhodium sodium bromide.

See **Bromorhodite, sodium.**

Rhodium *di*chloride, $RhCl_2$ (?).

Insol. in H_2O, HCl, or HNO_3+Aq. Not attacked by boiling KOH or K_2CO_3+Aq. (Fellenberg.)

Decomp. by boiling KOH+Aq. (Berzelius.)

Does not exist. (Leidié, C. R. **106.** 1076.

Rhodium *tri*chloride, $RhCl_3$.

Insol. in acids, even aqua regia. When boiled for a long time with KOH+Aq, it becomes sl. sol. in HCl+Aq.

Insol. in H_2O and acids; sol. in alkalies+Aq. (Leidié, C. R. 1899, **129.** 1251.)

$+4H_2O$. Very sl. deliquescent. Easily sol. in H_2O, HCl+Aq, or alcohol. Insol. in ether. Decomp. by H_2SO_4 only when boiling. (Claus, J. pr. **80.** 282.)

No definite amount of crystal H_2O. (Leidié A. ch. (6) **17.** 271.)

Rhodium chloride *with* **MCl.**
See **Chlororhodite, M.**

Rhodium *di***hydroxide,** RhO_2, $2H_2O$, *or* **Rhodium rhodate,** Rh_2O_3. RhO_3+6H_2O.
Sol. in HCl+Aq.

Rhodium *sesqui***hydroxide,** $Rh_2O_6H_6$.
Only sl. sol. in conc. HCl+Aq. (Claus.)
$+2H_2O$. Easily sol. in HCl, H_2SO_4, H_2SO_3, HNO_3, or HSCN+Aq; also when moist, in $HC_2H_3O_2$+Aq. Sol. in conc. KOH+Aq; very sl. sol. in H_3BO_3, H_3PO_4, $H_2C_4H_4O_6$, and HCN +Aq. Sol. in acid alkali oxalates+Aq. (Leidié, C. R. **107.** 234.)

Rhodium *tri***iodide,** RhI_3.
Ppt. (Goloubkine, Chem. Soc. 1911, **100.** (2) 45.)

Rhodium *mono***xide,** RhO.
Not attacked by acids. (Deville and Debray, A. ch. (3) **61.** 83.)

Rhodium *sesqui***oxide,** Rh_2O_3.
Insol. in H_2O, boiling KOH+Aq, or any acid, even aqua regia. (Claus.)

Rhodium *di***oxide,** RhO_2.
Insol. in all acids or alkalies.

Rhodium *tri***oxide,** RhO_3.
"Rhodic acid." Known only in solution of "Potassium rhodate," which is very easily decomp. (Claus.)

Rhodium oxybromide, $Rh(OH)_2Br+2H_2O$.
Sol. in H_2O. (Goloubkine, Chem. Soc. 1911, **100.** (2) 45.)

Rhodium *mono***sulphide,** RhS.
Insol. in aqua regia.

Rhodium *sesqui***sulphide,** Rh_2S_3.
Sol. in alkali sulphides+Aq. (Debray, C. R. **97.** 1332.)
Insol. in alkali sulphides+Aq. Not attacked by HNO_3, aqua regia, or Br_2+Aq. (Leidié, Bull. Soc. (2) **50.** 664.)

Rhodium sodium sulphide, $3Na_2S$, Rh_2S_3.
Decomp. by H_2O. (Leidié.)

Rhodium *sesqui***sulphydroxide,** $Rh_2S_6H_6$.
Easily sol. in aqua regia or Br_2+Aq. Insol. in alkali sulphides+Aq or acids. (Leidié, Bull. Soc. (2) **50.** 664.)

Rhodochromium bromide,
$HOCr_2(NH_3)_{10}Br_5+H_2O$.
Rather difficultly sol. in H_2O. Decomp. by boiling or standing. Sol. in NH_4OH+Aq or NaOH+Aq. Insol. in dil. HBr+Aq, KBr+Aq, or alcohol. (Jörgensen, J. pr. (2) **25.** 321.)

—— **bromide, basic,** $HOCr_2(NH_3)_{10}(OH)Br_4$ $+H_2O$.
Sl. sol. in H_2O. Sol. in NH_4OH or NaOH+Aq. Insol. in alcohol. (Jörgensen.)

—— **bromoplatinate,** $HOCr_2(NH_3)_{10}Br_3PtBr_6$, $HOCr_2(NH_3)_{10}Br_3(PtBr_6)_2+4H_2O$.
Ppt. (Jörgensen.)

—— **chloraurate,** $HOCr_2(NH_3)_{10}Cl_3(AuCl_4)_2$ $+2H_2O$.
Difficultly sol. but not insol. in H_2O. (Jörgensen).

—— **chloride,** $HOCr_2(NH_3)_{10}Cl_5+H_2O$.
Sol. in about 40 pts. of cold H_2O. Insol. in cold dil. HCl+Aq, NH_4Cl+Aq, or alcohol. Sol. in NH_4OH+Aq. (Jörgensen, J. pr. (2) **25.** 321.)

—— **chloroiodide, basic,**
$HOCr_2(NH_3)_{10}(OH)Cl_2I_2$.
Sl. sol. in cold H_2O; insol. in alcohol. (Jörgensen.)

—— **chloroplatinate,** $HOCr_2(NH_3)_{10}Cl_3PtCl_6$, $HOCr_2(NH_3)_{10}Cl(PtCl_6)_2+4H_2O$.
Precipitate. (Jörgensen.)

—— **dithionate,** $[HOCr_2(NH_3)_{10}]_2(S_2O_6)_5+$ $2H_2O$.
Nearly insol. in H_2O.

—— **dithionate, basic,**
$HOCr_2(NH_3)_{10}OH(S_2O_6)_2+H_2O$.
Insol. in H_2O, cold NH_4OH+Aq, or NaOH+Aq.

—— **iodide,** $HOCr_2(NH_3)_{10}I_5+H_2O$.
Very difficultly sol. in H_2O. Insol. in very dil. HI+Aq or alcohol. Sl. sol. in NH_4OH or KOH+Aq. (Jörgensen.)

—— **nitrate,** $HOCr_2(NH_3)_{10}(NO_3)_5$.
Rather difficultly sol. in H_2O, from which it is precipitated by a few drops of HNO_3+Aq. Sol. in hot dil. NH_4OH+Aq.

—— **nitrate chloroplatinate,**
$HOCr_2(NH_3)_{10}(NO_3)(PtCl_6)_2+4H_2O$.
Precipitate. (Jörgensen.)

Rhodochromium sulphate,
$[HOCr_2(NH_3)_{10}]_2(SO_4)_5+2H_2O$.
Very sl. sol. in cold H_2O. Easily sol. in cold dil. H_2SO_4+Aq.

Almost insol. in a mixture of 3 vols. H_2O, 1 vol. alcohol, and $^1/_3$ vol. dil. H_2SO_4+Aq. (Jörgensen.)

Rhodonitrous acid.

Ammonium rhodonitrite, $(NH_4)_6Rh_2(NO_2)_{12}$.

Nearly insol. in cold, sl. sol. in hot H_2O. Insol. in conc. NH_4Cl or $NH_4C_2H_3O_2$+Aq. Insol. in alcohol. (Leidié, C. R. **111.** 108.)

Barium rhodonitrite, $Ba_3Rh_2(NO_2)_{12}$.

Sl. sol. in cold, more easily in hot H_2O. (Lamy.)

+$12H_2O$. Sol. in 50 pts. H_2O at 16°, and 6.5 pts. at 100°. (Leidié, C. R. **111.** 108.)

Potassium rhodonitrite, $K_6Rh_2(NO_2)_{12}$.

Nearly insol. in cold, very sl. sol. in boiling H_2O. Completely insol. in KNO_2+Aq, and in KCl+Aq (30% KCl), or $KC_2H_3O_2$+Aq (50% $KC_2H_3O_2$). Insol. in alcohol. (Leidié, C. R. **111.** 106.)

Sodium rhodonitrite, $Na_6Rh_2(NO_2)_{12}$.

Sol. in 2½ pts. H_2O at 17°, and 1 pt. at 100°. Insol. in alcohol. Decomp. by HCl+Aq. (Leidié, C. R. **111.** 107.)

Rhodosochromium bromide.

Sol. in H_2O; insol. in dil. HBr+Aq (1 : 1). (Jörgensen, J. pr. (2) **45.** 260.)

—— **chloraurate,** $Cr_2(NH_3)_6(HO)_3Cl_3$, $2AuCl_3+2H_2O$.

Not insol. in cold H_2O. (Jörgensen.)

—— **chloride,** $Cr_2(NH_3)_6(HO)_3Cl_3+2H_2O$.

Sol. in 10.6 pts. H_2O at 18°; decomp. by boiling. Pptd. by ½ to 1 vol. dil. HCl+Aq. Sol. in cold dil. NH_4OH+Aq. (Jörgensen, J. pr. (2) **45.** 260.)

—— **chloroplatinate,** $2Cr_2(NH_3)_6(OH)_3Cl_3$, $3PtCl_4+6H_2O$.

Insol. in H_2O. (Jörgensen.)

$Cr_2(NH_3)_6(OH)_3Cl_3$, $2PtCl_4+2H_2O$. Insol. in 95% alcohol. (Jörgensen.)

—— **chromate,** $[Cr_2(NH_3)_6(OH)_3]_2(CrO_4)_3+7H_2O$. (Jörgensen.)

Very sl. sol. in H_2O. (Jörgensen.)

—— **iodide,** $Cr_2(NH_3)_6(OH)_3I_3+2H_2O$.

Sol. in H_2O. Insol. in dil. HI+Aq. (Jörgensen.)

—— **nitrate,** $Cr_2(NH_3)_6(OH)_3(NO_3)_3+H_2O$.

Much less sol. in cold H_2O than the chloride. Insol. in dil. HNO_3+Aq. (Jörgensen.)

—— **oxalate,** $[Cr_2(NH_3)_6(OH)_3]_2(C_2O_4)(HC_2O_4)_4+2H_2O$.

Sol. in cold H_2O, but not very easily. (Jörgensen.)

Rhodosochromium sulphate, $[Cr_2(NH_3)_6(OH)_3]_2(SO_4)_3+5H_2O$.

Very sl. sol. in cold H_2O. Easily sol. in dil. NH_4Cl+Aq. (Jörgensen.)

$[Cr_2(NH_3)_6(OH)_3]SO_4$, $HSO_4+1½H_2O$. Decomp. by H_2O into H_2SO_4 and above compound. (Jörgensen.)

—— *per***sulphide,** $[Cr_2(NH_3)_6(OH)_3]_2S_{11}+4H_2O$.

Ppt. Insol. in H_2O. (Jörgensen.)

Rhodosulphuric acid.

Potassium rhodosulphate, $K_6Rh_2(SO_4)_6$.

Two modifications:

(a) Slowly sol. in cold, easily in hot H_2O.

(b) Insol. in H_2O.

Does not exist. (Leidié, C. R. **107.** 234.)

Sodium rhodosulphate.

Insol. in H_2O, HCl, HNO_3, or aqua regia. (Claus.)

Does not exist. (Leidié.)

$Na_2Rh_2(SO_4)_4$. Insol. in H_2O. (Seubert and Kobbé, B. **23.** 2560.)

Rhodosulphurous acid.

Potassium rhodosulphite, $K_6Rh_2(SO_3)_5+6H_2O$.

Nearly insol. in H_2O. Slowly sol. in acids. Not decomp. by boiling KOH+Aq. (Claus.)

Sodium rhodosulphite, $Na_6Rh_2(SO_3)_5+4½H_2O=3Na_2SO_3$, $2RhSO_3$.

Insol. in cold, very sl. sol. in hot H_2O. Easily sol. in HNO_3+Aq. (Seubert and Kobbé, B. **23.** 2558.)

Roseochromium bromide, $Cr(NH_3)_5Br_3+H_2O$.

Easily sol. in H_2O. Insol. in HBr+Aq. (Christensen, J. pr. (2) **23.** 26.)

—— **bromochromate,** $Cr(NH_3)_5Br(CrO_4)$.

Somewhat sol. in H_2O, but decomp. on standing. (Jörgensen, J. pr. (2) **25.** 398.)

—— **bromoplatinate,** $Cr(NH_3)_5Br(PtBr_6)+2H_2O$.

Precipitate. Difficultly sol. in H_2O. (Christensen, *l. c.*)

—— **chloride,** $Cr(NH_3)_5Cl_3+H_2O$.

Easily sol. in H_2O with subsequent decomp. Insol. in alcohol. (Christensen, J. pr. (2) **23.** 26.)

—— **mercuric chloride,** $Cr(NH_3)_5Cl_3$, $3HgCl_2+2H_2O$.

Sl. sol. in H_2O. Sol. in dil. HCl+Aq with decomposition. (Christensen, *l. c.*)

Roseochromium dithionate, basic, $Cr(NH_3)_5(OH)_2S_2O_6+H_2O$.

Easily sol. in very dil. HCl+Aq. (Jörgensen, J. pr. (2) **25.** 398.)

—— **iodide,** $Cr(NH_3)_5I_3$.

Easily sol. in H_2O; decomp. by boiling. (Christensen, *l. c.*)

—— **nitrate,** $Cr(NH_3)_5(NO_3)_3+H_2O$.

Rather easily sol. in H_2O. (Christensen, *l. c.*)

$Cr(NH_3)_5(NO_3)_3(OH_2)_2$, HNO_3. Decomp. by H_2O or alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— **sulphate,** $[Cr(NH_3)_5]_2(SO_4)_3+5H_2O$.

Easily sol. in H_2O. Precipitated by alcohol. (Christensen, *l. c.*)

—— **sulphate bromoplatinate,** $[Cr(NH_3)_5(SO_4)]_2PtBr_6$.

Difficultly sol. in H_2O. (Christensen, *l. c.*)

—— **sulphate chloroplatinate,** $[Cr(NH_3)_5(SO_4)]_2PtCl_6$.

Difficultly sol. in H_2O. (Christensen, *l. c.*)

Roseocobaltic bromide, $Co(NH_3)_5(OH_2)Br_3$.

Sol. in H_2O; insol. in HBr+Aq. (Jörgensen, J. pr. (2) **31.** 49.)

—— **bromoplatinate,** $Co(NH_3)_5(OH_2)Br_3$, $PtBr_4+H_2O$.

Somewhat sol. in H_2O or dil. alcohol. Insol in strong alcohol. (Jörgensen.)

$2Co(NH_3)_5(OH_2)Br_3$, $3PtBr_4+4H_2O$. Ppt. (Jörgensen.)

—— **bromosulphate,** $Co(NH_3)_5(OH_2)Br(SO_4)$.

Sol. in H_2O. (Krok.)

—— **bromosulphate bromaurate,** $Co(NH_3)_5(OH_2)(SO_4)Br$, $AuBr_3$.

—— **carbonate.**

Very sol. in H_2O.

—— **chloraurate,** $Co(NH_3)_5(OH_2)Cl_3$, $AuCl_3$. Moderately sol. in cold H_2O.

—— **chloride,** $Co(NH_3)_5(OH_2)Cl_3$.

Sol. in 4.8 pts. H_2O at 10.1°, but decomp. on heating.

100 pts. H_2O dissolve 16.12 pts. at 0°, and 24.87 pts. at 16.19°. (Kurnakoff, J. russ. Soc. **24.** 269.)

Sl. sol. in 1000 pts. fuming HCl+Aq, more easily in 20% HCl+Aq. (Rose.)

Roseocobaltic mercuric chloride, $Co(NH_3)_5(OH_2)Cl_3$, $3HgCl_2+H_2O$.

More easily sol. in solvents than the anhydrous purpureo salt. (Carstanjen.)

$Co(NH_3)_5(OH_2)Cl_3$, $HgCl_2$. Sol. in HCl+Aq with decomp. into above salt. (Jörgensen.)

—— **chloroplatinate,** $Co(NH_3)_5(OH_2)Cl_3$, $PtCl_4+½H_2O$.

Decomp. by H_2O. (Jörgensen.)

$2Co(NH_3)_5(OH_2)Cl_3$, $PtCl_4+2H_2O$. Decomp by H_2O.

$2Co(NH_3)_5(OH_2)Cl_3$, $3PtCl_4+6H_2O$. Not difficultly sol. in warm H_2O. (Gibbs.)

$Co(NH_3)_5Cl_3$, $PtCl_4+H_2O$. (Gibbs.)

—— **chlorosulphate,** $Co(NH_3)_5Cl(SO_4)$.

Easily sol. in H_2O.

—— **chlorosulphate mercuric chloride,** $Co(NH_3)_5Cl(SO_4)$, $HgCl_2+3H_2O$.

Sol. in hot H_2O, and can be recrystallized without decomp. (Krok.)

—— *di*chromate, $[Co(NH_3)_5]_2(Cr_2O_7)_3+5H_2O$.

Can be recrystallized out of weak acetic acid.

—— **cobalticyanide,** $Co(NH_3)_5(OH_2)Co(CN)_6$.

Nearly absolutely insol. in cold H_2O. (Jörgensen.)

$+H_2O$. (Gibbs and Gentele.)

—— **dithionate,** $Co(NH_3)_5(S_2O_6)(OH)$.

Decomp. by H_2O. (Rammelsberg, Pogg. **58.** 296.)

$Co(NH_3)_5(OH_2)(S_2O_6)+2H_2O$. Ppt. (Jörgensen.)

—— **hydroxide,** $Co(NH_3)_5(OH)_3$.

Known only in aqueous solution.

—— **mercuric hydroxychloride,** $CoN_5H_{12}(HgOH)_3Cl_3$.

Ppt. Sol. in dil. acids. (Vortmann and Morgulis, B. **22.** 2646.)

$CoN_5H_{12}(HgOH)_3Cl_2(OH)$. Ppt. Sol. in dil. acids. (Vortmann and Morgulis.)

—— **iodide,** $Co(NH_3)_5(OH_2)I_3$.

Less sol. in H_2O than bromide. Insol. in HI+Aq. (Jörgensen.)

—— **iodosulphate,** $Co(NH_3)_5(OH_2)I(SO_4)$.

Easily sol. in H_2O. (Krok.)

—— **mercuriodide,** $[CoN_5H_{13}]_2(HgI)_3I_6$.

Ppt. (Vortmann and Borsbach, B. **23.** 2805.)

$CoN_5H_{13}(HgI)_2I_3$. Ppt. (Vortmann and Borsbach.)

$CoN_5H_{13}(HgI)_2I_2(OH)$. Ppt.

Roseocobaltic nitrate, $Co(NH_3)_5(OH_2)(NO_3)_3$.

Three modifications:

α. Sol. in 20 pts. H_2O at 15°. (Jörgensen.)

β. Known only in solution. Insol. in cold HNO_3+Aq. (Gibbs.)

γ. Easily sol. in hot H_2O. (Gibbs.) (Purpureo salt ?)

$Co(NH_3)_5(OH_2)(NO_3)_3$, HNO_3. Decomp. by H_2O or alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

—— **nitrate chloroplatinate,** $Co(NH_3)_5(OH_2)(NO_3)Cl_2$, $PtCl_4+H_2O$.

Ppt. (Jörgensen.)

—— **nitratosulphate,** $Co(NH_3)_5(OH_2)(NO_3)(SO_4)$.

Sl. sol. in cold, easily in hot H_2O.

—— **oxalate,** $[Co(NH_3)_5(OH_2)]_2(C_2O_4)_3+2H_2O$.

Nearly insol. in H_2O.

$[Co(NH_3)_5]_2(C_2O_4)_3$, $4H_2C_2O_4$.

—— **oxalochloroplatinate,** $[Co(NH_3)_5]_2C_2O_4Cl_2$, $PtCl_4$.

Sol. in hot H_2O.

—— **oxalosulphate,** $[Co(NH_3)_5]_2(SO_4)_2C_2O_4$, $H_2C_2O_4+2H_2O$.

Sol. in hot H_2O.

$[Co(NH_3)_5]_2(SO_4)_2(C_2O_4)(OH)_2+6H_2O$. Sl. sol. in H_2O.

—— *ortho***phosphate,** $Co(NH_3)_5(OH_2)(PO_4H)(OH)+xH_2O$.

Nearly insol. in H_2O.

$[Co(NH_3)_5(OH_2)]_2(PO_4H)_3+4H_2O$. Very sl. sol. in cold H_2O; easily in H_2O containing HCl. (Jörgensen.)

—— *pyro***phosphate,** $[Co(NH_3)_5(OH_2)]_4(P_2O_7)_3+12H_2O$.

Insol. in H_2O. (Jörgensen.)

$Co(NH_3)_5(OH_2)(P_2O_7Na)+12H_2O$. Nearly insol. in cold, easily sol. in hot H_2O containing NH_4OH. (Jörgensen, J. pr. (2) **23.** 252.)

—— **sulphate,** $[Co(NH_3)_5(OH_2)]_2(SO_4)_3+3H_2O$.

Three modifications:

α. Sl. sol. in cold H_2O. Sol. in 58 pts. at 27° (Gibbs); 83.5 pts. at 20.2°, and 94.6 pts at 17.2° (Jorgensen); more easily sol. in hot H_2O, and still more easily in NH_4OH+Aq.

β. Sol. in 1–2 pts. H_2O. (Gibbs.)

γ. Less sol. than luteosulphate. (Jörgensen.)

$+2H_2O$. Easily sol. in H_2O. (Vortmann.)

Roseocobaltic sulphate, acid, $[Co(NH_3)_5]_2(SO_4)_3$, $2H_2SO_4+3H_2O$. (Fremy), or $4[Co(NH_3)_5]_2(SO_4)_3$, $9H_2SO_4+11H_2O$ (Jörgensen).

More easily sol. in H_2O than neutral sulphate, into which it is converted by recrystallization. Sol. in about 13 pts. H_2O. (Jörgensen.)

—— **cerium sulphate,** $[Co(NH_3)_5(OH_2)]_2(SO_4)_3$, $Ce_2(SO_4)_3+2\frac{1}{2}H_2O$.

Sl. sol. in cold, practically insol. in boiling H_2O. Sol. in acids. (Gibbs, Am. Ch. J. **15.** 560.)

$[Co(NH_3)_5(OH_2)]_2(SO_4)_3$, $Ce(SO_4)_2+2\frac{1}{2}H_2O$. As above. (Gibbs.)

—— **sulphate chloraurate.**

Three modifications:

α. $Co(NH_3)_5(OH_2)(SO_4)Cl$, $AuCl_3$. Ppt. (Jörgensen.)

β. $Co(NH_3)_5(SO_4)$, $AuCl_3+2H_2O$. Sl. sol. in cold H_2O. (Gibbs.)

γ. As above. Can be recrystallized from hot H_2O.

—— **sulphate chloroplatinate,** $2Co(NH_3)_5(OH_2)(SO_4)Cl_2$, $PtCl_4$.

Three modifications, all difficultly sol. in hot or cold H_2O. (Jörgensen.)

—— **sulphite,** $[Co(NH_3)_5(OH_2)]_2(SO_3)_3+H_2O$.

Sl. sol. in cold, decomp. by hot H_2O. (Gibbs.)

—— **cobaltic sulphite,** $[Co(NH_3)_5]_2(SO_3)_3$, $Co_2(SO_3)_3+9H_2O$.

Insol. in cold, decomp. by hot H_2O. (Künzel.)

Roseocobaltic octamine compounds.

See **Roseotetramine cobaltic compounds.**

Roseoiridium compounds.

See **Iridoaquopentamine compounds.**

Roseorhodium bromide, $Rh(NH_3)_5(OH_2)Br_3$.

Sol. in cold H_2O. (Jörgensen, J. pr. (2) **34.** 394.)

Roseorhodium cobalticyanide, $Rh(NH_3)_5(OH_2)Co(CN)_6$.

Scarcely sol. in H_2O.

—— **iodosulphate,** $Rh(NH_3)_5(OH_2)I(SO_4)$.

Very sl. sol. in H_2O; easily sol. in NH_4OH+Aq. (Jörgensen.)

—— **nitrate,** $Rh(NH_3)_5(OH_2)(NO_3)_3$.

Moderately sol. in cold H_2O. (Jörgensen.)

$Rh(NH_3)_5(OH_2)(NO_3)_3$, HNO_3. Decomp.

by H_2O or alcohol. (Jörgensen, J. pr. (2) **44.** 63.)

Roseorhodium nitrate chloroplatinate, $[Rh(NH_3)_5(OH_2)(NO_3)]_2PtCl_6+?H_2O$.

Ppt. (Jörgensen.)

—— *ortho*phosphate, $[Rh(NH_3)_5(OH_2)]_2(HPO_4)_3+4H_2O$.

Very sl. sol. in H_2O.

—— **sodium *pyro*phosphate,** $[Rh(NH_3)_5(OH_2)]_2NaP_2O_7+23H_2O$.

Ppt. Very sl. sol. in cold H_2O. Easily sol. in very dil. acids.

—— **sulphate,** $[Rh(NH_3)_5(OH_2)]_2(SO_4)_3+3H_2O$.

Very sl. sol. in cold, much more in hot H_2O.

—— **sulphate chloroplatinate,** $Rh(NH_3)_5(OH_2)(SO_4)PtCl_6$.

Ppt. Nearly insol. in H_2O or alcohol.

Roseotetramine cobaltic bromide, $Co(NH_3)_4(OH_2)_2Br_3$.

Sol. in H_2O; insol. in HBr+Aq. Nearly insol. in alcohol. (Jörgensen, Z. anorg. **2.** 295.)

—— —— **chloride,** $Co(NH_3)_4(OH_2)_2Cl_3$.

Easily sol. in H_2O; insol. in conc. HCl+Aq; sol. in sat. $HgCl_2$+Aq. (Jörgensen.)

—— —— **cobalticyanide,** $Co(NH_3)_4(OH_2)_2Co(CN)_6$.

(Jörgensen.)

—— —— **oxalate sulphate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2C_2O_4$.

Ppt. (Jörgensen.)

—— —— ***pyro*phosphate,** $[Co(NH_3)_4(OH_2)_2]_4(P_2O_7)_3+6H_2O$.

Nearly insol. in H_2O, but easily sol. in very dil. acids+Aq. (Jörgensen.)

—— —— **sulphate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_3+3H_2O$.

Sol. in about 35 pts. H_2O, and more easily by addition of dil. HCl or H_2SO_4+Aq. (Jörgensen.)

—— —— **sulphate bromaurate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2AuBr_4$.

Sl. sol. in cold H_2O; insol. in alcohol. (Jörgensen.)

—— —— **sulphate chloroplatinate,** $[Co(NH_3)_4(OH_2)_2]_2(SO_4)_2PtCl_6$.

As the bromaurate. (Jörgensen.)

Rubidium, Rb_2.

Decomp. H_2O with violence. Insol. in hydrocarbons. Sol. in liquid NH_3. (Seely, C. N. **23.** 169); (Franklin, Am. Ch. J. 1898, **20.** 829).

Rubidium acetylide acetylene RbC_2, C_2H_2.

Very hygroscopic.

Insol. in CCl_4 and in ether. (Moissan, C. R. 1903, **136.** 1220.)

Rubidium amalgam, $RbHg_{12}$.

Stable in contact with Hg below 0°. Above 0° the composition of the amalgam varies. Can be cryst. from Hg without decomp. below 0°. (Kerp, Z. anorg. 1900, **25.** 68.)

Rubidium amide, $RbNH_2$.

Very deliquescent. Violently decomp. by H_2O; less violently acted on by alcohol. (Titherley, Chem. Soc. 1897, **71.** 470.)

Rubidium ammonia, $RbNH_3$.

Decomp. by H_2O.

Very sol. in liquid NH_3. (Moissan, C. R. 1903, **136.** 1178.)

Rubidium azoimide, RbN_3.

Sl. hydroscopic.

Stable in aq. solution.

107.1 pts. are sol. in 100 pts. H_2O at 16°.
114.1 " " " " 100 " H_2O " 17°.
0.182 " " " " 100 " abs. alcohol at 16°.

Insol. in pure ether.

(Curtius, J. pr. 1898, (2) **58.** 281.)

Rubidium bromide, RbBr.

100 pts. H_2O dissolve 98 pts. at 5°; 104.8 pts. at 16°. (Reissig, A. **127.** 33.)

Solubility in H_2O.

100 pts. of the solution contain at:

0.5°	5.0°	16.0°	
47.26	49.50	51.17	pts. RbBr,
39.7°	57.5°	113.5°	
56.87	60.39	67.24	pts. RbBr.

(Rimbach, B. 1905, **38.** 1557.)

Sp. gr. of RbBr containing g. equiv. RbBr per l.

G. equiv. RbBr	Sp. gr. 6°/6°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0.508	1.06448	1.06389	1.06326
1.020	1.12931	1.12799	1.12626
2.031	1.25622	1.25366	1.25187
4.072	1.50574	1.50107	1.49870

(Clausen, W. Ann. 1914, (4) **44.** 1070.)

RbBr+Aq. containing 6.60% RbBr has sp. gr. 20°/20° = 1.0525.

RbBr+Aq. containing 14.36% RbBr has sp. gr. 20°/20° = 1.1226.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Rubidium *tri*bromide, $RbBr_3$.

Very sol. in H_2O; decomp. by alcohol and ether. (Wells and Wheeler, Sill. Am. J. **143.** 475.)

Rubidium ruthenium bromide.

See **Bromoruthenate** and **bromoruthenite, rubidium.**

Rubidium selenium bromide.

See **Bromoselenate, rubidium.**

Rubidium tellurium bromide.

See **Bromotellurate, rubidium.**

Rubidium thallic bromide, RbBr, $TlBr_3+H_2O$.

Recryst. from H_2O unchanged. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

3RbBr, $TlBr_3+H_2O$. Very sol. in H_2O. **(Pratt.)**

Rubidium stannic bromide.

See **Bromostannate, rubidium.**

Rubidium bromochloride, $RbBr_2Cl$.

Easily decomp., even by H_2O. (Wells and Wheeler.)

$RbBrCl_2$. Sol. in H_2O; decomp. by alcohol and ether. (Wells and Wheeler.)

Rubidium bromochloroiodide, RbBrClI.

Sol. in H_2O and alcohol. Decomp. by ether. (Wells and Wheeler.)

Rubidium bromoiodide, $RbBr_2I$.

Very sol. in H_2O. Sat. solution contains about 44% $RbBr_2I$, and sp. gr. = 3.84. (Wells and Wheeler.)

Rubidium carbide, Rb_2C_2.

Decomp. violently by H_2O. (Moissan, C. R. 1903, **136.** 1221.)

Rubidium chloride, RbCl.

100 pts. H_2O dissolve 76.38 pts. at 1°; 82.89 pts. at 7°. (Bunsen.)

Solubility in H_2O at t°.
100 pts. of the solution contain pts. RbCl.

t°	Pts. RbCl
0.4	43.61
15.5	46.56
57.3	53.71
114.9	59.48

(Rimbach, B. 1902, **35.** 1304.)

Solubility of RbCl in H_2O at t°.

t°	G. RbCl per 100 g.		t°	G. RbCl per 100 g.	
	H_2O	Solution		H_2O	Solution
0	77.0	43.5	60	115.5	53.6
10	84.4	45.8	70	121.4	54.8
20	91.1	47.7	80	127.2	56.0
30	97.6	49.4	90	133.1	57.1
40	103.5	50.9	100	138.9	58.9
50	109.3	52.2	112.9	146.6	59.5

(Berkeley, Phil. Trans. Roy. Soc. 1904, **203,** A. 189.)

Sat. RbCl+Aq at 25° contains 48.57% RbCl. (Foote, Am. Ch. J. 1906, **35.** 242.)

Sp. gr. of RbCl+Aq containing in 100 pts. H_2O:

13.14	25.88	33.13	pts. RbCl.
1.1066	1.2156	1.2675	sp. gr.

(Tammann, W. Ann. **24.** 1885.)

A normal solution of RbCl has sp. gr. at 25° = 1.0610. (Wagner, Z. phys. Ch. 1890, **5.** 39.)

RbCl+Aq containing 6.64% RbCl has sp. gr. 20°/20° = 1.0502.

RbCl+Aq containing 10.59% RbCl has sp. gr. 20°/20° = 1.0815. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

Sp. gr. 20°/4° of a normal solution of RbCl = 1.085405. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of RbCl+Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.
0.55	1.4409	60.25	1.5558
18.7	1.4865	75.15	1.5746
31.5	1.5118	89.35	1.5905
44.7	1.5348	114*	1.6148

* Boiling point.
(Berkeley.)

Sp. gr. of RbCl containing g. equiv. RbCl per l.

G. equiv. RbCl	Sp. gr. 6°/6°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0.5123	1.06410	1.04538	1.04503
1.001	1.08916	1.08810	1.08749
2.073	1.18200	1.17959	1.17828
3.984	1.34334	1.33967	1.33757

(Clausen, W. Ann. 1914, (4) **44.** 1069.)

Very sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Solubility in alcohols at 25°.

100 g. methyl alcohol dissolve 1.41 g.
100 g. ethyl alcohol dissolve 0.078 g.
100 g. propyl alcohol dissolve 0.015 g.
100 g. isoamyl alcohol dissolve 0.0025 g.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Insol. in anhydrous pyridine and in 97% pyridine+Aq. Very sl. sol. in 95% pyridine +Aq; sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); acetone; (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014).

Rubidium ruthenium ***tri*****chloride.**

See **Chlororuthenite, rubidium.**

Rubidium ruthenium ***tetra*****chloride.**

See **Chlororuthenate, rubidium.**

Rubidium oxyruthenium chloride, $Rb_2RuO_2Cl_4$.

Ppt.; decomp. by H_2O; sol. in cold HCl. (Howe, J. Am. Chem. Soc. 1901, **23.** 779.)

Rubidium tellurium chloride.

See **Chlorotellurate, rubidium.**

Rubidium thallic chloride, 2RbCl, $TlCl_3$+H_2O.

Can be recryst. from H_2O without change. (Pratt, Am. J. Sci. 1895, (3) **49.** 399.)

3RbCl, $TlCl_3$. Crystallizes from HCl solution. (Neumann, A. 244. 348.)

+H_2O. Very sol. in cold H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 398.)

+2H_2O. Efflorescent in dry air. Sol. in 7.5 pts. H_2O at 18°, and 1.6 pts. at 100°. (Godeffroy, Zeitschr. d. allgem. österr. Apothekerv. **1880.** No. 9.)

Rubidium stannic chloride.

See **Chlorostannate, rubidium.**

Rubidium titanium chloride, 2RbCl, $TiCl_3$ +H_2O.

Sol. in H_2O. (Stähler, B. 1904, **37.** 4408.)

Rubidium tungsten chloride, $Rb_3W_2Cl_9$.

Sl. sol. in cold, more sol. in hot H_2O.
Sol. in very dil. NaOH+Aq.
Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 574.)

Rubidium uranous chloride, Rb_2UCl_6.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Rubidium uranyl chloride, 2RbCl, $(UO_2)Cl_2$ +2H_2O.

Solubility in H_2O.

100 pts. of the solution contain at:

24.8°	80.3°
57.8	65.73 pts. UO_2Cl_2, 2RbCl.

(Rimbach, B. 1904, **37.** 467.)

Rubidium vanadium chloride, Rb_2VCl_5 +H_2O.

Sl. sol. in H_2O and alcohol.

Decomp. by H_2O on standing so that it dissolves. (Stähler, B. 1904, **37.** 4411.)

Rubidium zinc chloride, 2RbCl, $ZnCl_2$.

Easily sol. in H_2O and HCl+Aq. (Godeffroy, B. **8.** 9.)

Rubidium chloride selenium dioxide, RbCl, 2SeO_2+2H_2O.

Sol. in H_2O. (Muthmann, B. 1893, **26.** 1013.)

Rubidium chloroiodide, $RbCl_2I$.

Properties are similar to those of RbBrClI. (Wells.)

$RbCl_4I$. Sol. in alcohol, not attacked by ether. (Wells and Wheeler, Sill. Am. J. **144.** 42.)

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Very stable; sl. sol. in H_2O at 0°; only very sl. sol. in HCl. (Erdmann, Arch. Pharm. 1894, **232.** 32.) (C. C. **1894,** I. 670.)

Rubidium fluoride, RbF.

Very sol. in H_2O. (Eggeling, Z. anorg. 1905, **46.** 174.)

100 g. H_2O dissolve 130.6 g. RbF at 18°. (de Forcrand, C. R. 1911, 152. 1210.)

Sol. in dil. HF. (Pennington, J. Am. Chem. Soc. 1896, **18.** 57.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Rubidium hydrogen fluoride, RbF, HF.

Very deliquescent.

Insol. in alcohol and ether. (Chabrié, C. R. 1905, **140.** 91.)

Very hygroscopic. Sol. in H_2O. (Eggeling, Z. anorg. 1905, **46.** 175.)

RbF, 2HF. Very sl. sol. in H_2O. (Eggeling, Z. anorg. 1905, **46.** 176.)

Rubidium silicon fluoride.

See **Fluosilicate, rubidium.**

Rubidium tantalum fluoride.

See **Fluotantalate, rubidium.**

Rubidium uranyl fluoride, 4RbF, UO_2F_2+ 6H_2O.

(Ditte, C. R. **91.** 115.)

Rubidium hydride, RbH.

Decomp. by H_2O with evolution of H_2. (Moissan, C. R. 1903, **136.** 589.)

Rubidium hydroxide, RbOH.

Deliquescent, and very sol. in H_2O. Sol. in alcohol. (Bunsen.)

Sat. RbOH+Aq contains 64.17% RbOH at 15°. (de Forcrand, C. R. 1909, **149.** 1344.)

Rubidium iodide, RbI.

100 pts. H_2O dissolve 137.5 pts. at 6.9°; 152 pts. at 17.4.° (Reissig, A. **127.** 33.)

Sat. RbI+Aq. at 25° contains 61.93% RbI. (Foote and Chalker, Am. Ch. J. 1908, **39.** 567.)

Sp. gr. of RbI+Aq containing:

	5%	10%	cold sat.	hot sat.
Sp. gr.	1.0353	1.0755	1.726	1.9629.

(Erdmann, Arch. Pharm. 1894, **232.** 25.)

Sp. gr. of RbI+Aq containing g. equiv. RbI per l.

G. equiv. RbI	Sp. gr. 6°/6°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0.510	1.08347	1.08268	1.08226
1.025	1.16751	1.16569	1.16433
2.025	1.33012	1.32637	1.32531
4.015	1.64781	1.64144	1.63780

(Clausen, W. Ann. 1914, (4) **44.** 1070.)

Nearly insol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Sol. in $AsCl_3$. (Walden, Z. anorg. 1900, **25.** 214); liquid SO_2. (Walden, Z. anorg. 1902, **30.** 161); S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217); SO_2Cl_2. (Walden); $POCl_3$. (Walden.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Solubility in organic solvents at t°.

C = pts. by wt. of RbI in 100 ccm. of the sat. solution.

L = no. of litres which at the saturation temp. hold in solution 1 mol. RbI.

Solvent	t°	C	L
Furfurol	25°	4.93	4.31
Acetonitrile	25°	1.350	15.73
"	0°	1.478	14.36
Propionitrile	25°	0.305	69.61
"	0°	0.274	77.48
Nitromethane	25°	0.518	41.00
"	0°	0.567	37.44
Acetone	25°	0.674	31.5
"	0°	0.960	22.1

(Walden, Z. phys. Ch. 1906, **55.** 718.)

Rubidium *tri*iodide, RbI_3.

Very sol. in H_2O. Sol. in about 1/3 pt. H_2O at 20°; sol. in alcohol. Decomp. by ether. (Wells and Wheller, Sill. Am. J. **143.** 475.)

Solubility determinations show that RbI_3 is the only polyiodide of rubidium formed at 25°. RbI_7 and RbI_9, mentioned by Abegg and Hamburger, (Z. anorg. **50,** 403) could not be obtained. (Foote and Chalker, Am. Ch. J. 1908, **39.** 567.)

Rubidium silver iodide, 2RbI, AgI.

Easily decomp. by H_2O. (Wells and Wheeler, Sill. Am. J. **144.** 155.)

RbI, AgI+$\frac{1}{2}H_2O$. (Marsh, Chem. Soc. 1913, **103.** 783.)

RbI, 2AgI. Not deliquescent.

Very sol. in acetone. (Marsh, Chem. Soc. 1913, **103.** 783.)

Rubidium tellurium iodide.

See **Iodotellurate, rubidium.**

Rubidium thallic iodide, RbI, TlI_3+2H_2O.

Decomp. by H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 403.)

Rubidium nitride,

Decomp. by heat. (Franz Fischer, B. 1910, **43.** 1468.)

See also **Rubidium azoimide.**

Rubidium *di*oxide, RbO_2.

Decomp. by H_2O. (Erdmann, A. 1897, **294.** 68.)

Rubidium sulphide, Rb_2S+4H_2O.

Deliquescent; very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 299.)

Rubidium *di*sulphide, Rb_2S_2.

Anhydrous.

Sol. in H_2O.

Very hydroscopic. (Biltz, Z. anorg. 1906, **50.** 72.)

$+H_2O$. From Rb_2S_2+Aq.

Hydroscopic. (Biltz.)

Rubidium *tri*sulphide, Rb_2S_3.

Anhydrous.

Sol. in H_2O.

Hydroscopic. (Biltz, Z. anorg. 1906, **50.** 75.)

$+H_2O$. From Rb_2S_3+Aq. (Biltz.)

Rubidium *tetra*sulphide $Rb_2S_4+2H_2O$.

Sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 304.)

Rubidium *penta*sulphide, Rb_2S_5.

Deliquescent. Decomp. by H_2O.

Very easily sol. in 70% alcohol.

Insol. in ether, ethyl sulphide or $CHCl_3$. (Biltz, B. 1905, **38.** 127.)

Rubidium hydrogen sulphide, RbHS.

Deliquescent, very sol. in H_2O. (Biltz, Z. anorg. 1906, **48.** 300.)

Rubidium copper *tetra*sulphide, $RbCuS_4$.

Decomp. very slowly in the air.

Sl. sol. in H_2O.

Very slowly decomp. by cold conc., more rapidly by hot conc., and still more rapidly by dil. HCl, H_2SO_4 and HNO_3. Sl. sol. in alcohol. (Biltz, B. 1907, **40.** 978.)

Ruthenic acid.

Barium ruthenate, $BaRuO_4+H_2O$.

Ppt. (Debray and Joly, C. R. **106.** 1494.)

Calcium ruthenate, $CaRuO_4$.

Ppt.

Magnesium ruthenate, $MgRuO_4$.

Ppt.

Potassium ruthenate, $K_2RuO_4+H_2O$.

Very sol. in H_2O.

*Per*ruthenic acid.

Potassium *per*ruthenate, $KRuO_4$.

Sl. sol. in H_2O. (Debray and Joly, C. R. **106.** 1494.)

Sodium *per*ruthenate, $NaRuO_4+H_2O$.

Sl. sol. in H_2O.

Ruthenium, Ru.

Not attacked by acids, except aqua regia, which dissolves it only very slightly. (Claus, Pogg. **65.** 218.)

Ruthenium ammonium comps.

See **Ruthenodiamine comps,** etc.

Ruthenium *tri*bromide, $RuBr_3$.

Sol. in H_2O. Solution decomposes slowly on standing, but rapidly on heating. (Gutbier, Z. anorg. 1905, **45.** 178.)

Ruthenium *tri*bromide, ammonia, $2RuBr_3$, $7NH_3$.

Sol. in H_2O and ammonia with slight warming.

Insol. in alcohol. (Gutbier, Z. anorg. 1905, **45.** 182.)

Ruthenium *di*chloride, $RuCl_2$.

Insol. in acids, even in aqua regia. Sl. attacked by acids. Traces are dissolved by boiling with conc. KOH+Aq.

$+xH_2O$. Known only in aqueous solution. (Claus, A. **59.** 238.)

Ruthenium *tri*chloride, $RuCl_3$.

Deliquescent. Sol. in H_2O and alcohol, but solution is decomp. by heating into Ru_2O_3 and HCl. (Claus.)

Pure $RuCl_3$ is insol. in cold H_2O, mineral, or organic acids. Slowly decomp. by boiling H_2O. Insol. in CCl_4, CS_2, $CHCl_3$, PCl_3, or ether. Slowly sol. in hot absolute alcohol, but decomp. into $Ru(OH)Cl_2$ by 95% alcohol. (Joly, C. R. **114.** 292.)

Hydroscopic.

Sol. in H_2O; decomp. at 50°.

Sol. in alcohol. (Gutbier, Z. anorg. 1905, **45.** 174.)

See also **Ruthenium nitrosochloride.**

Ruthenium *tetra*chloride, $RuCl_4$.

Sol. in H_2O and alcohol. (Claus.)

Ruthenium *tri*chloride *with* MCl.

See **Chlororuthenite, M.**

Ruthenium *tetra*chloride *with* MCl.

See **Chlororuthenate, M.**

Ruthenium *sesqui*hydroxide, $Ru_2O_6H_6$.

Sol. in acids; insol. in alkalies. Less sol. in NH_4OH+Aq than any other oxide of the Pt metals. (Claus.)

Ruthenium *di*hydroxide, $RuO_4H_4+3H_2O$.

Sol. in acids and alkalies. (Claus, A. **59.** 237.)

Contains NO. Joly, C. R. **107.** 994.)

Ruthenium *tri*odide, RuI_3.

Ppt. (Claus.)

Insol. in H_2O, KI+Aq, and alcohol. (Gutbier, Z. anorg. 1905, **45.** 181.)

Ruthenium *tri*iodide ammonia, $2RuI_3$, $7NH_3$.

Sol. in H_2O and ammonia with slight warming.

Insol. in alcohol. (Gutbier, Z. anorg. 1905, **45.** 182.)

Ruthenium nitrosochloride, $RuCl_3(NO)+H_2O$, and $5H_2O$.

Slowly sol. in cold, easily in hot H_2O. (Joly, C. R. **108.** 855.)

Ruthenium *di*hydronitrosochloride, $NO.Ru_2H_2Cl_3$, 2HCl.

Sol. in H_2O. (Brizard, A. ch. 1900, (7) **21.** 353.)

Ruthenium silver nitrosochloride, $NO.Ru_2H_2Cl_3$, 2HCl, 3AgCl.

Ppt. (Brizard, A. ch. 1900, (7) **21,** 357.)

Ruthenium nitroso*sesqui*oxide, $Ru_2O_3(NO)_2+2H_2O$.

Ppt. (Joly, C. R. **108.** 854.)

Ruthenium *di*hydronitrosohydroxide, $NO.Ru_2H_2(OH)_3+2H_2O$.

Sl. sol. in cold H_2O with decomp. (Brizard, A. ch. 1900, (7) **21.** 349.)

Ruthenium *di*hydronitrosooxychloride, $NO.Ru_2H_2Cl_2OH+2H_2O$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 349.)

Ruthenium *mon*oxide, RuO.

Insol. in acids. (Claus, A. **59.** 236.)

Ruthenium *sesqui*oxide, Ru_2O_3.

Insol. in acids. Mixture of Ru and RuO_2. (Debray and Joly, C. R. **106.** 1494.)
See **Ruthenium nitroso*sesqui*oxide.**

Ruthenium *di*oxide, RuO_2.

Insol. in acids. (Debray and Joly.)

Ruthenium *tri*oxide, RuO_3.

"Ruthenic acid." Known only in its salts.

Ruthenium *tetr*oxide, RuO_4.

Rather difficultly and slowly sol. in H_2O. (Claus.)
Decomp. in aqueous solution into $Ru_2O_5+2H_2O$. (Debray and Joly.)

Ruthenium *pent*oxide, Ru_2O_5.

(Debray and Joly, C. R. **106.** 1494.)
$+2H_2O$. Ppt. (Debray and Joly.)

Ruthenium *hept*oxide, Ru_2O_7.

"*Per*ruthenic acid." Known only in its salts.

Ruthenium oxide, Ru_4O_9.

(Debray and Joly.)

Ruthenium oxychloride, $Ru(OH)Cl_2$.

Very sol. in H_2O, but decomp. by an excess. (Joly, C. R. **114.** 293.)

Ruthenium silicide, RuSi.

Insol. in boiling acids; slowly attacked by a mixture of fused $KHSO_4$ and KNO_3. (Moissan, C. R. 1903, **137.** 231.)

Ruthenium *tri*sulphide, RuS_3.

Ppt. (Antony, Gazz. ch. it. 1900, **30.** 539.)

Rutheno*mon*amine hydroxide, $Ru(OH)_2(NH_3)_2+4H_2O$.

See **Ruthenosamine hydroxide.**

Rutheno*di*amine carbonate, $Ru(N_2H_6)_2CO_3+5H_2O$.

Easily sol. in H_2O. Insol. in alcohol. (Claus.)

Rutheno*di*amine chloride, $Ru(N_2H_6Cl)_2+3H_2O$.

Not very sol. in cold, easily sol. in hot H_2O. Insol. in alcohol.
See **Ruthenonitroso*di*amine comps.**

—— **mercuric chloride,** $Ru(N_2H_6Cl)_2$, $HgCl_2$.

Nearly insol. in cold, sol. in hot H_2O. (Gibbs, Sill. Am. J. (2) **34,** 350.)

—— **chloroplatinate,** $Ru(N_2H_6Cl)_2$, $PtCl_4$.

Sl. sol. in H_2O. (Claus.)

—— **hydroxide,** $Ru(N_2H_6OH)_2$.

Known only in aqueous solution.

—— **nitrate,** $Ru(N_2H_6NO_3)_2+2H_2O$.

Somewhat difficultly sol. in cold, easily in hot H_2O. Insol. in alcohol.

—— **sulphate,** $Ru(N_2H_6)_2SO_4+4H_2O$.

Moderately sol. in H_2O. Insol. in alcohol. (Claus.)

Ruthenocyanhydric acid, $H_4Ru(CN)_6$.

Easily sol. in H_2O and alcohol. Less sol. in ether. (Claus, J. B. **1855.** 444.)

Potassium ruthenocyanide, $K_4Ru(CN)_6+3H_2O$.

Sl. efflorescent. Very sol. in H_2O; sl. sol. in dil. alcohol. (Claus.)

Ruthenonitroso*di*amine bromide, $Ru(NO)(NH_3)_4Br_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)
$Ru(NO)OH(NH_3)_4Br_2$. Less sol. than corresponding chloride. (Joly, C. R. **108.** 300.)

—— **chloride,** $Ru(NO)(NH_3)_4Cl_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)
$Ru(NO)OH(NH_3)_4Cl_2$. Sol. in H_2O. (Joly, C. R. **108.** 1300.)
$Ru(NO)(NH_3)_4Cl_3+2H_2O=Ru(NO)(OH)(NH_3)_4Cl_2,\ HCl+H_2O$ (?). Very sol. in H_2O. (Joly, C. R. **111.** 969.)

—— **chloroplatinate,** $Ru(NO)OH(NH_3)_4PtCl_6$.

Scarcely sol. in boiling H_2O. (Joly, C. R. **108.** 1300.)
$Ru(NO)(NH_3)_4Cl_3$, $PtCl_4$. Ppt. (Joly, C. R. **111.** 969.)

—— **iodide,** $Ru(NO)(NH_3)_4I_3$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)
$Ru(NO)OH(NH_3)_4I_2$. Less sol. than the corresponding bromide. (Joly, C. R. **108.** 1300.)

—— **nitrate,** $Ru(NO)(NH_3)_4(NO_3)_3$.

More sol. in H_2O than $Ru(NO)(OH)(NH_3)_4(NO_3)_2$. (Joly, C. R. **111.** 969.)

$Ru(NO)OH(NH_3)_4(NO_3)_2$. Sl. sol. in cold H_2O; insol. in conc. HNO_3+Aq. (Joly, C. R. **108.** 1300.)

Ruthenonitroso*di*amine sulphate, $[Ru(NO)(NH_3)_4]_2(SO_4)_3+10H_2O$.

Sl. sol. in H_2O. (Joly, C. R. **111.** 969.)

$[Ru(NO)(NH_3)_4]_4(SO_4)_6$, $H_2SO_4+H_2O$. Decomp. by cold H_2O. (Joly.)

$Ru(NO)(OH)_4(NH_3)_4SO_4+H_2O$. Most sol. in H_2O of this class of salts. (Joly, C. R. **108.** 1300.)

Ruthenonitrous acid.

Ammonium ruthenonitrite, $RuH_2(NO_2)_4$, $3NH_4NO_2+2H_2O$.

Easily sol. in H_2O; practically insol. in KCl+Aq. (Brizard, A. ch. 1900, (7) **21.** 368.)

Potassium ruthenonitrite, $K_6Ru_2(NO_2)_{12}=6KNO_2$, $Ru_2(NO_2)_3$.

Easily sol. in H_2O, alcohol, or ether. (Gibbs, Sill. Am. J. (2), **34.** 344.)

Sl. sol. in H_2O. Easily sol. in KNO_2+Aq. (Claus.)

$K_4Ru_2(NO_2)_{10}=Ru_2O_2(N_2O_3)_3$, $4KNO_2$. Very sol. in H_2O. (Joly and Vèzes, C. R. **109.** 667.)

$K_8Ru_2(NO_2)_{14}=Ru_2O_2(N_2O_3)_2$, $8KNO_2$. Sl. sol. in H_2O. Sol. in cold dil. acids. (Joly and Vèzes.)

$Ru_2H_2(NO_2)_4$, $3KNO_2+4H_2O$. Very sol. in H_2O. Aqueous solution decomp. sl. on long boiling. Almost insol. in conc. KCl+Aq. (Brizard, C. R. 1899, **129.** 216.)

Silver ruthenonitrite, $NO.Ru_2H_2(NO_2)_4$, $3AgNO_2+2H_2O$.

Ppt. (Brizard, A. ch. 1900, (7) **21.** 368.)

Sodium ruthenonitrite, $Ru_2(NO_2)_6$, $4NaNO_2+4H_2O$.

Very sol. in H_2O without decomp. (Joly, C. R. 1894, **118.** 469.)

Ruthenosamine hydroxide, $Ru(NH_3OH)_2+4H_2O$ (?).

Very deliquescent, and sol. in H_2O. (Claus.)

Samarium, Sm.

The element has not been isolated.

Samarium bromide, $SmBr_3+6H_2O$.

Very deliquescent. (Cleve.)

Samarium carbide, SmC_2.

Decomp. by water and acids. (Moissan, C. R. 1900, **131.** 925.)

Samarium *di*chloride, $SmCl_2$.

Decomp. by H_2O with liberation of H_2 and formation of samarium oxide and samarium oxychloride. Insol. in CS_2, $CHCl_3$, benzene, abs. alcohol, pyridine and toluene. (Matignon, C. R. 1906, **142.** 85.)

Samarium *tri*chloride, $SmCl_3$.

The anhydrous salt is very hydroscopic and easily sol. in H_2O. (Matignon, C. R. 1902, **134.** 1309.)

Very sol. in H_2O. Very sol. in abs. alcohol. 6.38 g. are sol. in 100 grams pyridine at ord. temp; insol. in quinoline. (Matignon, A. ch. 1906, (8) **8.** 406.)

$+6H_2O$. Deliquescent.

Samarium chloride ammonia, $SmCl_3+NH_3$; $+2NH_3$; $+3NH_3$; $+4NH_3$; $+5NH_3$; $+8NH_3$; $+9.5NH_3$; $+11.5NH_3$.

(Matignon, C. R. 1905, **140.** 143.)

Samarium fluoride, $SmF_3+\frac{1}{2}H_2O$.

Precipitate. Insol. in H_2O and dil. acids. (Cleve.)

Samarium iodide, SmI_3.

(Matignon, A. ch. 1906, (8) **8.** 413.)

Samarium hydroxide, $Sm_2(OH)_6$.

Insol. in alkalies; easily sol. in acids, and decomposes ammonium salts. (Cleve, C. N. **51.** 145.)

Samarium oxide, Sm_2O_3.

Easily sol. in acids. (Cleve, C. N. **51.** 145.)

Samarium *per*oxide, Sm_4O_9.

Precipitate. (Cleve.)

Samarium oxychloride, SmOCl.

(Matignon, A. ch. 1906, (8) **8.** 412.)

Samarium sulphide, Sm_2S_3.

(Matignon, A. ch. 1906, (8) **8.** 415.)

Scandium, Sc.

Element has not been isolated.

Scandium bromide, Sc_2Br_6 $+3H_2O$, and $+12H_2O$.

(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Scandium chloride, Sc_2Cl_6, $+3H_2O$, and $+12H_2O$.

(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Scandium hydroxide.

Easily sol. in conc. HNO_3 or HCl+Aq. (Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Scandium oxide, Sc_2O_3.

Easily sol. by boiling with conc. HNO_3 or HCl+Aq.

Scandium sulphide, Sc_2S_3.

Decomp. by H_2O and by acids with evolution of H_2S. (Wirth, Z. anorg. 1914, **87.** 5.)

Selenantimonic acid.

Sodium selenantimonate, $Na_3SbSe_4+9H_2O$.

Sol. in 2 pts. cold H_2O. Insol. in alcohol. (Hofacker, A. **107.** 6.)

Sl. sol. in H_2O; unstable. (Pouget, A. ch. 1899, (7) **18.** 562.)

Selenantimonous acid.

Potassium ***ortho*****selenantimonite,** K_3SbSe_3.

Ppt. Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 560.)

Potassium ***para*****selenantimonite,** $K_2Sb_4Se_7+3H_2O$.

Sl. sol. in H_2O; unstable. (Pouget, A. ch. 1899, (7) **18.** 560.)

Sodium ***ortho*****selenantimonite,** $Na_3SbSe_3+9H_2O$.

Very sol. in H_2O. Aqueous solution on standing deposits red crystals of sodium selenantimonate, $Na_3SbSe_4+9H_2O$. (Pouget, A. ch. 1899, (7) **18.** 562.)

Sodium ***para*****selenantimonite,** $Na_2Sb_4Se_7$.

(Pouget, A. ch. 1899, (7) **18.** 561.)

Selenic acid, H_2SeO_4.

Very sol. in H_2O with evolution of heat.

If aqueous solution is evaporated at temp. of 165°, acid has 2.524 sp. gr.; at temp. of 267°, acid has 2.60 sp. gr.; at temp. of 285°, acid has 2.625 sp. gr. Decomp. to H_2SeO_3 at higher temp. (Mitscherlich, Pogg. **9.** 623.)

By evaporation at 265°, acid of 2.609 sp. gr. containing 95% H_2SeO_4 is obtained. If brought at same temp. in vacuo over H_2SO_4, acid of 2.627 sp. gr. with 97.5% H_2SeO_4 is obtained. (Fabian, A. Suppl. **1.** 243.)

Sp. gr. of H_2SeO_4+Aq.

% H_2SeO_4	Sp. gr.	% H_2SeO_4	Sp. gr.
99.73	2.6083	90.0	2.3848
99.50	2.6051	89.0	2.3568
99.00	2.6975	88.0	2.3291
98.5	2.5863	87.0	2.3061
98.0	2.5767	86.0	2.2795
97.5	2.5695	85.0	2.5558
97.0	2.5601	84.0	2.2258
96.0	2.5388	83.0	2.1946
95.0	2.5163	82.0	2.1757
94.0	2.4925	81.0	2.1479
93.0	2.4596	80.0	2.1216
92.0	2.4322	79.0	2.0922
91.0	2.4081	73.50	1.9675

(Cameron and Macallan, Lond. R. Soc. Proc. **46.** 13.)

Sp. gr. of H_2SeO_4+Aq at 20° compared with H_2O at 4°.
Wts. corrected to vacuum.

Sp. gr.	% H_2SeO_4	Sp. gr.	% H_2SeO_4	Sp. gr.	% H_2SeO_4
1.000	...	1.295	32.64	1.590	54.62
1.005	0.9	1.300	33.08	1.595	54.92
1.010	1.56	1.305	33.50	1.600	55.28
1.015	2.12	1.310	33.92	1.605	55.62
1.020	2.92	1.315	34.36	1.610	55.96
1.025	3.62	1.320	34.82	1.615	56.30
1.030	4.16	1.325	35.26	1.620	56.60
1.035	4.70	1.330	35.72	1.625	56.88
1.040	5.32	1.335	36.10	1.630	57.20
1.045	6.08	1.340	36.43	1.635	57.48
1.050	6.66	1.345	36.88	1.640	57.70
1.055	7.34	1.350	37.34	1.645	58.04
1.060	7.92	1.355	37.80	1.650	58.47
1.065	8.56	1.360	38.24	1.655	58.86
1.070	9.20	1.365	38.66	1.660	59.24
1.075	9.82	1.370	39.10	1.665	59.56
1.080	10.44	1.375	39.50	1.670	59.74
1.085	11.02	1.380	39.98	1.675	59.94
1.090	11.62	1.385	40.06	1.680	60.18
1.095	12.20	1.390	40.66	1.685	60.36
1.100	12.88	1.395	41.10	1.690	60.58
1.105	13.58	1.400	41.56	1.695	60.80
1.110	14.14	1.405	41.98	1.700	61.06
1.115	14.66	1.410	42.36	1.705	61.36
1.120	15.20	1.415	42.78	1.710	61.64
1.125	15.74	1.420	43.16	1.715	61.90
1.130	16.32	1.425	43.56	1.720	62.24
1.135	16.86	1.430	43.94	1.725	62.48
1.140	17.38	1.435	44.32	1.730	62.76
1.145	17.90	1.440	44.52	1.735	63.06
1.150	18.44	1.445	45.00	1.740	63.32
1.155	18.92	1.450	45.32	1.745	63.60
1.160	19.48	1.455	45.68	1.750	63.86
1.165	20.02	1.460	46.04	1.755	64.04
1.170	20.58	1.465	46.36	1.760	64.24
1.175	21.08	1.470	46.70	1.765	64.42
1.180	21.60	1.475	47.01	1.770	64.62
1.185	22.22	1.480	47.32	1.775	64.84
1.190	22.66	1.485	47.66	1.780	65.06
1.195	23.18	1.490	47.98	1.785	65.28
1.200	23.70	1.495	48.28	1.790	65.48
1:205	24.26	1.500	48.54	1.795	65.66
1.210	24.84	1.505	48.92	1.800	65.90
1.215	25.30	1.510	49.30	1.805	66.12
1.220	25.84	1.515	49.68	1.810	66.36
1.225	26.30	1.520	50.02	1.815	66.64
1.230	26.84	1.525	50.34	1.820	66.90
1.235	27.28	1.530	50.68	1.825	67.16
1.240	27.70	1.535	51.04	1.830	67.46
1.245	28.18	1.540	51.38	1.835	67.72
1.250	28.58	1.545	51.66	1.840	68.02
1.255	29.06	1.550	51.98	1.845	68.30
1.260	29.44	1.555	52.28	1.850	68.50
1.265	29.82	1.560	52.56	1.855	68.70
1.270	30.26	1.565	52.88	1.860	68.92
1.275	30.76	1.570	53.28	1.865	69.12
1.280	31.26	1.575	53.56	1.870	69.34
1.285	31.74	1.580	53.94	1.875	69.56
1.290	32.18	1.585	54.30	1.880	69.72

Sp. gr. of H_2SeO_4+Aq—*Concluded.*

Sp. gr.	% H_2SeO_4	Sp. gr.	% H_2SeO_4	Sp. gr.	% H_2SeO_4
1.885	69.94	2.125	80.25	2.365	89.14
1.890	70.14	2.130	80.42	2.370	89.30
1.895	70.38	2.135	80.68	2.375	89.48
1.900	70.64	2.140	80.74	2.380	89.60
1.905	70.78	2.145	80.96	2.385	89.72
1.910	71.00	2.150	81.14	2.390	89.84
1.915	71.21	2.155	81.36	2.395	89.96
1.920	71.38	2.160	81.60	2.400	90.10
1.925	71.68	2.165	81.80	2.405	90.20
1.930	72.00	2.170	82.02	2.410	90.30
1.935	72.38	2.175	82.22	2.415	90.46
1.940	72.66	2.180	82.44	2.420	90.74
1.945	72.88	2.185	82.64	2.425	91.00
1.950	73.12	2.190	82.78	2.430	91.24
1.955	73.34	2.195	82.96	2.435	91.46
1.960	73.54	2.200	83.10	2.440	91.70
1.965	73.74	2.205	83.24	2.445	92.00
1.970	73.98	2.210	83.44	2.450	92.28
1.975	74.22	2.215	83.62	2.455	92.56
1.980	74.44	2.220	83.78	2.460	92.85
1.985	74.66	2.225	83.96	2.465	93.02
1.990	74.86	2.230	84.14	2.470	93.20
1.995	75.08	2.235	84.30	2.475	93.36
2.000	75.28	2.240	84.48	2.480	93.68
2.005	75.46	2.245	84.60	2.485	94.02
2.010	75.66	2.250	84.82	2.490	94.32
2.015	75.88	2.255	85.02	2.495	94.48
2.020	76.06	2.260	85.26	2.500	94.64
2.025	76.14	2.265	85.44	2.505	94.80
2.030	76.48	2.270	85.60	2.510	94.96
2.035	76.68	2.275	85.78	2.515	95.32
2.040	76.84	2.280	85.96	2.520	95.58
2.045	77.08	2.285	86.16	2.525	95.86
2.050	77.36	2.290	86.38	2.530	96.10
2.055	77.50	2.295	86.60	2.535	96.41
2.060	77.62	2.300	86.82	2.540	96.68
2.065	77.80	2.305	87.04	2.545	96.92
2.070	78.06	2.310	87.26	2.550	97.12
2.075	78.24	2.315	87.46	2.555	97.30
2.080	78.48	2.320	87.66	2.560	97.48
2.085	78.68	2.325	87.84	2.565	97.68
2.090	78.84	2.330	88.00	2.570	97.94
2.095	79.08	2.335	88.18	2.575	98.20
2.100	79.28	2.340	88.34	2.580	98.46
2.105	79.50	2.345	88.48	2.585	98.70
2.110	79.68	2.350	88.66	2.590	99.04
2.115	79.90	2.355	88.82	2.595	99.36
2.120	80.10	2.360	88.98	...	...

(Diemer and Lenher. J. phys. Chem. 1909, **13.** 509.)

Sol. in conc. or fuming H_2SO_4.
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)
Decomp. by alcohol.
$+H_2O$. (Cameron and Macallan, C. N. **59.** 232.)
$+2H_2O$, and $+6H_2O$ (?). (C. and M.)
$+4H_2O$. (Kremann and Hofmeier, M. 1908, **29.** 1117.)

Selenates.

All the neutral and acid salts of H_2SeO_4 are sol. in H_2O, except $BaSeO_4$, $SrSeO_4$, $CaSeO_4$, and $PbSeO_4$, which are nearly or quite insol. in H_2O or HNO_3+Aq.

Aluminum selenate, $Al_2(SeO_4)_3$.

Resembles in every way aluminum sulphate. (Berzelius.)

Aluminum ammonium selenate, $Al_2(NH_4)_2(SeO_4)_4+24H_2O$.

More sol. in H_2O than the corresponding sulphate. (Wohlwill, A. **114.** 191.)

Aluminum cæsium selenate, $Al_2Cs_2(SeO_4)_4+24H_2O$.

(Peterson, B. **9.** 1563.)
Much more sol. in H_2O than the corresponding sulphate. (Fabre, C. R. **105.** 114.)

Aluminum potassium selenate, $Al_2K_2(SeO_4)_4+24H_2O$.

More sol. in H_2O than common alum. (Weber, Pogg. **108.** 615.)

Aluminum rubidium selenate, $Al_2Rb_2(SeO_4)_4+24H_2O$.

(Peterson, B. **9.** 1563.)
Much more sol. in H_2O than the corresponding sulphate. (Fabre, C. R. **105.** 114.)

Aluminum sodium selenate, $Al_2Na_2(SeO_4)_4+24H_2O$.

Sl. efflorescent. Very sol. in H_2O. (Wohlwill, A. **114.** 191.)

Aluminum thallium sulphate, $Al_2Tl_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Aluminum selenate potassium sulphate, $Al_2(SeO_4)_3$, $K_2SO_4+24H_2O$.

Sol. in H_2O. (v. Gerichten, A. **168.** 222.)

Ammonium selenate, $(NH_4)_2SeO_4$.

Easily sol. in H_2O.
100 g. H_2O dissolve 117 g. $(NH_4)_2SeO_4$ at 7°; 164 g. at 59°; 197 g. at 100°. (Tutton, Proc. Roy. Soc. 1907, 79, A. 351.)
Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Ammonium hydrogen selenate, NH_4HSeO_4.

Sol. in H_2O. (Topsoë.)

Ammonium cadmium selenate, $(NH_4)_2SeO_4$, $CdSeO_4+2H_2O$.

Sol. in H_2O. (Topsoë, W. A. B. **66, 2.** 2.)
$+6H_2O$. Efflorescent. Very easily sol. in H_2O. (Topsoë.)

Ammonium cerous selenate, $(NH_4)_2Ce_2(SeO_4)_4+9H_2O$.

Easily sol. in H_2O. (Jolin.)

Ammonium chromium selenate, $(NH_4)_2Cr_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Ammonium cobaltous selenate, $(NH_4)_2SeO_4$, $CoSeO_4+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Ammonium cupric selenate, $(NH_4)_2SeO_4$, $CuSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Ammonium didymium selenate, $(NH_4)_2SeO_4$, $Di_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve.)

$+10H_2O$. (Cleve, Bull. Soc. (2) **43.** 363.)

Ammonium erbium selenate, $(NH_4)_2SeO_4$, $Er_2(SeO_4)_3+4H_2O$.

Easily sol. in H_2O. (Cleve.)

Ammonium ferrous selenate, $(NH_4)_2Fe(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+2H_2O$.

Ammonium lanthanum selenate, $(NH_4)_2SeO_4$, $La_2(SeO_4)_3+9H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium magnesium selenate, $(NH_4)_2Mg(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Ammonium manganous selenate, $(NH_4)_2SeO_4$, $MnSeO_4+6H_2O$.

Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Ammonium nickel selenate, $(NH_4)_2SeO_4$, $NiSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Ammonium samarium selenate, $(NH_4)_2SeO_4$, $Sm_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve.)

Ammonium thallium selenate, $(NH_4)_2SeO_4$, $Tl_2(SeO_4)_3+8H_2O$.

Sol. in H_2O. (Fortini, C. C. **1903,** II. 706.)

Ammonium uranyl selenate, $(NH_4)_2SeO_4$, $(UO_2)SeO_4+2H_2O$.

Easily sol. in H_2O. (Sendtner.)

Ammonium yttrium selenate, $(NH_4)_2SeO_4$, $Y_2(SeO_4)_3+6HO$.

Very sol. in H_2O. (Cleve.)

Ammonium zinc selenate, $(NH_4)_2SeO_4$, $ZnSeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Antimony selenate.

Insol. in H_2O. Not very sol. in acids. Sol. in H_2SeO_4. (Cameron and Macallan.)

Barium selenate, $BaSeO_4$.

Somewhat more sol. in H_2O and dil. acids than $BaSO_4$. (Rose.) 100 ccm. H_2O dissolve 11.8 mg. in the cold, and 13.8 mg. at 100°. (Petersson, Z. anal. **12.** 287.)

Not decomp. by H_2SO_4. Insol. in HNO_3+Aq (Berzelius), but decomp. by solution of alkali carbonates at ordinary temp.

Very slowly decomp. by HCl+Aq. (Rose, Pogg. **95.** 426.)

Bismuth selenate.

Insol. in, and not decomp. by cold or hot H_2O. (Cameron and Macallan.)

Cæsium selenate, Cs_2SeO_4.

Sol. in H_2O. (Petersson, B. **9.** 1561.)

100 g. H_2O at 12° dissolve 244.8 g. Cs_2SeO_4. (Tutton, Chem. Soc. 1897, **71.** 850.)

Sp. gr. of Cs_2SeO_4+Aq at 20° compared with H_2O at 4°, containing:

% Cs_2SeO_4	45.94	53.43
Sp. gr.	1.5841	1.7432

(Tutton.)

Cæsium hydrogen selenate, $CsHSeO_4$.

Ppt. Very hygroscopic. (Norris, Am. Ch. J. 1901, **26.** 322.)

Cæsium chromic selenate, $Cs_2Cr_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Cæsium cobaltous selenate, $Cs_2Co(SeO_4)_2+6H_2O$.

Sol. in H_2O. (Topsoë.)

Cæsium indium selenate, $CsIn(SeO_4)_2+12H_2O$.

Efflorescent; sol. in H_2O. (Mathers, J. Am. Chem. Soc. 1908, **30.** 215.)

Cæsium iron (ferric) selenate, $Cs_2Fe_2(SeO_4)_4+24H_2O$.

Sl. sol. in H_2O. (Roncogliolo, Gazz. ch. it. 1905, **35.** (2) 553.)

Cæsium magnesium selenate, Cs_2SeO_4, $MgSeO_4+6H_2O$.

(Tutton, Chem. Soc. 1905, **87,** 1163.)

Cæsium zinc selenate, $Cs_2Zn(SeO_4)_2+6H_2O$.

(Tutton, Zeit. Kryst. 1900, **33.** 14.)

Cadmium selenate, $CdSeO_4+2H_2O$.

Very sol. in H_2O. (v. Hauer, W. A. B. **39.** 299.)

Cadmium potassium selenate, $CdSeO_4$, K_2SO_4 $+2H_2O$.

Sol. in H_2O; can be recrystallized without decomp. (v. Hauer, W. A. B. **54.** 209.)

Calcium selenate, $CaSeO_4+2H_2O$.

Less sol. in hot than in cold H_2O. (v. Hauer, J. pr. **80.** 214.)

Sat. $CaSeO_4$+Aq contains at:

—1°	+5°	20°	37°	67°
7.4	7.3	7.6	6.8	5 1% $CaSeO_4$.

(Étard, A. ch. 1894, (7) **2.** 551.)

Cerous selenate, $Ce_2(SO_4)_3+6H_2O$, $9H_2O$, or $12H_2O$.

More sol. in cold than hot H_2O. (Jolin.)

$+4H_2O$. Very easily in cold, sl. sol. in hot H_2O. (Cingolani, C. C. **1908,** I. 1606.)

Stable above 100°.

$+5H_2O$. Stable at 92–100°.

$+7H_2O$. Stable at 80–92°.

$+8H_2O$. Stable at 50–78°.

$+10H_2O$. Stable at 34–40°.

$+11H_2O$. Stable at 12–28°.

$+12H_2O$. Stable at 0–12°. (Cingolani, C. A. **1908.** 2658.)

Solubility of $Ce_2(SeO_4)_3$ in H_2O at t°.

(G. salt calculated as anhydrous $Ce_2(SO_4)_3$ dissolved in 100 cc. H_2O.)

t°	Using $Ce_2(SeO_4)_3$ $+11H_2O$	Using $Ce_2(SeO_4)_3$ $+4H_2O$	t°	Using $Ce_2(SeO_4)_3$ $+11H_2O$	Using $Ce_2(SeO_4)_3$ $+4H_2O$
0°	...	39.55	60°	13.68	...
11.6	37	...	60.8	...	13.12
12.6	...	36.9	78.2	5.52	...
26.6	33.84	...	80.5	...	4.56
28.8	...	33.2	91	2.02	...
34.2	33.15	...	95.4	1.53	...
45.6	32.16	...	98	...	1.785
45.9	...	31.89	100	...	2.513

(Cingolani, *l. c.*)

Cerous potassium selenate, $Ce_2(SeO_4)_3$, $5K_2SeO_4$.

More sol. in H_2O than the corresponding sulphate. (Jolin.)

Cerous sodium selenate, $Ce_2(SeO_4)_3$, Na_2SeO_4 $+5H_2O$.

Quite sol. in H_2O. (Jolin.)

Chromic potassium selenate, $Cr_2K_2(SeO_4)_4+24H_2O$.

Resembles the sulphate in every particular.

Chromic rubidium selenate, $Cr_2Rb_2(SeO_4)_4+24H_2O$.

Sol. in H_2O.

Chromic sodium selenate, $Cr_2Na_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Chromic thallous selenate, $Cr_2Tl_2(SeO_4)_4+24H_2O$.

Sol. in H_2O. (Fabre, C. R. **105.** 114.)

Chromic selenate potassium sulphate, $Cr_2(SeO_4)_3$, $K_2SO_4+24H_2O$.

Sol in H_2O. (v. Gerichten.)

Cobaltous selenate, basic, $4CoO$, $3SeO_3+H_2O$.

Insol. in H_2O; sol. in acids. (Bogdan, Bull. Soc. (3) **9.** 586.)

$Co_3(OH)_2(SeO_4)_3$. Insol. in H_2O. Sol. in acids. (Bogdan, C. C. **1895.** 630.)

Cobaltous selenate, $CoSeO_4+5H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+6H_2O$. Easily sol. in H_2O. (Topsoë.)

$+7H_2O$. Efflorescent. Extremely sol. in H_2O. (Topsoë.)

$+18H_2O$. Very unstable. (Copaux, A. ch. 1905, (8) **6.** 553.)

Cobaltous potassium selenate, $CoSeO_4$, $K_2SeO_4+6H_2O$.

More sol. in H_2O than corresponding sulphate. (v. Hauer, W. A. B. **39.** 837.)

Cobaltous rubidium selenate, $CoRb_2(SeO_4)_2$ $+6H_2O$.

Sol. in H_2O. (Topsoë.)

Cobaltous thallous selenate, $CoTl_2(SeO_4)_2+6H_2O$.

Sol. in H_2O. (Topsoë.)

Cupric selenate, basic, $3CuO$, $2SeO_3+4H_2O$.

Insol. in H_2O; sol. in acids. (Bogdan, Bull. Soc. (3) **9.** 588.)

$+5H_2O$. Sl. sol. in cold H_2O. (Metzner, C. R. 1898, **127.** 55.)

Cupric selenate, $CuSeO_4+5H_2O$.

Solubility in H_2O:—

257 g. salt in 1 l. sat. solution at 15°.
346 " " " 1 l. " " " 35°.
435 " " " 1 l. " " " 55°.

Aq. solution decomp. at 70°. (Metzner, C. R. 1898, **127.** 55.)

$+H_2O$, and $+2H_2O$. (Metzner.)

Cupric hydrazine selenate, $N_2H_4.H_2SeO_4$, $CuSeO_4+\frac{1}{2}H_2O$.

Decomp. in aq. solution. (Rimini, C. C. **1907,** I. 86.)

Cupric magnesium selenate, $CuMg_3(SeO_4)_4+28H_2O$.
Sol. in H_2O. (Wohlwill.)

Cupric nickel selenate, $CuSeO_4$, $NiSeO_4+14H_2O$.
Sol. in H_2O. (Wohlwill.)

Cupric potassium selenate, $CuSeO_4$, $K_2SeO_4+6H_2O$.
Sl. sol. in H_2O. (Topsoë.)

Cupric zinc selenate, $CuZn_3(SeO_4)_4+28H_2O$.
Sol. in H_2O. (Wohlwill.)

Cupric selenate ferrous sulphate, $2CuSeO_4$, $3FeSO_4+35H_2O$.
Sol. in H_2O. (Wohlwill.)

Cupric selenate magnesium sulphate, $CuSeO_4$, $3MgSO_4+28H_2O$.
Sol. in H_2O. (Wohlwill.)

Cupric selenate zinc sulphate, $CuSeO_4$, $3ZnSO_4+28H_2O$.
Sol. in H_2O. (Wohlwill.)

Didymium selenate, $Di_2(SeO_4)_3+5H_2O$, and $6H_2O$.
Sol. in H_2O.
$+8H_2O$. Easily sol. in H_2O. (Cleve.)
$+10H_2O$. Sol. in H_2O. (Cleve.)

Didymium potassium selenate, $Di_2(SeO_4)_3$, $K_2SeO_4+9H_2O$.
Not deliquescent. Easily sol. in H_2O. (Cleve.)

Didymium sodium selenate, $Di_2(SeO_4)_3$, $Na_2SeO_4+4H_2O$.
Easily sol. in H_2O. (Cleve.)

Dysprosium selenate, $Dy_2(SeO_4)_3+8H_2O$.
Easily sol. in H_2O; insol. in alcohol. (Jantsch, B. 1911, **44.** 1275.)

Erbium selenate, $Er_2(SeO_4)_3+8H_2O$, and $9H_2O$.
Fasily sol. in H_2O. (Topsoë.)

Erbium potassium selenate, $Er_2(SeO_4)_3$, $K_2SeO_4+8H_2O$.
Easily sol. in H_2O. (Cleve.)

Gadolinium selenate, $Gd_2(SeO_4)_3+10H_2O$.
Decomp. in the air. (Benedicks, Z. anorg. 1900, **22.** 410.)

Gadolinium potassium selenate, $Gd_2(SeO_4)_3$, $3K_2SeO_4+4H_2O$.
Sol. in H_2O. (Benedicks, Z. anorg. 1900, **22.** 412.)

Glucinum selenate, $GlSeO_4+4H_2O$.
Very sol. in H_2O. (Atterberg.)

Gold (auric) selenate, $Au_2(SeO_4)_3$.
Insol. in H_2O. Sol. in hot conc. H_2SeO_4+Aq. Somewhat sol. in H_2SO_4 and HNO_3+Aq. Decomp. by HCl+Aq. (Lenher, J. Am. Chem. Soc. 1902, **24.** 355.)

Indium selenate, $In_2(SeO_4)_3+10H_2O$.
Hydroscopic; easily sol. in H_2O. (Mathers, J. Am. Chem. Soc. 1908, **30.** 214.)

Iron (ferrous) selenate, $FeSeO_4+5H_2O$.
Sol. in H_2O. (Wohlwill, A. **114.** 169.)
$+7H_2O$. Efflorescent, and sol. in H_2O. (Topsoë.)

Iron (ferrous) potassium selenate, $FeSeO_4$, $K_2SeO_4+6H_2O$.
Easily sol. in H_2O. Solution decomp. somewhat on standing. (Topsoë.)

Iron (ferric) rubidium selenate, $Rb_2Fe_2(SeO_4)_4+24H_2O$.
Sl. sol. in H_2O. (Roncogliolo, Gazz. ch. it. 1905, **35.** (2) 553.)

Iron (ferric) selenate potassium sulphate, $Fe_2(SeO_4)_3$, $K_2SO_4+24H_2O$.
Sol. in H_2O. (v. Gerichten.)

Lanthanum selenate, $La_2(SeO_4)_3+6H_2O$, and $10H_2O$.
Easily sol. in cold H_2O. (Cleve.)
$+12H_2O$. (Frerichs and Smith, A. **191.** 355.)

Lanthanum potassium selenate, $La_2(SeO_4)_3$, $K_2SeO_4+9H_2O$.
Quite sol. in H_2O. (Cleve.)

Lanthanum sodium selenate, $La_2(SeO_4)_3$, $Na_2SeO_4+4H_2O$.
Easily sol. in H_2O. (Cleve.)

Lead selenate, basic, $2PbO$, SeO_3.
Decomp. by acids with separation of $PbSeO_4$.
$3PbO$, $PbSeO_4+H_2O$. Ppt. (Strömholm, Z. anorg. 1904, **38.** 443.)

Lead selenate, $PbSeO_4$.
Insol. in H_2O or HNO_3+Aq. (Schafarik, W. A. B. **47.** 256.)
Min. *Kerstenite.*

Lithium selenate, $Li_2SeO_4+H_2O$.
Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Magnesium selenate, $MgSeO_4+6H_2O$.

Solubility resembles closely that of $MgSO_4$. (Topsoë.)

Magnesium potassium selenate, $MgK_2(SeO_4)_2+6H_2O$.

Easily sol. in H_2O. (Topsoë.)

Magnesium rubidium selenate, $MgSeO_4$, $Rb_2SeO_4+6H_2O$.

(Tutton, Chem. Soc 1905, **87.** 1163.)

Manganous selenate, $MnSeO_4+2H_2O$.

Easily sol. in H_2O. (Topsoë.)

$+5H_2O$. Easily sol. in H_2O. Solution decomp. on warming or standing. (Topsoë.)

Manganous potassium selenate, K_2SeO_4, $MnSeO_4$.

Not deliquescent. Easily sol. in H_2O. (Topsoë.)

Mercurous selenate, $6Hg_2O$, $5SeO_3$.

Very sl. sol. in H_2O. Sl. attacked by boiling HNO_3. Insol. in HCl+Aq. (Köhler, Pogg. **89.** 146.)

Hg_2SeO_4. Very sl. sol. in H_2O; insol. in HCl+Aq. (Cameron and Davy, C. N. **44.** 63.)

Mercuric selenate, basic, $6HgO$, $2SeO_3+H_2O$.

Insol. in H_2O, or cold HNO_3+Aq. Sol. in hot HNO_3 or HCl+Aq. (Köhler.)

$HgSeO_4$, $2HgO$. Sol. in 10,330 pts. H_2O. (Cameron and Davy.)

Mercuric selenate, $HgSeO_4+H_2O$.

Decomp. by H_2O with formation of basic salt. (Köhler.)

Sol. in H_2SeO_4, H_2SO_4, HNO_3, or HCl+Aq, but decomp. by H_2O to $2HgO$, $HgSeO_4$. (Cameron and Davy, C. N. **44.** 63.)

Nickel selenate, $NiSeO_4+6H_2O$.

Very easily sol. in H_2O. (v. Hauer, W. A. B. **39.** 305.)

Nickel potassium selenate, $NiSeO_4$, $K_2SeO_4+6H_2O$.

Sol. in H_2O. (Topsoë.)

Nickel thallium selenate, $NiSeO_4$, $Tl_2SeO_4+6H_2O$.

Sol. in H_2O. (Petersson.)

Platinum selenate.

Sol. in boiling H_2O. Sol. in HCl+Aq. Insol. in alcohol. (Cameron and Macallan, Lond. R. Soc. Proc. **46.** 13.)

Potassium selenate, K_2SeO_4.

Nearly equally sol. in cold and hot H_2O. (Mitscherlich, Pogg. **9.** 623.)

100 g. H_2O dissolve 110.5 g. K_2SeO_4 at 0°; 112.8 g. at 20°; 122.7 g. at 100°. (Étard, C. R. 1888, **106.** 741.)

Sat. K_2SeO_4+Aq contains at:

−20°	−5°	+5°	18°	97°
51.5	51.7	52.0	52.6	54.9% K_2SeO_4.

(Étard, A. ch. 1894, (7) **2.** 550.)

100 g. H_2O at 12° dissolve 115.0 g. K_2SeO_4. (Tutton, Chem. Soc. 1897, **71.** 850.)

Sp. gr. of K_2SeO_4+Aq at 20° compared with H_2O at 4°, containing:

% K_2SeO_4	35.76	41.79	50.00
Sp. gr.	1.3591	1.4385	1.5590

(Tutton, Chem. Soc. 1897, **71.** 851.)

Potassium hydrogen selenate, $KHSeO_4$.

Sol. in H_2O.

Potassium praseodymium selenate, $3K_2SeO_4$, $Pr_2(SeO_4)_3+4H_2O$.

Sl. sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 361.)

Potassium samarium selenate, K_2SeO_4, $Sm_2(SeO_4)_3+6H_2O$.

Easily sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 166.)

Potassium sodium selenate, $3K_2SeO_4$, Na_2SeO_4.

Sol. in H_2O. (Topsoë.)

Potassium thallium selenate, K_2SeO_4, $Tl_2(SeO_4)_3+8H_2O$.

Very sol. in dil. acids. (Fortini, C. C. **1903,** II. 706.)

Potassium uranyl selenate, K_2SeO_4, $(UO_2)SeO_4+2H_2O$.

Sl. sol. in cold, easily in hot H_2O. (Sendtner.)

Potassium yttrium selenate, K_2SeO_4, $Y_2(SeO_4)_3+6H_2O$.

Very sol. in H_2O. (Cleve.)

Potassium zinc selenate, K_2SeO_4, $ZnSeO_4+2H_2O$.

Sol. in H_2O. (Topsoë.)

$+6H_2O$. Sol. in H_2O. (Topsoë.)

Potassium selenate aluminum sulphate, K_2SeO_4, $Al_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate chromic sulphate, K_2SeO_4, $Cr_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate ferric sulphate, K_2SeO_4, $Fe_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Potassium selenate manganous sulphate, K_2SeO_4, $MnSO_4+6H_2O$.

Sol. in H_2O. (v. Gerichten, A. **168.** 225.)

Potassium selenate manganic sulphate, K_2SeO_4, $Mn_2(SeO_4)_3+24H_2O$.

Sol. in H_2O. (v. Gerichten.)

Praseodymium selenate, $Pr_2(SeO_4)_2$.

Sol. in H_2O. (von Schule, Z. anorg. 1898, **18.** 360.)

$+8H_2O$. Sl. sol. in H_2O; sol. in H_2SO_4. (von Schule.)

Rubidium selenate, Rb_2SeO_4.

Sol. in H_2O. (Petersson.)

100 g. H_2O at 12° dissolve 158.9 g. Rb_2SeO_4. (Tutton, Chem. Soc. 1897, **71.** 850.)

Sp. gr. of Rb_2SeO_4+Aq at 20° compared with H_2O at 4°, containing:

% Rb_2SeO_4	40.60	47.07
Sp. gr.	1.4688	1.5806

(Tutton.)

Rubidium hydrogen selenate, $RbHSeO_4$.

Sol. in equal pts. H_2O; very hydroscopic. (Norris, Am. Ch. J. 1901, **26.** 321.)

Rubidium zinc selenate, $Rb_2Zn(SeO_4)_2+6H_2O$.

(Tutton, Zeit. Kryst. 1900, **33.** 8.)

Samarium selenate, $Sm_2(SeO_4)_3+8H_2O$.

More sol. in H_2O than $Sm_2(SO_4)_3$.

$+12H_2O$. Efflorescent. (Cleve.)

Scandium selenate, $Sc_2(SeO_4)_3+2H_2O$, and $+8H_2O$.

(Crookes, Roy. Soc. Proc. 1908, **80,** A. 518.)

Silver selenate, Ag_2SeO_4.

As Ag_2SO_4. (Mitscherlich, Pogg. **12.** 138.)

Silver selenate ammonia, Ag_2SeO_4, $4NH_3$.

Easily sol. in H_2O or NH_4OH+Aq without decomp. (Mitscherlich, Pogg. **12.** 141.)

Sodium selenate, Na_2SeO_4.

Very sol. in H_2O, forming supersat. solutions. Cryst. also with $10H_2O$, which effloresce. Maximum point of solubility is at 33°. (Mitscherlich.)

Solubility in H_2O at t°.

t°	% Na_2SeO_4	Mols. H_2O to 1 mol. Na_2SeO_4	Mols. anhydrous salt to 100 mols. H_2O
35.2	45.47	12.59	7.94
39.5	45.26	12.70	7.87
50	44.49	13.10	7.63
75	42.83	14.00	7.14
100	42.14	14.42	6.93

(Funk, B. 1900, **33.** 3697.)

$+10H_2O$. Solubility in H_2O at t°.

t°	% Na_2SeO_4	Mols. H_2O to 1 mol. Na_2SeO_4	Mols. anhydrous salt to 100 mols. H_2O
0	11.74	79.08	1.26
15	25.01	31.48	3.18
25.2	36.91	17.95	5.57
27	39.18	16.30	6.13
30	44.05	13.33	7.50

(Funk.)

Sp. gr. of sat. solution at 18° = 1.315. (Funk.)

Sodium selenate vanadate.

See **Selenovanadate, sodium.**

Strontium selenate, $SrSeO_4$.

Insol. in H_2O or HNO_3+Aq; decomp. by long boiling with HCl+Aq.

Tellurium selenate, $2TeO_2$, SeO_3.

As sulphate. (Metzner, A. ch. 1898, (7) **15.** 203.)

Thallous selenate, Tl_2SeO_4.

Sl. sol. in cold, much more in hot H_2O. Insol. in alcohol and ether. (Kuhlmann.)

100 g. H_2O dissolve 2.13 g. at 9.3; 2.4 g. at 12°; 10.86 g. at 100°. (Tutton, Proc. Roy. Soc. 1907, **79.** A, 351.)

2.8 g. are sol. in 100 g. H_2O at 20°; 8.5 g. at 80°. (Glauser, Z. anorg. 1910, **66.** 437.)

Thallous hydrogen selenate, $HTlSeO_4+3H_2O$.

(Oettinger.)

Thallous zinc selenate, Tl_2SeO_4, $ZnSeO_4+6H_2O$.

Easily sol. in H_2O, but less than the corresponding sulphate. (Werther, Bull. Soc. **1865.** 60.)

Thorium selenate, $Th(SeO_4)_4+9H_2O$.

100 pts. H_2O dissolve 0.498 pt. $Th(SeO_4)_4$ at 0°, and 1.972 pts. at 100°. (Cleve.)

Tin (stannic) selenate, basic, $SnO(SeO_4)+H_2O$.

Deliquescent. Sol. in H_2O. (Ditte, C. R. **104.** 231.)

Uranyl selenate, $(UO_2)SeO_4, H_2SeO_4+18H_2O$.

Very deliquescent.

$2(UO_2)SeO_4, H_2SeO_4+12H_2O$. Efflorescent. Sol. in H_2O. (Sendtner, A. **195.** 325.)

Ytterbium selenate, $Yb_2(SeO_4)_3$.

Anhydrous.

$+15H_2O$ (?), $+8H_2O$ Ppt. (Cleve, Z. anorg. 1902, **32.** 145.)

Yttrium selenate, $Y_2(SeO_4)_3$.

Anhydrous. Sol. in H_2O with hissing and evolution of heat. (Popp.)

$+8H_2O$. Easily sol. in H_2O. (Cleve.)

$+9H_2O$. Efflorescent.

Zinc selenate, $ZnSeO_4+5H_2O$.

Sol. in H_2O. (Topsoë.)

$+6H_2O$. Sol. in H_2O. (Topsoë.)

$+7H_2O$. Sol. in H_2O.

Selenious acid, H_2SeO_3.

Deliquescent in moist, efflorescent in dry air. Very sol. in cold, and in nearly every proportion in hot H_2O. Easily sol. in alcohol. (Berzelius.)

Sp. gr. of H_2SeO_3 and of H_2SeO_3+Aq at t°. Two series of experiments.

	t°	Sp. gr. at t°
H_2SeO_3+Aq (A)	18.0	1.4386
1 vol. A+0.5 vol. H_2O	18.0	1.3179
"+1 0 "	17.7	1.2337
"+1.5 "	16.6	1.2045
"+2.0 "	14.0	1.1984
"+2.5 "	17.0	1.1712
"+3.0 "	19.2	1.1600
H_2SeO_3+Aq (B)	15.8	1.4698
1 vol. B+0.5 vol. H_2O	16.5	1.3191
"+1.0 "	13.0	1.2515
"+1.5 "	14.2	1.2074
"+2.0 "	17.0	1.1992
"+2.5 "	16.5	1.1793
"+3.0 "	14.2	1.1678

(de Coninck, C. C. **1905,** I. 1693.)

See also **Selenium** ***di*****oxide.**

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Selenites.

Alkali selenites are sol. in H_2O. The other neutral selenites are insol. in H_2O, but sol. in HNO_3+Aq, Pb, and Ag salts slowly. The neutral salts are insol. in $HCl+Aq$. The acid salts of the heavy metals are sol. in H_2O.

Aluminum selenite, basic, $4Al_2O_3, 9SeO_2+36H_2O$.

Precipitate. (Nilson, Upsala, **1875.**)

Aluminum selenite, $Al_2(SeO_3)_3$.

Precipitate. (Berzelius.)

$+7H_2O$. Sl. sol. in H_2O. (Nilson.) Sol. in H_2SeO_3+Aq.

$+3H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano, A. ch (6) **17.** 289.)

Aluminum selenite, acid, $Al_2O_3, 4SeO_2+3H_2O$.

(Boutzoureano.)

$2Al_2O_3, 9SeO_2+12H_2O$. Sol. in H_2O. (Nilson.)

$Al_2O_3, 6SeO_2$. Very sol. in H_2O. (Berzelius.)

$+5H_2O$. (Nilson.)

$+2H_2O$. (Boutzoureano.)

Ammonium selenite, $(NH_4)_2SeO_3$.

Deliquescent. Very sol. in H_2O.

Precipitated from aqueous solution by alcohol. Insol. in ether. (Muspratt, A. **70.** 275.)

Ammonium hydrogen selenite, NH_4HSeO_3.

Not deliquescent. Sol. in H_2O. (Berzelius.)

Ammonium ***tri*****hydrogen selenite,** $NH_4H_3(SeO_3)_2$.

Deliquescent. (Berzelius.)

Ammonium vanadium selenite.

See **Vanadioselenite, ammonium.**

Ammonium uranyl selenite, $(NH_4)_2SeO_3, (UO_2)SeO_3$.

Completely insol. in H_2O. (Sendtner.)

Antimony selenite, $Sb_2(SeO_3)_3, SeO_2$.

(Nilson, Bull. Soc. (2) **23.** 494.)

Barium selenite, $BaSeO_3$.

Sl. sol. in H_2O. Sol. in H_2SeO_3+Aq. So in acids. (Nilson.)

$+H_2O$. (Nilson.)

Barium ***pyro*****selenite,** $BaSe_2O_5$.

Very sl. sol. in cold, more in warm H_2O. (Berzelius.)

Bismuth selenite, $Bi_2(SeO_3)_3, H_2SeO_3$.

(Nilson.)

$Bi_2(SeO_3)_3$. (Nilson.)

Cadmium selenite, $CdSeO_3$.

Insol. in H_2O. Sol. in H_2SeO_3+Aq. (Muspratt, Chem. Soc. **2.** 65.)

$2CdO$, $3SeO_2+H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano.)
$+\frac{1}{2}H_2O$. Insol. in H_2O; sol. in dil. acids. (Boutzoureano.)

Cadmium selenite ammonia, $CdSeO_3$, NH_3.
Insol. in cold or hot H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Calcium selenite, $CaSeO_3+{}^4/_3H_2O$.
Very sl. sol. in H_2O. (Berzelius.) More sol. in H_2SeO_3+Aq.
$+2H_2O$. (Nilson.)

Calcium hydrogen selenite, $CaH_2(SeO_3)_2+H_2O$.
Quite sol. in H_2O. (Nilson.)
$Ca_2H_2Se_4O_{11}$. Easily sol. in H_2O. (Nilson.)

Cerous selenite, basic, $2Ce_2O_3$, $5SeO_2+30H_2O$.
Precipitate. (Nilson.)

Cerous selenite, $Ce_2(SeO_3)_3+3H_2O$.
Insol. in H_2O. Sol. in much selenious acid. (Jolin.)
$+12H_2O$. (Nilson.)

Cerous selenite, acid, Ce_2O_3, $4SeO_2$+5, or 6 H_2O.
Insol. in H_2O, but sol. in selenious, and other acids. (Jolin.)
Ce_2O_3, $6SeO_2+5H_2O$. Not decomp. by H_2O. (Nilson.)

Ceric selenite, $Ce(SeO_3)_2$.
Insol. in H_2O.
Sl. sol. in conc. HNO_3. Sol. in dil. acids.
Sol. in H_2O_2+Aq. (Barbieri, B. 1910, **43.** 2215.)

Chromium selenite, basic, $4Cr_2O_3$, $9SeO_2+64H_2O$.
Precipitate. (Nilson.)

Chromic selenite, $Cr_2(SeO_3)_3+3H_2O$.
(Boutzoureano.)
$+15H_2O$. (Nilson.)
Very sl. sol. or insol. in H_2O; sl. sol. in H_2SeO_3+Aq; sol. in hot conc. HCl+Aq. (Taquet, C. R. **96.** 107.)

Chromic selenite, acid, Cr_2O_3, $4SeO_2+13H_2O$.
Slowly sol. in HCl+Aq. Insol. in H_2O. (*Nilson.*)
Cr_2O_3, $5SeO_2+9H_2O$. Insol. in H_2O. (Nilson.)

Chromic *di*selenite.
Insol. in H_2O; sol. in acids. (Taquet, C. R. **97.** 1435.)

Cobaltous selenite, $CoSeO_3$.
Insol. in H_2O. (Berzelius.)
$+{}^1/_3H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano, A. ch. (6) **17.** 289.)

Cobaltous hydrogen selenite, $CoH_2(SeO_3)_2$.
Sol. in H_2O. (Berzelius.)
$+2H_2O$. Sol. in H_2O with decomp. (Boutzoureano.)

Cuprous selenite.
Insol. in H_2O. Sol. in NH_4OH+Aq. (Berzelius.)

Cupric selenite, basic, $2CuO$, SeO_2.
Insol. in H_2O; sol. in NH_4OH+Aq. (Boutzoureano.)
Sol. in acids.

Cupric selenite, $CuSeO_3+\frac{1}{2}H_2O$.
Insol. in H_2O or H_2SeO_3+Aq. (Berzelius.)
$+H_2O$, and $2H_2O$. (Boutzoureano.)
$+2H_2O$. Min. *Chalcomenite.* Insol. in H_2O or H_2SeO_3+Aq. (Friedel and Sarasin, Zeit. Kryst. 1881, **6.** 300.)

Cupric selenite, acid, CuO, $2SeO_2+H_2O=CuH_2(SeO_3)_2$.
Insol. in H_2O. Sol. in acids. (Nilson.)
$+2H_2O$. As above. (Boutzoureano.)
$+4H_2O$. As above. (B.)

Cupric selenite ammonia, $CuSeO_3$, NH_3+H_2O.
Decomp. by H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Didymium selenite, basic, $3Di_2O_3$, $8SeO_2+28H_2O$.
Precipitate. (Nilson.)
$+21H_2O$. Insol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 363.)

Didymium selenite, $Di_2(SeO_3)_3+6H_2O$.
Precipitate. (Smith.)

Didymium selenite, acid, Di_2O_3, $4SeO_2+5H_2O$.
Precipitate. (Cleve.)
Composition is $Di_2(SeO_3)_3+6H_2O$. (Smith.)
$+9H_2O$. (Nilson.)
$2Di_2O_3$, $9SeO_2+18H_2O$. (Nilson.)

Erbium selenite, $Er_2(SeO_3)_3+5H_2O$, and $9H_2O$.
Precipitate. (Nilson.)

Erbium hydrogen selenite, $Er_2H_2(SeO_3)_4+4H_2O$.
Decomp. by hot H_2O.

Gadolinium hydrogen selenite, $Gd_2(SeO_3)_3, H_2SeO_3+6H_2O$.

Ppt. (Benedicks, Z. anorg. 1900, 22. 413.)

Glucinum selenite, basic, 5GlO, $2SeO_2+10H_2O$.

Precipitate. (Nilson.) According to Atterberg, is 7GlO, $3SeO_2+14H_2O$.

2GlO, SeO_2+4H_2O. (Atterberg, Bull. Soc. (2) **19.** 497.)

3GlO, $2SeO_2+6H_2O$. Insol. in H_2O. (Atterberg.)

Glucinum selenite, $GlSeO_4+2H_2O$.

Sol. in little H_2O, decomp by excess. (Nilson.)

Glucinum selenite, acid.

(*a*) 3GlO, $5SeO_2+3H_2O$; (*b*) GlO, $2SeO_2+H_2O$; (*c*) 3GlO, $7SeO_2+5H_2O$; (*d*) GlO, $3SeO_2+2H_2O$. All are very sl. sol. in cold or warm H_2O. *a*, *b*, and *c* are sol. in warm H_2O containing HCl; *d* is sol. only in boiling dil. HCl+Aq. (Nilson.)

Indium selenite, basic, $In_8Se_9O_{30}+64H_2O$. (Nilson.)

Indium selenite, $In_2(SO_3)_3+6H_2O$.

Sl. sol. in H_2O. (Nilson.)

Indium hydrogen selenite, $In_2(SeO_3)_3$, $3H_2SeO_3+4H_2O$.

Sol. in H_2O. (Nilson.)

$2In_2(SeO_3)_3$, $3H_2SeO_3+12H_2O$. Sol. in H_2O. (Nilson.)

Iron (ferrous) selenite.

Ppt. Sol. in HCl+Aq with partial separation of Se. (Berzelius.)

Iron (ferrous) hydrogen selenite.

Sl. sol. in H_2O. (Berzelius.)

Iron (ferric) selenite, basic, $2Fe_2O_3$, $3SeO_2+xH_2O$.

Insol. in H_2O. (Berzelius.)

Fe_2O_3, $2SeO_2$. Insol. in H_2O, easily sol. in acids. (Boutzoureano, A. ch. (6) **17.** 289.)

$3Fe_2O_3$, $8SeO_2+28H_2O$. Insol. in H_2O. (Nilson.)

Iron (ferric) selenite, $Fe_2(SeO_3)_3+4H_2O$.

Insol. in H_2O. (Muspratt, Chem. Soc. **2.** 52.)

$+H_2O$. Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

$+3H_2O$. Insol. in H_2O. (B.)

$+10H_2O$. Insol. in H_2O. (B.)

Iron (ferric) selenite, acid, Fe_2O_3, $6SeO_2+xH_2O$.

Insol. in H_2O. Sol. in HCl+Aq. (Berzelius.)

$+2H_2O$. (Boutzoureano, A. ch. (6) **17.** 289.)

Fe_2O_3, $4SeO_2+H_2O$. Insol. in H_2O; sol. in acids. (Boutzoureano.)

Lanthanum selenite, basic, $3La_2O_3$, $8SeO_2+28H_2O$.

Precipitate. (Nilson.)

Lanthanum selenite, $La_2(SeO_3)_3+9H_2O$, or $12H_2O$.

Insol. in H_2O. (Nilson.)

Lanthanum selenite, acid, $La_2H_4(SeO_3)_5+4H_2O$.

(Nilson.)

$La_2H_6(SeO_3)_6+2H_2O$. (Cleve.)

Lead selenite, $PbSeO_3$.

Scarcely sol. in H_2O, even when it contains H_2SeO_3. Sl. sol. in HNO_3+Aq. (Berzelius.)

Lithium selenite, $Li_2SeO_3+H_2O$.

Difficultly sol. in H_2O. (Nilson, Bull. Soc. (2) **21.** 253.)

Lithium hydrogen selenite, $LiHSO_3$.

Very sol. in H_2O. (Nilson.)

Lithium *tri*hydrogen selenite, $LiH_3(SeO_3)_2$.

Not deliquescent. Sol. in H_2O. (Nilson.)

Lithium vanadium selenite.

See **Vanadioselenite, lithium.**

Magnesium selenite, $MgSeO_3+2H_2O$.

Insol. in H_2O; sol. in dil. acids, especially if warm, also in H_2SeO_3+Aq. (Boutzoureano, A. ch. (6) **18.** 302.)

$+3H_2O$. Very sl. sol. in hot H_2O. (Berzelius.)

$+6H_2O$. As the $2H_2O$ salt. (Boutzoureano.)

$+7H_2O$. Sl. sol. in H_2O. Easily sol. in acetic, and mineral acids. (Hilger, Z. anal. **13.** 132.)

Magnesium hydrogen selenite, $MgH_2(SeO_3)_2+3H_2O$.

Very deliquescent. Easily sol. in H_2O. (Nilson.)

Insol. in alcohol. (Muspratt.)

MgO, $2SeO_2$. Insol. in H_2O; sol. in acids. (Boutzoureano.)

Magnesium *tetra*hydrogen selenite, $MgH_4(SeO_3)_3$, and $+3H_2O$.

Sol. in H_2O. (Nilson.)

Manganous selenite, $MnSeO_3+H_2O$.
Precipitate. (Nilson.)
$+2H_2O$. Insol. in H_2O. (Berzelius.)
Sol. in cold $HCl+Aq$. (Muspratt.)
$+\frac{1}{2}H_2O$. Insol. in H_2O; sol. in dil. acids. (Boutzoureano.)

Manganous selenite, acid, $MnSe_2O_5$.
Sol. in H_2O. (Berzelius; Nilson.)
$MnO, 2SeO_2+H_2O=MnH_2(SeO_3)_2$. (Boutzoureano, A. ch. (6) **17.** 289.)
$+5H_2O$. Decomp. by H_2O to $MnSeO_3$. (Boutzoureano.)

Manganic selenite, basic, $Mn_2O_3, 2SeO_2$.
Insol. in H_2O, cold H_2SO_4, or HNO_3+Aq; insol. in hot dil. H_2SO_4 or HNO_3+Aq. (Laugier, C. R. **104.** 1508.)
Sol. in warm $HCl+Aq$ with decomp.

Manganic selenite, $Mn_2(SeO_3)_3+5H_2O$.
(Laugier.)

Manganic selenite, acid, $Mn_2O_3, 4SeO_2$.
Insol. in H_2O, cold H_2SO_4, and HNO_3+Aq. Insol. in dil. hot H_2SO_4, and HNO_3+Aq. Sol. in cold $HCl+Aq$; and in H_2SO_3+Aq with separation of Se. (Laugier, C. R. **104.** 1508.)

Mercurous selenite, basic, $3Hg_2O, 2SeO_2+5H_2O$.
(Boutzoureano.)

Mercurous selenite, Hg_2SeO_3.
Insol. in H_2O or H_2SeO_3+Aq. Sol. in hot HNO_3+Aq. (Köhler, Pogg. **89.** 146.)
Sl. sol. in $HCl+Aq$, and $KOH+Aq$. (Berzelius.)

Mercurous selenite, acid, $3Hg_2O, 4SeO_2$.
Insol. in H_2O or H_2SeO_3+Aq. Sl. sol. in boiling HNO_3+Aq. (Köhler.)

Mercuric selenite, basic, $7HgO, 4SeO_2$.
Insol. in H_2O. Sl. sol. in HNO_3+Aq. Easily sol. in $HCl+Aq$. (Köhler, Pogg. **89.** 146.)

Mercuric selenite, $HgSeO_3$.
Insol. in H_2O. (Berzelius.) Nearly insol. in HNO_3+Aq. Sol. in K_2SeO_3+Aq. (Divers, Chem. Soc. **48.** 585.)
Insol. in dil. HNO_3+Aq; sol. in $HCl+Aq$. **(Rosenheim and Pritze, Z. anorg. 1909, 63. 278.)**

Solubility in Na_2SeO_3+Aq at 25°.

Na_2SeO_3+Aq Normality	% $HgSeO_3$
2.0	2.73
1.0	1.39
0.5	0.70
0.25	0.53
0.125	0.32
0.0625	0.18

(Rosenheim and Pritze, Z. anorg. 1909, 63. 281.)

$HgSeO_3, H_2SeO_3$. Easily sol. in H_2O; very sl. sol. in alcohol. (Berzelius.)
See also **selenium** ***dioxide.***

Mercuric sodium selenite, $HgSeO_3, Na_2SeO_3$.
Decomp. by H_2O and alkalies with pptn. of $HgSeO_3$. (Rosenheim and Pritze, Z. anorg. 1909, **63.** 279.)

Mercuric selenite sodium chloride, $HgSeO_3, NaCl+2H_2O$.
Decomp. by H_2O. (Rosenheim and Pritze, Z. anorg. 1909, **63.** 280.)

Nickel selenite, $NiSeO_3+H_2O$.
Insol. in H_2O; sol. in H_2SeO_3+Aq. (Muspratt, Chem. Soc. **2.** 52.)
$+\frac{1}{2}H_2O$. Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 28.)

Nickel selenite, acid.
Sol. in H_2O. (Berzelius.)

Potassium selenite, $K_2SeO_3+H_2O$.
Very deliquescent. Sol. in nearly all proportions in H_2O. Insol. in alcohol, which separates it as oil from aqueous solution. (Muspratt, Chem. Soc. **2.** 52.)

Potassium hydrogen selenite, $KHSeO_3$.
Very deliquescent. Very sl. sol. in alcohol. (Muspratt, Chem. Soc. **2.** 52.)

Potassium ***tri*****hydrogen selenite,** $KH_3(SeO_3)_2$.
Very deliquescent. Pptd. from H_2O by alcohol. (Muspratt.)
Not deliquescent. (Nilson.)

Potassium hydrogen ***pyro*****selenite,** $KHSe_2O_5+H_2O$.
(Muthmann, B. 1893, **26.** 1015.)

Potassium uranyl selenite, $K_2SeO_3, (UO_2)SeO_3$.
Absolutely insol. in H_2O. (Sendtner.)

Praseodymium hydrogen selenite, $Pr_2(SeO_3)_3, H_2SeO_3+3H_2O$.
Sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 362.)

Samarium selenite, basic, $3Sm_2O_3, 8SeO_2+7H_2O$.
Precipitate. (Cleve.)

Samarium selenite, acid, $Sm_2O_3, 4SeO_2+5H_2O$.
Precipitate. (Cleve.)

Scandium selenite, $Sc_2(SeO_3)_3+H_2O$.
Insol. precipitate.

Scandium hydrogen selenite, $Sc_2(SeO_3)_3$, $3H_2SeO_3$.
Insol. in H_2O. Not attacked by cold dil. acids, but easily if warmed.

Silver selenite, Ag_2SeO_3.
Very sl. sol. in cold, somewhat more sol. in hot H_2O. Easily sol. in hot HNO_3+Aq, from which it is precipitated by H_2O. (Berzelius.)
Insol. in K_2SeO_3+Aq; sl. sol. in dil HNO_3+Aq. (Divers, Chem. Soc. **49.** 585.)

Silver selenite ammonia, Ag_2SeO_3, NH_3.
Insol. in boiling H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Sodium selenite, Na_2SeO_3.
Very sol. in H_2O. Insol. in alcohol. (Berzelius.)
$+5H_2O$.

Sodium selenite, acid, $NaHSeO_3$.
Permanent. Sol. in H_2O.
$Na_4Se_3O_8$. Sol. in H_2O. (Sacc, A. ch. (3) **21.** 119.)
$NaH_3(SeO_3)_2$. Not deliquescent. Sol. in H_2O.

Sodium vanadium selenite.
See **Vanadioselenite, sodium.**

Strontium selenite, $SrSeO_3+7H_2O$.
Precipitate. Insol. in H_2O. Sol. in HNO_3+Aq. (Muspratt.)

Strontium hydrogen selenite, $SrH_2(SeO_3)_2$.
Easily sol. in hot or cold H_2O. (Nilson.)
Nearly insol. in hot or cold H_2O. (Berzelius.)

Thallous selenite, Tl_2SeO_3.
Easily sol. in H_2O. Insol. in alcohol and ether. (Kuhlmann, Bull. Soc. (2) **1.** 330.)

Thallous hydrogen selenite, $TlHSeO_3$.
More sol. in H_2O than the above comp. (Kuhlmann.)

Thallic selenite, $Tl_2(SeO_3)_3$.
Insol. in H_2O. Sol. in dil. HNO_3.
Easily decomp. by HCl and H_2SO_4. (Marino, Z. anorg. 1909, **62.** 177.)

Thorium selenite, $Th(SeO_3)_2+H_2O$, or $8H_2O$.
Insol. in H_2O; easily sol. in HCl+Aq. (Nilson.)

Thorium selenite, acid, $2ThO_2$, $7SeO_2+16H_2O$.
ThO_2, $5SeO_2+8H_2O$. (Nilson.)

Tin (stannic) selenite.
Insol. in H_2O; sol. in HCl+Aq, from which it is pptd. by H_2O. (Berzelius.)

Uranic selenite, U_2O_3, SeO_2.
Insol. in H_2O. (Boutzoureano.)
$+2H_2O$. (B.)

Uranic selenite, acid, $2U_2O_3$, $3SeO_2+7H_2O$.
Insol. in H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Uranyl selenite, $(UO_2)SeO_3+2H_2O$.
Precipitate. (Nilson.)

Uranyl selenite, acid, $3UO_3$, $5SeO_2+7H_2O$, or $9H_2O$.
Insol. in H_2O.
UO_3, $2SeO_2+H_2O=(UO_3)H_2(SeO_3)_2$. Absolutely insol. in H_2O and H_2SeO_3+Aq. (Sendtner, A. **195.** 325.)

Vanadium selenite.
See **Vanadioselenious acid.**

Ytterbium selenite, $Yb_2(SeO_3)_3$.
Insol. precipitate.

Ytterbium hydrogen selenite, $Yb_2H_2(SeO_3)_4+4H_2O$.
Insol. in H_2O.

Yttrium selenite, $Y_2(SeO_3)_3+12H_2O$.
Insol. in H_2O or H_2SeO_3+Aq. (Berzelius.)
Sol. in hot H_2SeO_3+Aq. (Nilson.)

Yttrium hydrogen selenite, $Y_2H_2(SeO_3)_4+3H_2O$.
Sl. sol. in H_2O. Easily sol. in HCl or HNO_3+Aq. (Cleve.)

Zinc selenite, $ZnSeO_3$.
Insol. in H_2O; sol. in acids. (Boutzoureano, A. ch. (6) **18.** 289.)
$+2H_2O$. Insol. in H_2O. Sol. in H_2SeO_3, or HNO_3+Aq. (Muspratt, Chem. Soc. **2.** 52.)

Zinc hydrogen selenite, $ZnH_2(SeO_3)_2$.
Easily sol. in H_2O. (Berzelius.)
$+2H_2O$. Sol. in cold H_2O. (Boutzoureano.)
ZnO, $4SeO_2+3H_2O$. Easily sol. in H_2O. (Wöhler, A. **63.** 279.)

Zinc selenite ammonia, $ZnSeO_3$, NH_3.
Insol. in cold or hot H_2O. (Boutzoureano, A. ch. (6) **17.** 289.)

Zirconium selenite, basic, $4ZrO_2$, $3SeO_2+18H_2O$.
Precipitate. Sl. sol. in HCl+Aq. (Nilson.)

Zirconium selenite, $Zr(SeO_3)_2$.

Absolutely insol. in H_2O; difficultly sol. in boiling HCl+Aq. (Nilson.)

$+H_2O$. (Nilson.)

Selenium, Se.

Insol. in H_2O. Schultz (J. pr. (2) **32.** 390) has obtained a soluble colloidal modification which can be isolated by dialysis.

Insol. in HCl+Aq. Decomp. by HNO_3+Aq. Sol. in fuming H_2SO_4. (Schultz-Sellac, B. **4.** 113.)

1000 pts. CS_2 dissolve 1 pt. cryst. Se at boiling-point (46.6°), and 0.16 pt. at 0° (Mitscherlich, J. B. **1855.** 314.) Solubility of Se in CS_2 is variable—1 pt. Se is sol. in 1376–2464–3746 pts. CS_2 at 20° (Rammelsberg, B. **7.** 669). Cryst. Se, which is sol. in CS_2, becomes insol. in CS_2 after heating to 110°, but after fusion is again sol. (Otto).

Four modifications.—(1) Amorphous red; (2) crystalline red; (3) granular gray; (4) laminated. 1 and 2 are sol. in CS_2, 3 and 4 are insol. in CS_2. All forms are sol. in $SeCl_2$, from which crystallizes a black modification, insol. in CS_2. CCl_4 with trace of CS_2 dissolves red Se slightly, black Se not at all. $Se(C_2H_5)_2$ dissolves all modifications in small but apparently equal quantities. (Rathke, A. **152.** 181.)

According to Saunders (J. phys. Chem. 1900, **4.** 428) selenium exists in three modifications.

1. Liquid, including vitreous, amorphous, and colloidal selenium.

a. *Vitreous.*

Sol. in liquid NH_3 at 25°. (Franklin, Am. Ch. J. 1898, **20.** 820.)

Insol. in liquid NH_3 between —30° and +10°. Franklin's results are due to impure selenium and not completely dry NH_3. (Hugot, A. Ch. 1900, (7) **21.** 5.)

Almost insol. in CS_2. (Schützenberger Chimie générale **1.** 438.)

Action of light increases solubility in CS_2. (Saunders, J. phys. Chem. 1900, **4.** 456.)

Solubility in methylene iodide at 12° is 1.3 pts in 100. (Retgers, Z. anorg. 1893, **3.** 343.)

Sol. in CSe_2, ethyl selenide, and in ethyl sulphide.

Very sol. in Se_2Cl_2. (Rathke, A. 1869, **152.** 181.)

b. *Amorphous.*

Completely sol. in CS_2 at ord. temp. if Se has not been heated. If heated or extracted with warm CS_2 it becomes partly insol. (Peterson, Z. phys. Chem. 1891, **81.** 612.)

Passes into red crystalline form in solution in CS_2, C_6H_6, isobutyric acid, acetophenone, acetone, $CHCl_3$, thiophene, toluene, benzonitrile, ethyl acetate, and alcohol. (Saunders, J. phys. Chem. 1900, **4.** 463.)

Solution in quinoline, aniline, pyridine, etc., cause conversion into gray metallic form.

c. *Colloidal.*

Forms colloidal solution with H_2O.

A colloidal solution of Se in H_2O can be obtained. It is not decomp. by boiling, but is decomp. by electrolytes with separation of red selenium. (Gutbier, Z. anorg. 1902, **32.** 106.)

2. *Red crystalline.*

Sol. in CS_2.

3. *Gray, crystalline or metallic.*

Sol. in selenium chloride and other solvents as vitreous Se. (Rathke, A. 1869, **152.** 181.)

Sl. sol. in CS_2, toluene, nitrobenzene, quinoline, aniline, and KOH. Pptd. from conc. KOH+Aq. in long needles with mpt. 219°. (Coste, C. R. 1909, **149.** 674.)

Sol. in many organic substances at high temp. as quinoline, ethyl benzoate, aniline and naphthaline. (Saunders, J. phys. Chem. 1900, **4.** 469.)

Completely insol. in CS_2. (Saunders, J. phys. Chem. 1900, **4.** 474.)

Solubility of the two modifications of gray crystalline Se in CS_2.

100 cc. boiling CS_2 dissolve mg. Se.

I	II	III
Mg. Se	Mg. Se	Mg. Se
3.2	4.1	2.7
2.8	4.0	2.2
3.6	2.9	1.9
3.3	2.8	1.0
2.2	2.9	2.0
...	4.0	...

I. Se heated 1 hr. at 140°. Modification A.

II. Modification A.

III. Se heated 48 hrs. at 190°–200°. Modification B.

(Marc, Z. anorg. 1907, **53.** 302.)

Se_2Br_2 dissolves 22% Se. (Schneider, Pogg. **128.** 327.)

Red Se is sol. in $(NH_4)_2SO_3$+Aq. (Uelsmann, A. **116.** 122.)

Sol. in alkalies and Mg sulphites+Aq.

365 pts. K_2SO_3+Aq dissolve 102 pts. Se.

360 pts. $MgSO_3$, $3H_2O$+Aq dissolve 116 pts. Se.

Insol. in $BaSO_3$+Aq. (Rathke and Zschiesche, J. pr. **92.** 145.)

Sol. in KCN+Aq with formation of KSeCN. (Franklin, Am. Ch. J. 1898, **20.** 830.)

100 pts. methylene iodide dissolve 1.3 pts. Se at 12°. (Retgers, Z. anorg. **3.** 343.)

Sol. in quinoline, but reacts with the solvent with evolution of H. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Selenium *mono*bromide, Se_2Br_2.

Insol. in H_2O, but gradually decomp. thereby. Decomp. by absolute alcohol and benzene. Sol. in C_2H_5I, but soon decomposed. Miscible with CS_2; less sol. in $CHCl_3$ and C_2H_5Br. (Schneider, Pogg. **128.** 327.)

Selenium *tetra*bromide, $SeBr_4$.

Sol. in H_2O with decomp. Decomp. by alcohol. Sol. in HCl+Aq; sl. sol. in CS_2, $CHCl_3$, and C_2H_5Br. (Schneider, Pogg. **129.** 450.)

Decomp. by C_2H_5I.

Selenium bromo*tri*chloride, $SeCl_3Br$.

Insol. in CS_2. (Evans and Ramsay, Chem. Soc. **45.** 62.)

Selenium *tetra*bromide sulphur *tri*oxide, $SeBr_4$, $2SO_3$.

Decomp. by H_2O. (Prandtl, Z. anorg. 1909, **62.** 242.)

Selenium *tri*bromochloride, $SeClBr_3$.

See **Selenium chloro*tri*bromide.**

Selenium *mono*chloride, Se_2Cl_2.

Gradually decomp. by H_2O. Dissolves all modifications of selenium on heating (Rathke, A. **152.** 181). Insol. in conc. H_2SO_4; easily sol. in fuming H_2SO_4. Sol. in $CHCl_3$, C_6H_6, CCl_4. Gradually decomp. by H_2O, alcohol, and ether. (Divers and Shimosé, B. **17.** 862.) Sol. in CS_2. (Evans and Ramsay, Chem. Soc. **45.** 62.)

Selenium *tetra*chloride, $SeCl_4$.

Deliquescent on moist air. Decomp. with H_2O. (Berzelius, A. ch. **9.** 225.) Insol. in CS_2. Easily sol. in hot $POCl_3$, from which it crystallizes on cooling. (Michaelis, Zeit. Chem. (2) **6.** 460.) Very sl. sol. in CS_2. (Evans and Ramsay, Chem. Soc. **45.** 62.)

Selenium *di*chlorobromide, $SeCl_2Br_2$.

(Evans and Ramsay, Chem. Soc. **45.** 62.)

Selenium chloro*tri*bromide, $SeClBr_3$.

Very sl. sol. in CS_2. (Evans and Ramsay.)

Selenium *tri*chlorobromide, $SeCl_3Br$.

See **Selenium bromo*tri*chloride.**

Selenium fluoride.

Sol. in conc. HF+Aq. Decomp. immediately by H_2O. (Knox.)

Selenium *mono*iodide, Se_2I_2.

Decomp. by H_2O. All solvents of iodine dissolve out that element. (Schneider, Pogg. **129.** 627.)

Selenium *tetra*iodide, SeI_4.

Slowly decomp. by much H_2O. Iodine is dissolved out by all solvents of that element. (Schneider, Pogg. **129.** 627.)

Selenium nitride.

See **Nitrogen selenide.**

Selenium *mono*xide, SeO (?).

Sl. sol. in H_2O. (Berzelius.)

Does not exist. (Sacc.)

Selenium *di*oxide, SeO_2.

Deliquescent. Easily sol. in H_2O and alcohol. Sol. in glacial $HC_2H_3O_2$. (Hinsberg, A. **260.** 40)

Solubility in H_2O between $-3°$ and $+36°$ $=45.0+0.7692t$. (Étard, C. R. 1888, **106.** 742.)

1 pt. is sol. in 2.67 pts. H_2O at 11.3.°
1 pt. " " " 2.60 " " " 14.°
1 pt. " " " 2.54 " " " 15.6.°
(de Coninck, C. R. 1906, **142.** 571.)

Sp. gr. of SeO_2+Aq at t°.

t°	% SeO_2	Sp. gr.
15.1	1	0.9923
15.3	2	1.0068
13.0	3	1.0200
13.0	4	1.0302
14.5	5	1.0346
14.8	6	1.0402
14.1	7	1.0535
15.0	8	1.0571
15.6	9	1.0719
15.2	10	1.0743

(de Coninck, C. R. 1906, **142.** 571.)

See also **Selenious acid.**

1 pt. SeO_2 is sol. in 9.84 pts. alcohol (93°) at 14.°

1 pt. SeO_2 is sol. in 15.0 pts. methyl alcohol at 11.8°.

1 pt. SeO_2 is sol. in 23.0 pts. acetone at 15.3.°

1 pt. SeO_2 is sol. in 90.0 pts. acetic acid at 12.9.° (de Coninck, C. R. 1906, **142.** 572.)

Traces dissolve in acetic anhydride. Sol. in phenyl mercaptan. (Hinsberg, A. 1890, **260.** 40.)

Insol. in pure C_6H_6. (Clausnizer, A. 1879, **196.** 271.)

See **Selenious acid.**

Selenium *tri*oxide, SeO_3.

Not obtained in a pure state. (Cameron and Macallan.)

See **Selenic acid.**

Selenium *di*oxide hydrobromic acid, SeO_2, $4HBr$.

Decomp. at 55.° (Ditte, A. ch. (5) **10.** 82.)

SeO_5, 5HBr. Decomp. at 65.° (Ditte, A. ch. (5) **10.** 82.)

Selenium *di*oxide hydrochloric acid, SeO_2, 2HCl.

Decomp. at 26°.

SeO_2, 4HCl. Decomp. at 0°. Sol. in H_2O without evolution of gas. (Ditte, A. ch. (5) **10.** 82.)

Selenium *di*oxide sulphur *tri*oxide, SeO_2, SO_3.

Decomp. violently by H_2O. (Weber, B. **19.** 3185.)

Composition may be $(SeO)SO_4$ (?).

Selenium oxy-compounds.

See **Selenyl compounds.**

Selenium *di*phosphide, P_2Se.

See **Phosphorus *mono*selenide.**

Selenium *tetra*phosphide, P_4Se.

See **Phosphorus *semi*selenide.**

Selenium *mono*sulphide, SeS.

Insol. in H_2O and ether. Sol. in CS_2. Decomp. by alcohol. (Ditte, C. R. **73.** 625, 660.)

Other compounds of Se and S are probably mixtures of the two elements.

Selenium *di*sulphide, SeS_2.

Compound of this formula is a mixture of SeS and S. (Ditte, C. R. **73.** 625, 660.)

Selenium sulphoxide, $SeSO_3$.

Decomp. by H_2O. Sol. in fuming H_2SO_4, conc. H_2SO_4. Sol. in H_2SO_4 of 1.806 sp. gr. without decomp. (Weber, Pogg. **156.** 531.)

Decomp. by H_2O; sol. in H_2SO_4. (Divers and Shimosé, B. **17.** 858.)

Seleniuretted hydrogen, H_2Se.

See **Hydrogen selenide.**

Selenoarsenic acid.

Potassium selenoarsenate, $KAsSe_3+2H_2O$.

Only sl. sol. in cold H_2O; sol. in warm H_2O with decomp.; more stable in KOH+Aq. (Clever, Z. anorg. 1895, **10.** 132.)

Sodium selenoarsenate, $Na_3AsSe_4+9H_2O$.

Very sol. in H_2O; very unstable. (Szarvasy, B. 1895, **28.** 2658.)

Selenoarsenious acid.

Sodium selenoarsenite, $Na_3AsSe_3+9H_2O$.

Moderately sol. in H_2O. (Clever and Muthmann, Z. anorg. 1895, **10.** 139.)

Selenobismuthous acid.

Potassium *meta*selenobismuthite, Bi_2Se_3, K_2Se or $KBiSe_2$.

Insol. in cold dil. HCl+Aq. Sol. on warming, with evolution of H_2Se. (Hilger and van Scherpenberg, Mitt. Pharm. **II.** 4.)

Selenocyanhydric acid, HSeCN.

Known only in aqueous solution.

Ammonium selenocyanide, NH_4SeCN.

Very deliquescent, and sol. in H_2O.

Barium ——, $Ba(SeSCN)_2$.

Very sol. in H_2O.

Lead ——, $Pb(SeCN)_2$.

Sl. sol. in cold, sol. with sl. decomp. in boiling H_2O. Insol. in alcohol.

Mercurous ——, $Hg_2(SeCN)_2$.

Ppt.

Mercuric ——, $Hg(SeCN)_2$.

Sl. sol. in cold H_2O. Easily sol. in MCN, MSCN, or MSeCN+Aq; also sol. in hot $HgCl_2$+Aq. (Cameron and Davy, C. N. **44.** 63.)

Decomp. by hot H_2O. (Rosenheim, Z. anorg. 1909, **63.** 276.)

Mercuric potassium ——, $Hg(SeCN)_2$, KSeCN.

Easily sol. in H_2O. Sl. sol. in cold alcohol. (Cameron and Davy, C. N. **44.** 63.)

Mercuric selenocyanide chloride, $Hg(SeCN)_2$, $HgCl_2$.

Sol. in boiling H_2O and in abs. alcohol.

Decomp. by long boiling with H_2O. (Rosenheim and Pritze, Z. anorg. 1909, **63.** 276.)

Platinum potassium —— (Potassium platinoselenocyanide), $K_2Pt(SeCN)_6$.

Sol. in H_2O and alcohol. (Clarke, B. **11.** 1325.)

Potassium ——, KSeCN.

Very deliquescent, and sol. in H_2O with absorption of heat. More sol. in H_2O than KSCN. Sol. in alcohol.

Potassium —— mercuric bromide, KSeCN, $HgBr_2$.

Sl. sol. in cold, more easily in hot H_2O or alcohol. (Cameron and Davy, C. N. **44.** 63.)

Potassium selenocyanide mercuric chloride, KSeCN, $HgCl_2$.

As the bromide.

Potassium —— mercuric iodide, KSeCN, HgI_2.

Sl. sol. in cold, easily in hot H_2O or alcohol (Cameron and Davy.)

Potassium —— mercuric sulphocyanide, KSeCN, $Hg(SCN)_2$.

Sl. sol. in cold, much more in hot H_2O or alcohol. Somewhat sol. in ether. (Cameron and Davy.)

Silver ——, AgSeCN.

Insol. in H_2O. Almost insol. in NH_4OH+Aq or cold dil. acids. Quickly decomp. by hot conc. acids.

Sodium ——, NaSeCN.

Very sol. in H_2O.

Selenomolybdic acid.

Potassium selenomolybdate, $5K_2O$, $6SeO_2$, $17MoO_3$.

Readily sol. in H_2O without decomp. (Gibbs, Am. Ch. J. 1895, **17.** 177.)

Selenopentathionic acid.

Sodium selenopentathionate, $Na_2S_4SeO_6$.

A dil. solution may be boiled for some time without change. (Norris and Fay, Am. Ch. J. 1900, **23.** 121.)

Selenophosphoric acid.

Ammonium selenophosphate, $2(NH_4)_2O$, P_2O_5, $2SeO_3+3H_2O$.

Sol. in H_2O with decomp. (Weinland, B. 1903, **36.** 1402.)

Potassium selenophosphate, $2K_2O$, P_2O_5, $2SeO_3+3H_2O$.

Sol. in H_2O with decomp.

$3.5K_2O$, P_2O_5, $5SeO_3+5.5H_2O$. Easily sol. in H_2O. (Weinland.)

Rubidium selenophosphate, $2Rb_2O$, P_2O_5, $2SeO_3+3H_2O$.

Sol. in H_2O with decom. (Weinland.)

*Tri*selenophosphorous acid.

Potassium *tri*selenophosphite, $K_2HPSe_3+2\frac{1}{2}H_2O$.

Decomp. by moist air and dil. acids; sol. in conc. KOH+Aq.; sl. sol. in cold, easily sol. in hot H_2O. (Muthmann, Z. anorg. 1897, **13.** 198.)

Selenosamic acid, $HSeO_2NH_2$.

Known only in its salts.

Ammonium selenosamate, $(NH_4)SeO_2NH_2$.

Deliquescent. Decomp. slowly by H_2O into $(NH_4)_2SeO_3$.

1 pt. is sol. in 116 pts. cold alcoholic ammonia at 12°. More sol. in hot alcoholic ammonia. Sl. attacked by cold HCl or HNO_3. (Cameron and Macallan, C. N. 1888, **57.** 163.)

Ammonium hydrogen selenosamate, $NH_4H(SeO_2NH_2)_2$.

Deliquescent. Sol. in 14 pts. alcohol at 14° (Cameron and Macallan, Proc. Roy. Soc. **44.** 112.)

Selenostannic acid.

Ammonium selenostannate, $3SnSe_2$, $(NH_4)_2Se+3H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

Platinum potassium ——, K_2Se, 3PtSe, $SnSe_2$.

Insol. in hot or cold H_2O, NH_4OH, or KOH+Aq. Not attacked by hot HCl+Aq. (Schneider, J. pr. (2) **44.** 507.)

Platinum sodium ——, Na_2Se, 3PtSe, $SnSe_2$.

Properties as the corresponding K salt. (Schneider.)

Potassium ——, $K_2SnSe_3+3H_2O$.

Easily sol. in H_2O. (Ditte, C. R. **95.** 441.)

Selenosulphantimonic acid.

Sodium selenosulphantimonate, $Na_3SbSeS_3+9H_2O$.

Sol. in H_2O. (Hofacker, A. **107.** 6.)

$Na_3SbS_{1.5}Se_{2.5}+9H_2O$. Somewhat sol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 564.)

Selenosulphantimonous acid.

Potassium selenosulphantimonite, $Sb_4S_5Se_6K_{10}+4H_2O$.

Sol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 563.)

Sodium selenosulphantimonite, $Na_3SbS_{1.5}Se_{1.5}+9H_2O$.

Sol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 564.)

Selenosulpharsenic acid.

Potassium selenosulpharsenate, $3K_2S$, $As_2Se_5+12H_2O$.

Very unstable in the air. Very sol. in H_2O. Fairly stable in aqueous solution. Decomp. by acids. (Clever, Z. anorg. 1895, **10.** 134.)

Sodium selenosulpharsenate, $Na_3AsS_3Se + 8H_2O$.

Decomp. by acids; stable in dry air. (Messinger, B. 1897, **30.** 801.)

$3Na_2S, As_2Se_5 + 18H_2O$. Quite sol. in H_2O; quite stable in air. (Clever, Z. anorg. 1895, **10.** 140.)

$Na_6As_2S_5Se_3 + 16H_2O$. Sl. sol. in H_2O; decomp. by acids. (Messinger, B. 1897, **30.** 803.)

$Na_6As_2S_7Se + 16H_2O$. Stable in dry air; easily sol. in H_2O; decomp. by acids. (Messinger, B. 1897, **30.** 800.)

$Na_3AsS_2Se_2 + 9H_2O$. Decomp. in aq. solution by dil. acids. (Messinger, B. 1897, **30.** 802.)

$Na_3AsSSe_3 + 9H_2O$. Sol. in H_2O; decomp. by aq. acids; hydroscopic. (Messinger.)

Selenosulphophosphorous acid.

Potassium selenosulphophosphite, $2K_2S, P_2Se_3 + 5H_2O$.

Sol. in H_2O; decomp. by acids. (Muthmann, Z. anorg. 1897, **13.** 198.)

Selenosulphostannic acid.

Ammonium selenosulphostannate, $(NH_4)_2S, 3SnSe_2 + 3H_2O$.

Easily decomp. (Ditte, C. R. 1882, **95.** 643.)

Potassium ——, $K_2SnSe_2S + 3H_2O$.

Very easily sol. in H_2O. (Ditte, C. R. **95.** 641.)

Sodium ——, $Na_2SnSe_2S + 3H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

Selenosulphoxyarsenic acid.

Sodium selenosulphoxyarsenate, $Na_3AsO_2SSe + 10H_2O$.

Easily sol. in H_2O but solution rapidly decomp. (Messinger, B. 1897, **30.** 798.)

$Na_6As_2S_2SeO_5 + 24H_2O$. Sol. in H_2O. (Messinger.)

$Na_6As_2SeS_3O_4 + 20H_2O$. Stable in dry air. Sl. sol. in H_2O; decomp. by dil. acids. (Messinger.)

$Na_6As_2S_3Se_2O_3 + 20H_2O$. Ppt. (Messinger.)

$Na_9As_3S_2Se_2O_8 + 36H_2O$. Decomp. by aq. acids; sol. in H_2O; quite stable. (Messinger.)

Selenosulphur *tri*oxide, $SeSO_3$.

See **Selenium sulphoxide.**

Selenosulphuric acid, H_2SeSO_3.

Known only in its salts.

Potassium selenosulphate, $K_2SeSO_3 + xH_2O$.

Deliquescent in moist air; decomp. by H_2O. (Rathke, J. pr. **95.** 1.)

Selenotrithionic acid, $H_2S_2SeO_6$.

Known only in solution, which is stable in dark. (Schulze, J. pr. (2) **32.** 390.)

Barium selenotrithionate.

Sol. in H_2O. (Rathke.)

Potassium ——, $K_2SeS_2O_6$.

Sol. in H_2O with gradual decomp. (Rathke J. pr. **95.** 8; **97.** 56.)

*Di*selenotrithionic acid, $H_2SSe_2O_6$.

Exceedingly unstable. (Schulze.)

Selenovanadic acid.

Lithium selenovanadate, $4Li_2O, 6V_2O_5, 5SeO_2 + 30H_2O$.

Very sol. in H_2O. (Prandtl and Lustig, Z. anorg. 1907, **53.** 401.)

Potassium selenovanadate, $2K_2O, 3V_2O_5, 12SeO_2 + 12H_2O$.

(Prandtl and Lustig.)

$3K_2O, 5V_2O_5, 16SeO_2 + 40H_2O$. (Prandtl and Lustig.)

$4K_2O, 6V_2O_5, 21SeO_2 + 37H_2O$. (Prandtl and Lustig.)

$5K_2O, 10V_2O_5, 26SeO_2 + 43H_2O$. (Prandtl and Lustig.)

Sodium selenovanadate, $4Na_2O, 6V_2O_5, 5SeO_2 + 20H_2O$.

Very sol. in H_2O. Solution decomp. gradually. (Prandtl and Lustig.)

$2Na_2O, 7V_2O_5, 10SeO_2 + 13H_2O$. (Prandtl and Lustig.)

$2Na_2O, 7V_2O_5, 12SeO_2 + 45H_2O$, and $+90H_2O$. (Prandtl and Lustig.)

Selenoxyarsenic acid.

Ammonium selenoxyarsenate, $2(NH_4)_2O, 2SeO_3, As_2O_5 + 3H_2O$.

Sol. in H_2O with decomp. (Weinland, B. 1903, **36.** 1403.)

Barium sodium selenoxyarsenate, $BaNaAsO_3Se + 9H_2O$.

Ppt. (Weinland, Z. anorg. 1897, **14.** 56.)

Potassium selenoxyarsenate, $2K_2O, 2SeO_3, As_2O_5 + 3H_2O$.

Sol. in H_2O with decomp. (Weinland and Barttlingck, B. 1903, **36.** 1403.)

$7K_2O, 10SeO_3, 2As_2O_5 + 11H_2O$. Very sol. in H_2O. (Weinland and Barttlingck.)

$3K_2O, As_2Se_5 + 10H_2O$. Easily decomp. by

moisture. Very sol. in H_2O. (Clever, Z. anorg. 1895, **10.** 126.)

Rubidium selenoxyarsenate, $2Rb_2O$, $2SeO_2$, $As_2O_5+3H_2O$.

Sol. in H_2O with decomp. (Weinland and Barttlingck.)

Sodium selenoxyarsenate, Na_3AsSeO_3.

Fairly stable in air and in aq. solution. (Weinland, B. 1896, **29.** 1010.)

$Na_3AsSeO_3+12H_2O$. Stable in the air when pure; sol. in H_2O with decomp (Weinland, Z. anorg. 1897, **14.** 50.)

$Na_3AsSeO_3+12H_2O$. Very sol. in H_2O; very unstable. (Szarvasy, B. 1895, **28.** 2657.)

$3Na_2O$, $3Na_2Se$, $As_2O_5+50H_2O$. Easily sol. in H_2O. Solution may be boiled for a long time without decomp. (Clever, Z. anorg. 1895, **10.** 136.)

Selenoxyphosphoric acid.

Ammonium *tri*selen*mono*oxyphosphate, $(NH_4)_3PSe_3O+10H_2O$.

Ppt. (Ephraim, B. 1910, **43.** 280.)

Ammonium hydrogen *tri*selen*mono*oxyphosphate, $(NH_4)_5H(PSe_3O)_2+18H_2O$.

Ppt. (Ephraim.)

Barium hydrogen *di*selen*di*oxyphosphate, $BaHPSe_2O_2+14H_2O$.

Decomp. in moist air. (Ephraim.)

Potassium selenoxyphosphate, $K_3PSe_{2.5}O_{1.5}+H_2O$.

Decomp. by HNO_3. Insol. in alcohol and ether. (Ephraim.)

Sodium *mono*selen*tri*oxyphosphate, $Na_3PSeO_3+20H_2O$.

Decomp. by H_2O. (Ephraim.)

Sodium *tri*selen*mono*oxyphosphate, $Na_3PSe_3O+10H_2O$.

Sol. in H_2O. Decomp. in aq. solution. Easily sol. in conc. $NaOH$+Aq. (Muthmann, Z. anorg. 1897, **13.** 199.)

Selenyl bromide, $SeOBr_2$ (?).

(Schneider, Pogg. **129.** 450.)

Selenyl bromide sulphur *tri*oxide, $SeOBr_2$, SO_3.

(Prandtl, Z. anorg. 1909, **62.** 242.)

Selenyl chloride, SeO_2Cl_2.

Easily decomp. by H_2O. (Weber, Pogg. **118.** 615.)

Selenyl sulphur chloride.

See **Sulphoselenyl chloride.**

Selenyl stannic chloride, $2SeOCl$, $SnCl_4$.

Extremely deliquescent. Completely sol. in H_2O (Weber, B. A. B. **1865.** 154.)

Selenyl titanium chloride, $2SeOCl_2$, $TiCl_4$.

Decomp. by H_2O with separation of an insol. residue. Decomp. by NH_4OH+Aq. (Weber, B. A. B. **1865.** 154.)

Sesquiauramine.

*See Sesqui***auramine.**

Sesquihydraurylamine, $(HOAu)_3N$, NH_3.

*See Sesqui***hydraurylamine.**

Silicic acid, SiO_2, xH_2O.

See also **Silicon *di*oxide.**

Silicic acid is sol. in 1000 pts. pure H_2O. (Kirwan.)

When pptd. from alkali silicates+Aq by CO_2, 0.021 pt. SiO_2 remains dissolved in 100 pts. H_2O. (Struckmann, A. **94.** 341.)

When pptd. as above, 100 pts. H_2O dissolve 0.09 pt. SiO_2 in 3 days; 100 pts. H_2CO_3+Aq dissolve 0.078 pt. SiO_2 in 3 days. But if heated much more dissolves, the jelly itself becoming liquid, such jelly containing 2.49 pts. SiO_2 to 100 pts. H_2O. This solution is not pptd. by considerable quantities of alcohol, but conc. $(NH_4)_2CO_3$, NaCl, or $CaCl_2$+Aq, etc., cause gelatinization. (Maschke, J. pr **68.** 234.)

Solubility in H_2O depends on the amt. of H_2O, in presence of which the silicic acid is set free by dil. acids, CO_2, or alkali salts+Aq. If H_2O is present in sufficient quantity to retain the silicic acid, much more will remain in solution than can be dissolved by digesting the gelatinous acid with H_2O afterwards. 1 pt. SiO_2 can thus be held in solution by 500 pts. H_2O. Presence of NH_4OH, $(NH_4)_2CO_3$, or NH_4Cl (in solutions of which SiO_2 is remarkably insol.) diminishes the power of H_2O to retain SiO_2 in solution. SiO_2 is always more sol. in dil. than conc. NH_4OH+Aq. (Liebig, A. **94.** 373.)

Silicic acid from the coagulation of the colloidal form (see p. 802) is sol. in about 5000 pts. H_2O when formed from a 1% solution, and 10,000 pts. when formed from a 5% solution, but is insol. after being dried. (Graham, A. **121.** 36.)

Silicic acid is more sol. in dil. acids than in H_2O, because, when acid is added in excess to moderately dil. K_2SiO_3+Aq, the solution remains clear, but if only enough acid is added to neutralize the base present, silicic acid will gradually separate out. If acid is added to conc. K_2SiO_3+Aq, silicic acid separates out insol. in excess of acid, but if 20–30 pts. H_2O are present to 1 pt. K_2SiO_3, and an excess of acid added at once, the silicic acid will remain in solution. This result is obtained with HCl, HNO_3, H_2SO_4, or

$HC_2H_3O_2$+Aq. These solutions may dissolve a neutral salt until saturated and no silicic acid will separate out. Therefore it is the acid that holds the SiO_2 in solution, and not the H_2O. (C. J. B. Karsten, (**1826**) Pogg. **6.** 353.)

Even CO_2 has the power of holding SiO_2 in solution. (Karsten, *l. c.*)

Solubility in acids of silicic acid of Struckmann (*see* above): 100 pts. dil. HCl+Aq of 1.088 sp. gr. dissolve 0.0172 g. SiO_2 in 11 days; 100 pts. H_2O sat. with CO_2 dissolve 0.0136 g. SiO_2 in 7 days.

Silicic acid obtained by passing SiF_4 into H_2O is sol. while still moist in 11,000 pts. cold, and 5500 pts. boiling HCl+Aq of 1.115 sp. gr. (Fuchs, A. **82.** 119.)

Silicic acid at the moment of separation (as in dissolving cast-iron, steel, etc.) is abundantly sol. in aqua regia (3 pts. HCl+Aq of sp. gr. 1.13 and 1 pt. HNO_3+Aq of sp. gr. 1.33). (Wittstein, Z. anal. **7.** 433.)

The aq. solution obtained by the hydrolysis of ethyl silicate is more stable in acids+Aq or alkali than in pure H_2O. (Jordis, Z. anorg. 1903, **35.** 16.)

NH_4OH+Aq dissolves considerable freshly precipitated silicic acid, $(NH_4)_2CO_3$ only a very little. (Karsten, Pogg. **6.** 357.)

Dry or ignited SiO_2 is sol. in NH_4OH+Aq. 100 pts. NH_4OH+Aq containing 10% NH_3 dissolve: 0.714 pt. SiO_2 from gelatinous silicic acid; 0.303 pt. from artificially dried silicic acid; 0.377 pt. from amorphous SiO_2; 0.017 pt. from quartz. (Pribram, Z. anal. **6.** 119.)

NH_4OH+Aq dissolves 0.382 pt. SiO_2 from dry silicic acid: 0.357 pt. from ignited SiO_2; 0.00827 pt. from quartz. (Souchay, Z. anal. **11.** 182.)

Silicic acid precipitated from alkali silicates +Aq with CO_2 is sol. as follows: 100 pts. pure H_2O dissolve 0.021 pt. SiO_2; 100 pts. $(NH_4)_2CO_3$+Aq containing 5% $(NH_4)_2CO_3$, 0.020 pt.; 100 pts. containing 1%$(NH_4)_2CO_3$, 0.062 pt.; 100 pts. NH_4OH+Aq containing 19.2% NH_3, 0.071 pt.; 100 pts. containing 1.6%, 0.0986 pt. (Struckmann, A. **94.** 341.)

100 pts. NH_4OH+Aq (10% NH_3) dissolve of: crystallised SiO_2, 0.017 pt.; amorphous SiO_2, ignited, 0.38 pt.; amorphous $3SiO_2$, $4H_2O$, 0.21 pt.; amorphous silicic acid in form of jelly, 0.71 pt. Upon evaporation no ppt. is formed, even when 80 mols. SiO_2 are present to 1 mol. NH_3. (Wittstein, J. B. **1866.** 192.)

Sol. in KOH or NaOH+Aq, especially if warm. (Dumas.)

Sol. in K_2SiO_3 or Na_2SiO_3+Aq. (Fuchs.)

Easily sol. in boiling Na_2CO_3+Aq, separating as a jelly on cooling. (Pfaff.)

NH_4Cl or other NH_4 salts ppt. SiO_2 from solution in Na_2CO_3+Aq.

100 pts. Tl_2O in H_2O dissolve 4.17 pts. amorphous SiO_2 in 24 hours' boiling. (Flemming, Jena. Zeit. **4.** 36.)

Sol. in butyl amine. (Wurtz, A. ch. (3) **42.** *166.*)

Not more sol. in H_2O containing sugar than in pure H_2O. (Petzholdt, J. pr. **60.** 368.)

Soluble silicic acid.

Colloidal form by dialysis. Solutions containing 4.9% SiO_2 may be evaporated until they contain 14% SiO_2. The SiO_2 is separated from its solution thus made in many ways—

(1) By standing. This happens the more easily the more conc. the solution is, and is hastened by heat. A 10–12% solution gelatinizes at ordinary temp. in a few hours, and immediately upon heating. A 5–6% solution may be kept 5–6 days, a 2% solution, 2–3 months, and a 1% solution may be kept 2 or more years without gelatinizing.

(2) When the solution is evaporated to dryness in vacuo at 15° a transparent glass is left which is insol. in H_2O.

(3) The coagulation of colloidal silicic acid is accelerated by powdered graphite and other indifferent bodies, and it is brought about in a few minutes by a solution of the alkali carbonates, even when only $^1/_{10,000}$ pt. of the carbonate is present. (Graham, A. **121.** 36.)

(4) Coagulation is also brought about by passing CO_2 through the solution. (Liebig.)

CO_2 does not cause coagulation. (Maschke.)

Coagulation is not caused by H_2SO_4, HCl, HNO_3, $HC_2H_3O_2$, $H_2C_4H_4O_6$, or NH_4OH+Aq, or by neutral or acid salts+Aq. (Graham.)

NaCl and Na_2SO_4+Aq coagulate the solution. (Maschke.)

Alcohol, sugar, glycerine, or caramel do not coagulate.

Soluble $Al_2O_6H_6$, $Fe_2O_6H_6$, albumen, and casein precipitate soluble SiO_2. (Graham, A. **121.** 36.)

The jelly from colloidal SiO_2 is very sol. in slightly alkaline H_2O. 1 pt. NaOH in 10,000 pts. H_2O dissolves in an hour at 100° an amt. of the jelly corresponding to 200 pts. SiO_2. (Graham.)

Other colloidal forms.

Various solutions of silicic acid may be obtained as follows:

The jelly formed when SiF_4 is passed through H_2O dissolves in a large amt. of H_2O, and SiO_2 separates out on evaporation. This is still sol. in H_2O, but is made insol. by evaporation with HCl or H_2SO_4. (Berzelius.)

When SiF_4 is absorbed by crystallized H_3BO_3, and the HF and H_3BO_3 removed by a large excess of NH_4OH+Aq, a silicic acid is obtained which is very sol. in H_2O. The solution is not decomp. by boiling, but on evaporation an insol. powder remains. (Berzelius, A. ch. **14.** 366.)

When K_2SiO_3+Aq is precipitated by $CuCl_2$, the precipitate washed and dissolved in HCl+Aq, the solution treated with H_2S filtered and boiled, a solution of silicic acid is obtained

which gelatinizes with KOH or NH_4OH+Aq. (Doveri, A. ch. (3) **21.** 40.)

When Na_2SiO_3+Aq containing at most 3% SiO_2 is saturated with HCl+Aq of 1.10 sp. gr., and Na_2SiO_3 added until the solution is slightly opalescent and carefully warmed to 30°, a gelatinous mass is obtained which will dissolve in H_2O by 12–16 hours' boiling if treated before being exposed to the air. The solution is slightly opalescent. The solution can be evaporated by heat until it contains 6% SiO_2. In a vacuum or over H_2SO_4, solutions containing 10% may be obtained. The electric current, freezing, alcohol, or H_2SO_4 precipitate or coagulate the solution. (Kühn, J. pr. **59.** 1.)

SiS_2 with H_2O gives off H_2S, and forms a solution of SiO_2 which, after dilution, can be kept for months. But when boiled or evaporated, or when a sol. silicate is added, it becomes gelatinous. It leaves an insol. residue when evaporated to dryness. (Fremy, A. ch. (3) **38.** 314.)

Various forms of silicic acid have been described as definite compounds of SiO_2 with varying amounts of H_2O, but it is doubtful if any true definite compounds exist, as the percentage of H_2O varies with the moisture of the air to which it is exposed. (*See* Ebelmen, A. ch. (3) **16.** 129; Doveri, A. ch. (3) **21.** 40; Fuchs, A. **82.** 19; Merz, J. pr. **99.** 177; van Bemmelen, B. **11.** 2232, etc.)

Silicates.

The silicates are insol. in H_2O with the exception of the alkali salts, and these are sol. only when the ratio of the base to the acid is above a certain limit.

Aluminum silicate, $2Al_2O_3$, SiO_2+10H_2O.

Min. *Collyrite.* Sol. in acids, with formation of SiO_2, xH_2O. Becomes transparent in H_2O and is decomp.

$4Al_2O_3$, $3SiO_2$. Min. *Dillnite.*

Al_2O_3, SiO_2. Min. *Andalusite, Chiastolite, Sillimannite, Disthene* or *Cyanite.* Insol. in acids.

+5–7 H_2O. Min. *Allophane.* Completely sol. in dil. acids; decomp. by conc. acids with separation of SiO_2, xH_2O.

$2Al_2O_3$, $3SiO_2+4H_2O$. Min. *Pholerite.* Insol. in HNO_3+Aq.

$+6H_2O$. Min. *Glagerite.*

Al_2O_3, $2SiO_2+2H_2O$. Min. *Kaolin, Clay.* Insol. in dil. HCl or HNO_3+Aq; moderately dil. H_2SO_4+Aq, when heated to evaporation, extracts Al_2O_3 and some SiO_2, and leaves the rest of the SiO_2, sol. in boiling Na_2CO_3+Aq. All the Al_2O_3 is dissolved by heating with 5–6 pts. H_2SO_4+1 pt. H_2O until H_2SO_4 evaporates, and then treating with H_2O.

Quickly attacked by H_2SiF_6+Aq.

Decomp. by boiling KOH+Aq, with residue of SiO_2. (Rammelsberg.)

KOH+Aq extracts ¼ of the SiO_2 (Malaguti); is converted thereby into double silicates of K and Al, which are sol. in HCl+Aq. (Lemberg.)

Solubility in KOH and HCl increased if first heated to a low glow. (Glinka, C. C. **1899,** II. 1063.)

Colloidal clay. (Schlösing, C. R. **79.** 473.)

$+4H_2O$. *Halloysite.* Decomp. by acids.

$4Al_2O_3$, $9SiO_2+12H_2O$. Min. *Porcelain clay* from Passau.

Al_2O_3, $3SiO_2+3H_2O$. Min. *Razoumoffskine.*

Al_2O_3, $4SiO_2+7H_2O$. Min. *Montmorillonite.* Not decomp. by HCl+Aq, but by hot H_2SO_4.

$+H_2O$. Min. *Pyrophyllite.* Not decomp. by H_2SO_4.

$+3H_2O$. Min. *Anauxite.*

$2Al_2O_3$, $9SiO_2+6H_2O$. Min. *Cimolite.*

"Aluminum silicate" is insol. in acetone. (Naumann, B 1904, **37.** 4328); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Aluminum barium silicate, Al_2O_3, BaO, $2SiO_2$ $+H_2O$ (?).

Min. *Edingtonite.* Decomp. by HCl+Aq with separation of SiO_2, xH_2O.

$5Al_2O_3$, 4BaO, $10SiO_2$. (Fremy and Feil, C. R. **85.** 1033.)

$2Al_2O_3$, 4BaO, $7SiO_2$. Min. *Barylite.* Very sl. decomp. by alkali carbonates+Aq. (Blomstrand.)

Aluminum barium potassium silicate, Al_2O_3, (Ba, K_2)O, $5SiO_2+2H_2O$.

Min. *Harmotome.* When finely powdered, difficultly decomp. by HCl+Aq with separation of pulverulent SiO_2, xH_2O.

Al_2O_3, (Ba,K_2)O, $4SiO_2$. Min. *Hagalophane.* Scarcely attacked by acids.

Aluminum cæsium silicate, $H_2Cs_2Al_2Si_5O_{15}$ (?)

Min. *Pollucite.* Very sl. decomp. by HCl+Aq.

Aluminum calcium silicate, Al_2O_3, CaO, $2SiO_2$.

Min. *Anorthite.* Completely decomp. by HCl+Aq with separation of pulverulent SiO_2, xH_2O.

Min. *Barsowite.* Instantaneously decomp. by HCl+Aq, with separation of gelatinous SiO_2, xH_2O.

$+4H_2O$. Min. *Gismondite.* Gelatinizes with HCl+Aq.

Al_2O_3, CaO, $3SiO_2+3H_2O$. Min. *Scolezite.* Easily sol. in HCl+Aq, without formation of gelatinous SiO_2. Sol. in $H_2C_2O_4$+Aq with pptn. of CaC_2O_4.

Decomp. by, and sol. to a certain extent in H_2CO_3+Aq, and decomp. also even by pure H_2O. (Rogers, Am. J. Sci. (2) **5.** 408.)

$+5H_2O$. Min. *Levyn.* Decomp. by acids without gelatinizing.

Al_2O_3, CaO, $4SiO_2+3H_2O$. Min. *Caporcianite. Leonhardite.* Efflorescent. Easily

sol. in acids, with pptn. of gelatinous SiO_2, xH_2O.

Al_2O_3, CaO, $4SiO_2+4H_2O$. Min. *Laumontite.* Easily gelatinizes with HCl or HNO_3+Aq, but is not affected by H_2SO_4 unless hot.

Al_2O_3, CaO, $6SiO_2+5H_2O$. Min. *Epistilbite.* Gelatinizes with conc. HCl+Aq. (Goldschmidt, Z. anal. **17.** 267.)

Scarcely decomp. by boiling conc. HCl+Aq. (Jannasch and Tenne, Miner. Jahrb. **1880, 1.** 43.)

$+6H_2O$. *Stilbite. Heulandite.* Slowly but completely gelatinized by HCl+Aq.

Al_2O_3, 2CaO, $3SiO_2+H_2O$. Min. *Prehnite.* Imperfectly decomp. by acids before ignition, but easily afterwards.

Al_2O_3, 3CaO, $3SiO_2$. *Lime alumina garnet. Grossularite.* Partially decomp. by acids before ignition, but easily afterwards.

$2Al_2O_3$, CaO, $2SiO_2+H_2O$. *Margarite.* Not attacked by acids.

$3Al_2O_3$, 4CaO, $6SiO_2+H_2O$. *Zoisite.* Partially decomp. by HCl+Aq.

$4Al_2O_3$, 6CaO, $9SiO_2$. Min. *Meionite.* Completely sol. in HCl+Aq.

Aluminum calcium ferric silicate, $2Al_2O_3$, 4CaO, Fe_2O_3, $6SiO_2+H_2O$.

Min. *Epidote.* Only sl. attacked by HCl+Aq before ignition.

Aluminum calcium ferric magnesium silicate, $H_{14}(Ca, Mg)_{40}(Al_2, Fe_2)_{10}Si_{35}O_{147}$.

Min. *Vesuvianite, Idiocrase.* Only partially decomp. by HCl+Aq before ignition.

Aluminum calcium iron, etc., silicate borate, $H_2R^{II}_6(Al_2, B_2)_3Si_8O_{32}$.

Min. *Axinite.* Not attacked by HCl+Aq before ignition.

Aluminum calcium magnesium silicate, $4H_4Ca_2Mg_8Si_6O_{24}$, $5H_2CaMgAl_6O_{12}$ = $15Al_2O_3$, 13CaO, 37MgO, $24SiO_2+13H_2O$.

Min. *Clintonite.* Completely decomp. by HCl+Aq without gelatinization.

$3H_4Ca_2Mg_8Si_6O_{24}$, $4H_2CaMgAl_6O_{12}$. Min. *Brandisite.* Not attacked by HCl+Aq. Slowly decomp. by boiling conc. H_2SO_4.

$5H_4Ca_2Mg_8Si_6O_{24}$, $8H_2CaMgAl_6O_{12}$. Min. *Xanthophyllite.* Very sl. decomp. by hot HCl+Aq.

3(Ca, Mg)O, Al_2O_3, $2SiO_2$. Min. *Gehlenite.* Easily decomp. by acids.

Aluminum calcium potassium silicate, $(H, K)_2CaAl_2Si_5O_{15}+6H_2O$.

Min. *Chabasite.* Decomp. by HCl+Aq.

$(K_2, Ca)Al_2Si_3O_{10}+4H_2O$. Min. *Zeagonite.* Completely sol. in HCl+Aq.

Aluminum calcium sodium silicate, $3Al_2O_3$, 8CaO, Na_2O, $9SiO_2$.

Min. *Sarcolite* Decomp. by acids.

$2Al_2O_3$, $12(Ca,Na_2)O$, $9SiO_2$ (?). Min. *Mellilite.* Gelatinized by acids.

$Na_2CaAl_4Si_2O_{12}$ (?). Min. *Margarite.*

$Na_2CaAl_4Si_{10}O_{28}$. Min. *Faujasite.* Decomp. by HCl+Aq.

$(Na_2, Ca)Al_2Si_4O_{12}$. Min. *Gmelinite.* Decomp. by HCl+Aq.

$(Ca, Na_2)Al_2Si_6O_{19}+6H_2O$. Min. *Foresite.* Difficultly decomp. by HCl+Aq.

$(Ca, Na_2)Al_2Si_2O_8+2\frac{1}{2}H_2O$. Min. *Thomsonite.* Gelatinizes with HCl+Aq.

$xNa_2Al_2Si_6O_{16}$, $yCaAl_2Si_2O_8$. Min. *Oligoclase, Labradorite.* Sl. decomp. by acids, more easily the larger the amt. of Ca present.

Aluminum calcium sodium silicate sulphate, $2(Na_2, Ca)Al_2(SiO_4)_2$, $(Na_2, Ca)SO_4$.

Min. *Hauyn.* Gelatinizes with HCl+Aq.

Aluminum glucinum silicate, Al_2O_3, 3GlO, $6SiO_2$.

Min. *Beryl.* Emerald. Not decomp. by acids, excepting partially by H_2SO_4 after being ignited.

Al_2O_3, 2GlO, $2SiO_2+H_2O$. Min. *Euclase.* Not attacked by acids.

Aluminum ferrous silicate, $Al_2Fe(SO_4)_3$.

Min. *Garnet.* Sl. decomp. by HCl+Aq.

$H_2FeAl_2SiO_7$. Min. *Chloritoid.* Not attacked by HCl+Aq. Completely decomp. by H_2SO_4.

Al_2O_3, 3FeO, $3SiO_2+3H_2O$. Min. *Voigtite.*

Aluminum iron lithium potassium silicate, $K_3Li_3Fe_4Al_{12}Si_{20}O_{65}$.

Min. *Zinnwaldite.* Sl. decomp. by acids.

Aluminum ferrous magnesium silicate, $6Al_2O_3$, 3(Mg, Fe)O, $6SiO_2+H_2O$.

Min. *Staurolite.* Not attacked by acids.

Aluminum ferric magnesium silicate, $2(Al_2, Fe_2)O_3$, 2MgO, $5SiO_2$.

Min. *Cordierite.* Sl. attacked by acids.

$+xH_2O$. Min. *Esmarkite, Chlorophyllite.*

Aluminum ferrous manganous silicate, Al_2O_3, FeO, 2MnO, $3SiO_2$.

Min. *Partschinite.*

Aluminum ferrous sodium, etc., silicate borate, $R^{I}_6(Al_2)(B_2)Si_4O_{20}+R^{II}_3(Al_2)_2(B_2)Si_4O_{20}$, **etc.**

Min. *Tourmaline.* Not decomp. by HCl+Aq; very sl. decomp. by H_2SO_4.

Aluminum lithium silicate, Al_2O_3, Li_2O, $5SiO_2$.

Not attacked by acids. (Hautefeuille, C. R. **90.** 541.)

Al_2O_3, Li_2O, $6SiO_2$.

Al_2O_3, Li_2O, $4SiO_2$. Min. *Spodumene.* Not attacked by acids.

$4Al_2O_3$, $3Li_2O$, $30SiO_2$. Min. *Petalite.* Not attacked by acids.

Aluminum lithium potassium silicate, $(Li, K)_{10}Al_{10}Si_{16}O_{52}$.

Min. *Lepidolite.* Sl. decomp. by acids.

Aluminum magnesium silicate, $5Al_2O_3$, $4MgO$, $2SiO_2$.

Min. *Sapphirine.*

Aluminum magnesium potassium silicate, $xH_4K_2Al_6Si_6O_{24}$, $yMg_{12}Si_6O_{24}$.

Min. *Lepidomelane.* Easily decomp by HCl or HNO_3+Aq, with residue of a skeleton of SiO_2.

$3Al_2O_3$, $12MgO$, $2K_2O$, $12SiO_2+H_2O$. Min. *Anomite.*

$7Al_2O_3$, $35MgO$, $7K_2O$, $36SiO_2$. Min. *Phlogopite.*

Aluminum manganous silicate, $2Al_2O_3$, $6MnO$, $6SiO_2$.

Not decomp. by very dil. HCl+Aq. (Gorgeu, C. R. **97.** 1303.)

Aluminum potassium silicate, Al_2O_3, K_2O, SiO_2.

Very slowly decomp. by cold H_2O; 12% is dissolved by hot H_2O. Sol. in alkali hydroxides+Aq, but insol. in carbonates+Aq.

K_2O, Al_2O_3, $2SiO_2$. Insol. in cold H_2O, but 6% dissolves on boiling. Sol. in dil. acids. Insol. in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) **10.** 45.)

K_2O, Al_2O_3, $3SiO_2+3H_2O$. Easily sol. in HNO_3+Aq. (Deville, A. ch. (3) **61.** 313.)

K_2O, Al_2O_3, $4SiO_2$. Min. *Leucite.* Decomp. by HCl+Aq with separation of pulverulent SiO_2.

$+4H_2O$. Ppt. (Deville, C. R. **54.** 324.)

$H_4K_2Al_6Si_6O_{24}$. Min. *Muscovite*, "Mica." Not attacked by HCl or H_2SO_4+Aq.

$K_2Al_4Si_5O_{17}+3H_2O$. Min. *Pinite.* Partly decomp. by HCl+Aq.

$K_2Al_2Si_6O_{16}$. Min. *Orthoclase. Feldspar.* Scarcely attacked by acids. Slowly sol. in H_2SO_4 or HCl+Aq when finely powdered. (Rogers.)

Aluminum potassium sodium silicate, $K_2Al_2(SiO_3)_4$, $5Na_2Al_2(SiO_4)_2$ (?).

Min. *Nepheline.* Decomp. by HCl+Aq.

Aluminum silver silicate, $Al_2Ag_4Si_2O_9$.

Insol. in NH_4OH+Aq. (Silber, B. **14.** 941.)

$Al_6Ag_2Na_4Si_6O_4$. As above. (Silber.)

Aluminum sodium silicate, Al_2O_3, Na_2O, SiO_2.

Insol. in cold H_2O, but 38–40% dissolves in hot H_2O. (Gorgeu.)

Al_2O_3, Na_2O, $2SiO_2$. Insol. in cold H_2O; boiling H_2O dissolves 1–2%. Sol. in HCl or HNO_3 diluted with 10–20 vols. H_2O. Insol. in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) **10.** 145.)

Not attacked by H_2O. (Silber, B. **14.** 941.)

$+3H_2O$. Easily sol. in HCl+Aq. (v. Ammon.)

Al_2O_3, Na_2O, $3SiO_2+3H_2O$. Decomp. by acids. (Deville, A. ch. (3) **61.** 326.)

Al_2O_3, Na_2O, $4SiO_2+3H_2O$. Easily sol. in HCl+Aq. (v. Ammon.)

$2Al_2O_3$, $3Na_2O$, $3SiO_2$. Insol. in cold H_2O, but 27–30% dissolves on boiling. (Gorgeu.)

$H_4Na_2Al_6Si_6O_{24}$. Min. *Paragonite.* Decomp. by conc. H_2SO_4.

$Na_2Al_2Si_4O_{12}+2H_2O$. Min. *Analcite.* Readily decomp. by HCl+Aq.

$Na_2Al_2Si_3O_{10}+2H_2O$. Min. *Natrolite.* Sol. in H_2O with separation of SiO_2. Also sol. in $H_2C_2O_4$+Aq.

$Na_2Al_2Si_6O_{16}$. Min. *Albite.* Not attacked by acids.

Aluminum sodium silicate chloride, $3Na_2Al_2(SiO_4)_2$, $2NaCl$.

Min. *Sodalite.* Easily decomp. by HCl, and HNO_3+Aq.

Aluminum sodium silicate sulphate, $3Na_2Al_2(SiO_4)_2$, Na_2SO_4.

Min. *Nosean.* Easily decomp. by HCl+Aq.

Aluminum sodium silicate sulphide.

See **Ultramarine.**

Barium silicate, $BaSiO_3$.

Somewhat sol. in boiling H_2O. Completely sol. in dil. HCl+Aq. (v. Ammon.)

$+6H_2O$, or $7H_2O$. Boiling H_2O decomposes, and dissolves about ½ the weight of this substance. (le Chatelier, C. R. **92.** 931.)

$2BaO$, SiO_2. Decomp. by H_2O into $BaSiO_3$ $+6H_2O$. (Laudrin.)

Bismuth silicate, $2Bi_2O_3$, $3SiO_2$.

Min. *Eulytite.* Decomp. by HCl+Aq.

Bismuth ferric silicate, $Bi_2Fe_4Si_4O_{17}$.

Min. *Bismuthoferrite.*

Boron calcium silicate.

See **Borate silicate, calcium,** *and* **Silicate borate, calcium.**

Cadmium silicate, $CdSiO_3+1½H_2O$.

Sol. in HCl+Aq with deposition of pulverulent SiO_2, xH_2O. (Rousseau and Tite, C. R. **114.** 1262.)

Cæsium silicate, Cs_2SiO_3.

(Kahlenberg, J. phys. Chem. 1898, **2.** 82.)

Calcium silicate, $CaSiO_3$.

Slowly sol. in H_2O; sol. in HCl+Aq.

Sol. in about 100,000 pts. H_2O. (Gorgeu, A. ch. 1885, (6) **4.** 550.)

100 cc. sat. aq. solution of air dried calcium silicate contains 0.0046 g. CaO = 0.0095 g. $CaSiO_3$ at 17°. (Weisberg, Bull. Soc. 1896, (3) **15.** 1097.)

100 cc. sat. solution of air dried calcium silicate in 10% sugar solution at 17° contains 0.0065 g. CaO = 0.0135 g. $CaSiO_3$; 20% sugar solution, 0.0076 g. CaO = 0.0175 g. $CaSiO_3$.

After boiling and filtering hot, 10% sugar solution contains 0.0094 g. CaO = 0.0195 g. $CaSiO_3$; 20% sugar solution, 0.0120 g. CaO = 0.0249 g. $CaSiO_3$. (Weisberg.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

4CaO, $3SiO_2$. (Laudrin.)

5CaO, $3SiO_2+5H_2O$. When freshly precipitated is somewhat sol. in H_2O and easily decomp. by HCl+Aq. (v. Ammon.)

CaO, $3SiO_2+2H_2O$. (Hjeldt, J. pr. **94.** 129.)

2CaO, $9SiO_2+3H_2O$. Ppt.

$CaSiO_3$. Min. *Wollastonite.* Gelatinizes with HCl+Aq.

$CaSi_2O_5+2H_2O$. Min. *Okenite.* Easily decomp. by cold HCl+Aq when powdered.

Calcium glucinum silicate sodium fluoride, $(Ca, Gl)_{15}Si_{14}O_{43}$, 6NaF.

Min. *Leucophane.*

$7(Ca, Gl)_3Si_2O_7$, 6NaF. Min. *Melinophane.*

Calcium ferrous silicate, $CaSiO_3$, $FeSiO_3$.

Min. *Hedenbergite, Pyroxene.* Sl. decomp. by acids.

Calcium ferric silicate, $Ca_3Fe_2(SiO_4)_3$.

Min. *Garnet.* Sl. decomp. by HCl+Aq.

$2CaSiO_3$, 11 $Fe_2(SiO_3)_3$. Min. *Szaboite.* Sl. attacked by HCl+Aq, and still less by H_2SO_4+Aq.

Calcium ferroferric silicate, 2CaO, 4FeO, Fe_2O_3, $4SiO_2+H_2O=H_2Ca_2Fe_4Fe_2Si_4O_{18}$.

Min. *Lievrite, Ilvaite.* Easily gelatinizes with HCl+Aq.

Calcium ferrous magnesium silicate, $(Ca, Fe, Mg)SiO_3$.

Min. *Amphibole, Hornblende, Asbestos, Actinolite, Tremolite.* Only sl. attacked by acids.

Calcium ferroferric sodium silicate, $CaSiO_3$, $FeSiO_3$, $Fe_2(SiO_3)_3$, Na_2SiO_3.

Min. *Aegirite.*

Calcium magnesium silicate, CaO, MgO, $4SiO_2$.

(Mutschler, A. **176.** 86.)

Ca_2SiO_4, Mg_2SiO_4. Min. *Monticellite.* Completely sol. in dil. HCl+Aq.

$(Ca,Mg)SiO_3$. Min. *Diopside, Pyroxene.* Very sl. attacked by acids.

Calcium manganous silicate, $CaSiO_3$, $2MnSiO_3$.

Min. *Bustamite.*

Calcium potassium silicate.

See under **Glass.**

Calcium sodium silicate, $(Ca, Na_2, H_2)SiO_3$

Min. *Pectolite.* Decomp. by HCl+Aq *See under* **glass.**

Calcium sodium silicate zirconate, $Na_4Ca(Si,Zr)_9O_{21}+9H_2O$.

Min. *Wöhlerite.* Decomp. by HCl+Aq.

Calcium uranyl silicate, 3CaO, $5UO_3$, $6SiO_2+18H_2O$.

Min. *Uranophane.* Gelatinizes with acids CaO, $3UO_3$, $3SiO_2+9H_2O$. Min. *Uranotile.*

Calcium silicate chloride, 2CaO, SiO_2, $CaCl_2$

Insol. in H_2O or alcohol. Sol. in HCl+Aq (le Chatelier, C. R. **97.** 1510.)

Calcium silicate fluoride, 2CaO, $3SiO_2$, $6CaF_2$

(Deville, C. R. **52.** 110.)

Calcium silicate potassium fluoride, $4H_2CaSi_2O_6$, $KF+4H_2O$.

Min. *Apophyllite.*. Decomp. by HCl+Aq

Calcium silicate stannate.

See **Silicostannate, calcium.**

Calcium silicate titanate, CaO, SiO_2, TiO_2.

(Hautefeuille, A. ch. (4) **4.** 154.)

Min. *Titanite.* Incompletely decomp. by HCl+Aq, wholly by H_2SO_4+Aq.

Cerous silicate, $Ce_2(SiO_3)_3$.

More or less attacked by HCl, HNO_3, or H_2SO_4+Aq, according to the concentration (Didier, C. R. **101.** 882.)

Cerium didymium lanthanum silicate, $2(Ce,La,Di)_2O_3$, $3SiO_2$.

Min. *Cerite.* Gelatinizes with HCl+Aq.

Cerium glucinum yttrium silicate, $(Y,Ce,Gl)_2SiO_5$.

Min. *Gadolinite.* Easily gelatinized by HCl+Aq.

Cerous silicate chloride, $2Ce_2O_3$, $3SiO_2$, $4CeCl_3=Ce_4(SiO_4)_3$, $4CeCl_3$.

Insol. in H_2O, but slowly decomp. thereby (Didier, C. R. **101.** 882.)

Cobaltous silicate, Co_2SiO_4.

Gelatinizes with HCl+Aq. (Bourgeois, C. R. **108.** 1077.)

Cupric silicate, CuH_2SiO_4.

Min. *Dioptase.* Sol. in HCl, HNO_3, or NH_4OH+Aq with separation of SiO_2. Not attacked by KOH+Aq.

$CuSiO_3+2H_2O$. Min. *Chrysocolla.* Decomp. by HCl+Aq.

$+3H_2O$. Min. *Asperolite.* Easily decomp. by HCl+Aq.

"Cupric silicate" is insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Cupric silicate ammonia, $CuSi_2O_5$, $2NH_3$.

Ppt. (Schiff, A. **123.** 38.)

Glucinum silicate, Gl_2SiO_4.

Min. *Phenacite.* Not attacked by acids.

Glucinum ferrous manganous silicate ferrous manganous sulphide, $3(Gl, Fe, Mn)_2SiO_4$, (Mn, Fe)S.

Min. *Helvine.* Decomp. by HCl+Aq.

Iron (ferrous) silicate, Fe_2SiO_4.

Min. *Fayalite.* Gelatinizes with HCl+Aq.

$FeSiO_3$. Min. *Grunerite.*

$+6H_2O$. Min. *Chlorophite.*

4FeO, SiO_2. (Zobel, Dingl. **154.** 111.)

Iron (ferric) silicate, $Fe_2Si_3O_9+5H_2O$.

Min. *Nontronite.* Gelatinizes with hot acids.

$4Fe_2O_3$, $9SiO_2+18H_2O$. Min. *Hisingerite.*

$2Fe_2O_3$, $9SiO_2+2H_2O$. Min. *Anthosiderite.*

Iron (ferroferric) magnesium silicate, $(Fe, Mg)_3Fe_2Si_2O_{10}+4H_2O$.

Min. *Cronstadtite.* Gelatinizes with acids.

Iron (ferroferric) sodium silicate, $5Na_2SiO_3$, $2FeSiO_3$, $4Fe_2(SiO_3)_3$.

Min. *Aknite.* Sl. decomp. by acids.

Iron (ferrous) magnesium silicate, Fe_2SiO_4, Mg_2SiO_4.

Min. *Olivene, Chrysolite, Peridote.* Gelatinizes with HCl or H_2SO_4+Aq.

$(Fe, Mg)SiO_3+{}^3/_2H_2O$. Min. *Picrophyllite.*

$+\frac{1}{4}H_2O$. Min. *Monradite.*

$(Fe,Mg)SiO_3$. Min. *Bronzite, Hypersthene.* Not attacked by acids.

$xMgSiO_3$, $yFeSiO_3$. Min. *Anthophyllite.* Not attacked by acids.

Iron (ferrous) manganous silicate, Fe_2SiO_4, Mn_2SiO_4.

Min. *Knebelite.* Gelatinizes with HCl+Aq.

Iron (ferrous) manganous silicate chloride, $7(Fe,Mn)SiO_3$, $(Fe,Mn)Cl_2+5H_2O$.

Min. *Pyrosmalite.* Completely decomp. by conc. HNO_3+Aq.

Iron (ferric) potassium silicate, $Fe(SiO_3)_3$, K_2SiO_3.

(Hautefeuille and Perrey, C. R. **107.** 1150.)

Iron (ferric) sodium silicate, $Na_2Fe_2Si_4O_{12}$.

Min. *Crokydolite.* Not attacked by acids.

Lead silicate.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

See under **Glass.**

Lithium silicate, $Li_2Si_5O_{11}$.

Li_4SiO_4.

Li_2SiO_3. More stable towards H_2O than the other alkali metasilicates. (Rieke and Endell, C. C. **1911,** I. 7.)

Decomp. by boiling H_2O and acids. (Friedel, C. C. **1901,** II. 89.)

Scarcely attacked by cold H_2O. (Friedel, Bull. Soc. Min. **1901,** 24. 141.)

Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Magnesium silicate, $Mg_3Si_2O_7+2H_2O$.

Min. *Serpentine.* Decomp. by HCl+Aq, more easily by H_2SO_4.

Min. *Chrysotile.*

$Mg_4Si_3O_{10}+6H_2O$. Min. *Gymnite, Soapstone.* Decomp. by H_2SO_4.

$MgSiO_3$. Not completely decomp. by HCl+Aq.

$+\frac{1}{4}H_2O$. Min. *Aphrodite.* Decomp. by hot acids.

$+\frac{1}{2}H_2O$. Min. *Picrosmine.*

$+1^2/_3H_2O$. Sol. in dil. acids. (v. Ammon.) Min. *Forsterite.*

3MgO, $4SiO_2+H_2O$ or 4MgO, $5SiO_2+\frac{3}{4}H_2O$. Min. *Talc* or *Steatite.* Not attacked by HCl or H_2SO_4+Aq.

$Mg_5Si_6O_{17}+4H_2O$. Min. *Spadaite.* Decomp. by conc. HCl+Aq.

$Mg_2Si_3O_8+4H_2O$. Min. *Meerschaum.* Decomp. by HCl+Aq.

"Magnesium silicate," is insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Magnesium potassium silicate, MgO, K_2O, $3SiO_2$.

Easily sol. in acids with decomp. (Duboin, C. R. 1895, **120.** 681.)

Magnesium silicate fluosilicate, $Mg_5Si_2O_9$, $Mg_5Si_2F_{18}$.

Min. *Humite, Chondrodite.* Gelatinizes with HCl or H_2SO_4+Aq.

Manganous silicate, Mn_2SiO_4.

Min. *Tephroite.* Decomp. by HCl+Aq with formation of a stiff jelly.

$MnSiO_3$. Min. *Rhodonite, Hermannite.* Not attacked by HCl+Aq.

$Mn_4Si_3O_{10}+2H_2O$. Min. *Friedelite.* Easily gelatinized by HCl+Aq.

"Manganous silicate" is insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Manganous zinc silicate, $(Mn,Zn)_2SiO_4$.

Min. *Troostite.*

Manganous silicate chloride, $MnSiO_3$, MnO, $MnCl_2$.

Decomp. by H_2O. (Gorgeu.)

Nickel silicate, Ni_2SiO_4.

Easily decomp. by acids. (Bourgeois, C. R. **108.** 1077.)

Potassium silicate, K_2SiO_3.

Completely sol. in H_2O. (Ordway, Sill. Am. J. (2) **33.** 34.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$K_2Si_2O_5$. Sol. in H_2O. Conc. $K_2Si_{24}O_5$+Aq contains 28% of the salt, and has sp. gr. 1.25. (Fuchs.)

Hydroscopic. Decomp. at once by H_2O. (Morey, J. Am. Chem. Soc. 1914, **36.** 222.)

$K_2Si_8O_{17}$. Partially sol. in H_2O as K_2SiO_3.

$K_2Si_{24}O_{49}+16H_2O$. Insol. in H_2O. (Forchhammer.)

The K silicates are pptd. from their aqueous solution by alcohol with partial decomp., but less readily than Na silicates.

More sol. in H_2O than the corresponding Na salts. (Ordway, Sill. Am. J. (2) **32.** 155.)

Solution can be obtained which is perfectly clear when $4\frac{1}{2}SiO_2$ are present to $1K_2O$, if there are no impurities present. (Ordway.)

The K silicates resemble the Na salts, which see for further data.

Potassium hydrogen silicate, $KHSi_2O_5$.

Not readily affected by H_2O, even by treatment at 100° for several hours.

Decomp. by heating with dil. HCl. (Morey, J. Am. Chem. Soc. 1914, **36.** 222.)

Potassium zinc silicate.

Sol. in KOH+Aq. (Schindler.)

K_2O, 6ZnO, $4SiO_2$. Sol. in HCl+Aq. (Duboin, C. R. 1905, **141.** 255.)

$8K_2O$, 9ZnO, $17SiO_2$. Sol. in HCl+Aq. (Duboin.)

Potassium zirconium silicate, K_2O, ZrO_2, $2SiO_2$.

Decomp. by HCl+Aq. (Melliss.)

Rubidium silicate, Rb_2SiO_3.

(Kahlenberg, J. phys. Chem. 1898, **2.** 82.)

Silver silicate, Ag_2SiO_3.

Decomp. by all acids; sol. in NH_4OH+Aq. (Hawkins, Sill. Am. J. **139.** 311.)

Sodium silicate, Na_2SiO_3.

Rapidly decomp. by H_2O. (Morey, J. Am. Chem. Soc. 1914, **36.** 224.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

+5, 6, and $8H_2O$. Easily sol. in H_2O.

$+9H_2O$. Solubility in ½-N NaOH+Aq.

100 ccm. of the solution contain 25.56 g. $Na_2SiO_3+9H_2O$ at 17.5.°

Sp. gr. of the solution = 1.129. (Vesterberg, C. C. **1913.** 777.)

100 ccm. of a sat. solution of sodium silicate in ½-N. NaCl+Aq. contain 3.83 g. $Na_2SiO_3+9H_2O$ at 17.5.° Sp. gr. of solution = 1.15.

100 ccm. of a sat. solution of sodium silicate in sat. NaCl+Aq contain 20.64 g. $Na_2SiO_3+9H_2O$ at 17.5°. (Vesterberg.)

$Na_2Si_2O_5$. Sol. in H_2O.

Slowly decomp. by cold H_2O. (Morey J. Am. Chem. Soc. 1914, **36.** 223.)

$Na_4Si_5O_{12}$.

$Na_2Si_3O_7$.

$Na_2Si_4O_9$. Slowly sol. in H_2O.

$+12H_2O$.

Above compounds are all more or less indefinite.

Water glass. xNa_2O, $ySiO_2+zH_2O$. Sol. in H_2O, but solution is decomposed by all weak acids, even CO_2.

Fused water glass is but little acted on by cold H_2O, but when pure, easily dissolves in H_2O by long boiling. (Ordway, Am. J. Sci. (2) **32.** 337.)

When the SiO_2 is present in greater proportion than in Na_2O, $3SiO_2$, it is very difficult to dissolve in H_2O.

Na silicate is less easily sol. in H_2O than the corresponding K compound.

Solubility of water glass in H_2O is much impaired by earthy impurities, so that traces have great effect in preventing the solubility.

NH_4 salts decomp. water glass solutions. A solution containing ½% Na_2SiO_3 is scarcely precipitated by NH_4Cl, but easily by NH_4NO_3. (Fluckinger.)

Precipitated by NH_4OH+Aq as Na_2SiO_3.

Many sodium and potassium salts, especially the chlorides and acetates, form precipitates in solutions of water glass; these precipitates are larger the more concentrated the solution is, and the greater amount of SiO_2 it contains. Heating hastens the precipitation by chlorides, nitrates, and sulphates, but delays that by acetates. KOH+Aq does not precipitate.

Cold sat. Na_2SO_4+Aq does not precipitate even on heating, but 1 pt. anyhydrous Na_2SO_4 dissolved in 2 pts. H_2O precipitates a hot solution of Na_2SiO_3.

$NaNO_3$ dissolved in 1 pt. H_2O precipitate Na_2SiO_3+Aq of 1.392 sp. gr.; $NaNO_3$ in 2 pts. H_2O when mixed with a solution of Na_2SiO_3, as above, if the two are present in equal vols., causes no ppt. in the cold, but solidifies when warmed to 54°, and redissolves on cooling rapidly, but if 2 vols. $NaNO_3$ +Aq are present to 1 vol. Na_2SiO_3+Aq, the precipitate does not disappear on cooling.

If 1 pt. NH_4OH+Aq (0.921 sp. gr.) is added to 10 pts. Na_2SiO_3+Aq, no ppt. forms, but by increasing the amt. of NH_4OH+Aq to 2 pts., the greater pt. of the Na_2SiO_3 is pptd., but redissolves on heating to 90°, separating again on cooling. When 1 pt. NH_4OH +Aq is added to 6–8 pts. Na_2SiO_3+Aq and heated to 30°, a clear liquid is formed which separates into two layers at ordinary temp.

The most sol. K, Na, Li, and NH_4 salts separate SiO_2 from conc. Na_2SiO_2+Aq. Most of these salts lose this power by dilution, but the NH_4 salts and KSCN keep this power until the solution is very dil. This is especially the case with NH_4Cl and NH_4NO_3.

Bromine, chlorine, propyl amine, creosote, phenole dissolved in glycerine, chloral hydrate, dil. albumen solution, and glue solution ppt. SiO_2 from Na_2SiO_3+Aq; but sugar, dextrine, glycerine, urea, sl. alkaline solution of urea nitrate, coniine, nicotine, saponine, convolvuline, jalappine, and colophonium dissolved in KOH+Aq do not ppt. SiO_2. (Fluckinger, Arch. Pharm. (2) **144.** 97.)

Alcohol ppts. water glass as such from its aqueous solution, even when this is very dil., but there is some decomposition, the alcohol tending to hold in solution a portion of a silicate more alkaline than that previously dissolved in H_2O, while the ppt. formed contains more SiO_2 than the original silicate.

Many neutral K or Na salts ppt. water glass as such when added to aqueous solutions. Like alcohol, these solutions exert a decomposing action, the ppt. being always more siliceous than the original silicate. Na silicate yields a larger deposit than K silicate; when a silicate of one base is pptd. by a salt of the other, both bases enter into the composition of the ppt, and the relative proportion of Na and K is very nearly the same as in the average of the liquids mixed.

Different salts have very unequal pptg. power, the acetates and chlorides being particularly efficient. Heat increases the pptg. power of the chlorides, sulphates, and nitrates, and diminishes that of the acetates. The alkali acetates are somewhat more efficient than the chlorides, but $NaC_2H_3O_2$ gives only a slight ppt. with Na_2O, $2\frac{1}{4}SiO_2$, even after some time.

$NaNO_3$ has but little effect on the more alkaline silicates.

Na_2SO_4 has still less power than $NaNO_3$.

Na_2CO_3 has no pptg. power, and Na_3AsO_4 or Na_3PO_4 have very little effect.

$MHSO_4$, $MHCO_3$, M_2HPO_4, M_2HAsO_4 ppt. SiO_2. NH_4 salts also have that effect.

Pptd. water glass, as mentioned above, is much more sol. in H_2O than ordinary water glass, and dissolves in H_2O without decomp. For numerous further details, see articles by Ordway in Sill. Am. J. Sci. vols. **32** and **33**; also Storer's Dict.

Sp. gr. of water glass solution containing 14–15% SiO_2, 13–14% Na_2O, and 70–72% H_2O is 1.30–1.35. (Hager, Comm. **1883.**)

Sp. gr. of sat. Na_2SiO_3+Aq freshly prepared at 18° is 1.2600, and 1 litre contains 4.5 gramme-equivalents $\frac{1}{2}Na_2SiO_3$.

Sp. gr. of sat. solution of Na_2O, $3.4SiO_2$ is 1.366, and 1 litre contains 3.7 gramme-equivalents $\frac{1}{2}(Na_2O$, $3.4SiO_2)$. (Kohlrausch, Z. phys. Ch. **12.** 773.)

Sodium zirconium silicate, Na_2O, ZrO_2, SiO_2.

Decomp. by hot H_2O or HCl+Aq. (Gibbs, Pogg. **71.** 559.)

Na_2O, $8ZrO_2$, SiO_2+11H_2O. Decomp. by H_2SO_4. (Melliss.)

Strontium silicate, $SrSiO_3$.

(Stein, Z. anorg. 1907, **55.** 164.)

$+H_2O$. Sol. in H_2O. (Jordis and Kanter, Z. anorg. 1903, **35.** 90.)

Sr_2SiO_4. (Stein, Z. anorg. 1907, **55.** 167.)

$3SrO$, SiO_2. Sl. sol. in H_2O. Sol. in acids. (Vauquelin.)

Thallous silicate, $3Tl_2O$, $10SiO_2$.

100 pts. of a solution of Tl_2O dissolve 4.17 pts. SiO_2 by 24 hours' boiling. Sol. in H_2O. (Flemming, J. B. **1868.** 251.)

Thorium silicate, ThO_2, SiO_2.

Insol. in acids. Attacked by $KHSO_4$. (Troost and Ouvrard, C. R. **105.** 255.)

$+1\frac{1}{2}H_2O$. Min. *Thorite.* Decomp. by HCl+Aq.

ThO_2, $2SiO_2$. Insol. in acids or $KHSO_4$. (T. and O.)

Yttrium silicate, Y_2O_3, SiO_2.

Attacked by HCl, HNO_3, or H_2SO_4+Aq. (Duboin, C. R. **107.** 99.)

Zinc silicate, $ZnSiO_3$.

(Stein, Z. anorg. 1907, **55.** 165.)

Zn_2SiO_4. Min. *Willemite.* Gelatinizes with HCl+Aq; sol. in KOH+Aq.

Decomp. by cold sat. citric acid+Aq. (Bolton, C. N. 1881, **43.** 34.)

$+H_2O$. Min. *Calamine.* Sol. in HCl+Aq with separation of gelatinous SiO_2, xH_2O. Sol. in $HC_2H_3O_2$+Aq, and KOH+Aq.

Insol. in $NH_4OH+(NH_4)_2CO_3$+Aq. (Brandhorst, Zeit. angew. Ch. 1904, **17.** 513.)

ZnO, $3SiO_2$. (Bornträger, Ch. Z. 1893, **8.** 186.)

Zirconium silicate, SiO_2, ZrO_2.

Min. *Zircon.* Insol. in acids, except H_2SO_4, in which it is very slowly and sl. sol.

$3SiO_2$, $2ZrO_2$ Min. *Auerbachite.*

"Silicium oxide," $Si_8H_2O_5$.

(Geuther, J. pr. **95.** 430.) This substance is identical with silicoformic anhydride according to Otto-Graham's Handb. anorgan. Chem. 7te Aufl. **2.** 953.

Siliciuretted hydrogen.

See **Silicon hydride.**

Silicobromoform, $HSiBr_3$.

Fumes on air; decomp. by H_2O.

Silicochloroform, $HSiCl_3$.

Decomp. by H_2O and alcohol.

Completely miscible with CS_2, CCl_4, $CHCl_3$, C_6H_6, $SiCl_4$, $SnCl_4$, $TiCl_4$, and $AsCl_3$. (Ruff, B. 1905, **38.** 2230.)

Silicoethane.

See **Silicon hydride.**

Silicofluoroform, $SiHF_3$.

Decomp. by H_2O. Decomp. by NaOH and abs. alcohol with evolution of hydrogen. Decomp. by abs. ether. Sol. in toluene. (Ruff, B. 1905, **38.** 63.)

Silicoformic anhydride, $H_2Si_2O_3 = (HSiO)_2O$.

Somewhat sol. in H_2O. Acids, even conc. HNO_3+Aq, have no action, except HF, which dissolves it easily with evolution of hydrogen. Solutions of alkali hydrates, ammonium hydrate, and alkali carbonates+Aq also dissolve with evolution of hydrogen. (Ruff and Wöhler, A. **104.** 101.)

Silicoiodoform, $HSiI_3$.

Decomp. by H_2O. Sol. in CS_2. (Friedel, A. **149.** 96.)

Miscible with C_6H_6 and CS_2. (Ruff, B. 1908, **41.** 3739.)

Silicomethane, SiH_4.

See **Silicon hydride.**

Silicomethyl chloride, SiH_3Cl.

Decomp. by H_2O and by alkalies. (Besson and Fournier, C. R. 1909, **148.** 556.)

Silicomethylene chloride, SiH_2Cl_2.

Decomp. by H_2O and by alkalies. (Besson and Fournier, C. R. 1909, **148.** 556.)

Silicomolybdic acid, SiO_2, $12MoO_3+26H_2O$.

Very easily sol. in H_2O and dil. acids. (Parmentier, C. R. **94.** 213.)

Forms a solution with a little ether, which separates into two layers by addition of H_2O or more ether. (Parmentier, C. R. **104.** 686.) (Copaux, Bull. Soc. Min. 1906, **29.** 79.)

$+32H_2O$. Decomp. by alkali. (Asch, Z. anorg. 1901, **28.** 293.)

$+33H_2O$. (Copaux, Bull. Soc. Min. 1906, **29.** 79.)

Aluminum silicomolybdate, $2Al_2O_3$, $3(SiO_2, 12MoO_3)+93H_2O$.

(Copaux, A. ch. 1906, (8) **7.** 118.)

Aluminum sodium silicomolybdate, $4(Na_2O, Al_2O_3, 2SiO_2)$, $Na_2MoO_4+7H_2O$.

Sol. in HCl+Aq. (Thugutt, Z. anorg. 1892, **2.** 87.)

Ammonium silicomolybdate.

Sol. in H_2O. (Parmentier, C. R. **94.** 213.)

Barium silicomolybdate, $2BaO$, SiO_2, $12MoO_3+16H_2O$.

(Copaux, A. ch. 1906, (8) **7.** 118.)

$+22H_2O$. Sol. in 4 pts. H_2O. (Copaux, Bull. Soc. Min. 1906, **29.** 80.)

$+24H_2O$. Efflorescent. Very sol. in H_2O. (Asch, Z. anorg. 1901, **28.** 282.)

$+29H_2O$. Efflorescent. (Copaux, A. ch. 1906, (8) **7.** 118.)

Cadmium silicomolybdate, $2CdO$, SiO_2, $12MoO_3+22H_2O$.

Very unusually sol. in H_2O. (Copaux, A. ch. 1906, (8) **7.** 140.)

Cæsium silicomolybdate.

Sl. sol. in H_2O; insol. in silicomolybdic acid+Aq.

Calcium silicomolybdate, $2CaO$, SiO_2, $12MoO_3+24H_2O$.

Efflorescent. Very sol. in H_2O. (Asch, Z. anorg. 1901, **28.** 282.)

$+26H_2O$. (Copaux, A. ch. 1906, (8) 7. 118.)

$+31H_2O$. (Copaux.)

Chromium silicomolybdate, $2Cr_2O_3$, $3(SiO_2, 12MoO_3)+93H_2O$.

(Copaux.)

Cupric silicomolybdate, $2CuO$, SiO_2, $12MoO_3+31H_2O$.

Very sol. in H_2O. (Copaux.)

Lithium silicomolybdate, $2Li_2O$, SiO_2, $12MoO_3+29H_2O$.

Very sol. in H_2O. (Copaux.)

Magnesium silicomolybdate, $2MgO$, SiO_2, $12MoO_3+30H_2O$.

(Asch, Z. anorg. 1901, **28.** 282.)

$+31H_2O$. Very efflorescent and sol. in H_2O. (Copaux.)

Potassium silicomolybdate, $2K_2O, SiO_2, 12MoO_3+16H_2O$.

Efflorescent. Very sol. in H_2O. (Asch, Z. anorg. 1901, **28.** 282.)

$1.5K_2O, SiO_2, 12MoO_3+14H_2O$. (Asch.) Sol. in H_2O with decomp. (Copaux.)

Potassium silver silicomolybdate, $K_2O, 3Ag_2O, 2(SiO_2, 12MoO_3)+14H_2O$; $+22H_2O$; $+30H_2O$.

Sol. in H_2O with decomp. Sol. unchanged in dil. mother liquor. (Copaux, Bull. Soc. Min. 1907, **30.** 293.)

Rubidium silicomolybdate.

Sl. sol in H_2O.

Silver silicomolybdate, $1.5Ag_2O, SiO_2, 12MoO_3+11H_2O$.

Sol. in cold H_2O. (Asch.)

$2Ag_2O, SiO_2, 12MoO_3+12H_2O$. Decomp. by boiling H_2O. Sol. in NH_4OH+Aq.

$4Ag_2O, SiO_2, 12MoO_3+15H_2O$. (Asch.)

Sodium silicomolybdate, $2Na_2O, SiO_2, 12MoO_3+14H_2O$.

(Copaux.)

$2Na_2O, SiO_2, 12MoO_3+21H_2O$. Very sol. in H_2O. Efflorescent. (Asch.)

$+22H_2O$. (Copaux.)

$1.5Na_2O, SiO_2, 12MoO_3+17H_2O$. (Asch.)

$3Na_2O, 2(SiO_2, 12MoO_3)+17H_2O$. (Copaux.)

Strontium silicomolybdate, $2SrO, SiO_2, 12MoO_3+26H_2O$.

(Copaux.)

Zinc silicomolybdate, $2ZnO, SiO_2, 12MoO_3+31H_2O$.

Extremely sol. in H_2O. (Copaux.)

Silicon, Si.

Amorphous. Insol. in H_2O. Sol. before igniting in cold HF. Insol. in other mineral acids and aqua regia. Sol. in conc. KOH+Aq. When amorphous Si is ignited, it becomes insol. in HF and KOH+Aq.

Amorphous Si is sol. in aqua regia and in a mixture of HNO_3 and HF. (Vigouroux-Moissan, C. R. 1895, **120.** 367.)

Insol. in liquid CO_2. (Buchner, Z. phys. Ch. 1906, **54.** 674.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Graphitic. Sol. in HNO_3+HF. (Berzelius, A. **49.** 247.)

Crystalline. Insol. in all acids, except a mixture of HF and HNO_3. Sol. in moderately conc. KOH+Aq even when cold. (Deville.)

Although it has been generally understood that crystallized Si is not attacked by HF, it is now found that this applies only to HF+Aq. Gaseous HF readily attacks cryst. Si. (Newth, C. N. 1896, **72.** 287.)

Si cryst. from Ag is incompletely sol. in HF. According to the temp. to which the Ag Si mixture has been heated, the following percentages of Si are dissolved in HF: 970°, 58.02%; 1150°, 27.66%; 1250°, 19%; 1470°, 16%. (Moissan and Siemens, C. R. 1904, 138. 657, 1300.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Silicon amide, $Si(NH_2)_4$.

Unstable; decomp. by H_2O and partially decomp. by HNO_3; sol. in most organic solvents. (Lengfeld, Am. Ch. J. 1899, **21.** 531.)

Decomp. by H_2O; insol. in liquid NH_3. (Vigouroux, C. R. 1903, **136.** 1670.)

Silicon *tri*boride, SiB_3.

Slowly attacked by HNO_3. Decomp. by hot conc. H_2SO_4 or fused KOH. (Moissan, C. R. 1900, **131.** 142.)

Silicon *hexa*boride, SiB_6.

Readily attacked by HNO_3. Slowly decomp. by hot conc. H_2SO_4. Not attacked by fused KOH. (Moissan, C. R. 1900, **131.** 142.)

Silicon *tri*bromide, Si_2Br_6.

Decomp. by KOH+Aq. (Friedel and Ladenburg, A. **203.** 253.)

$HSiBr_3$. *See* **Silicobromoform.**

Silicon *tetra*bromide, $SiBr_4$.

Rapidly decomp. by H_2O; decomp. in several days by H_2SO_4. (Friedel and Ladenburg, A. **147.** 362.)

Silicon bromide, Si_3Br_8.

(Besson, C. R. 1910, **151.** 1056.)

Si_4Br_{10}. (Besson.)

***Di*silicon hydrogen *penta*bromide,** HSi_2Br_5 or Si_2Br_5 (?).

Decomp. by H_2O. (Mahn, Zeit. Chem. (2) **5.** 279.)

Silicon *tetra*bromide ammonia, $SiBr_4, 6NH_3$.

Decomp. by H_2O. (Lay, Dissert. **1910.**)

$SiBr_4, 7NH_3$. Decomp. by H_2O. (Besson, C. R. **110.** 240.)

Silicon bromoiodide, $SiIBr_3$.

Decomp. by H_2O. Sol. in CS_2. (Friedel, B. **2.** 60.)

$SiBr_2I_2$. As above. (F.)

$SiBrI_3$. As above. (F.)

Silicon bromosulphide, $SiSBr_2$.

Decomp. in moist air. Violently decomp. by H_2O. Sol. in CS_2 and other organic solvents. (Blix, B. 1903, **36.** 4218.)

Silicon carbide, SiC.

Very stable; insol. in H_2SO_4 and HNO_3; sol. in fused KOH at red heat. (Moissan, Bull. Soc. 1894, (3) **11.** 997.)

Cryst. modification. Insol. in acids; sol. in fused alkalies. (Moissan, C. R. 1893, **117.** 427.)

Insol. in all acids; sol. in molten alkalies. (Muhlhaeuser, Z. anorg. 1894, **5.** 116.)

See **Silundum.**

Silicon *sub*chloride, $SiCl_2$ (?).

Decomp. by H_2O. (Troost and Hautefeuille, A. ch. (5) **7.** 463.)

Silicon *tri*chloride, Si_2C_6.

Decomp. by H_2O and alkalies. (Troost and Hautefeuille, A. ch. (5) **7.** 459.)

$SiHCl_3$. *See* **Silicochloroform.**

Silicon *tetra*chloride, $SiCl_4$.

Decomp. by H_2O and alcohol.

Silicon *octo*chloride, Si_3Cl_8.

"Perchlorsilicopropane." Decomp. by H_2O. (Gattermann, B. 1894, **27.** 1947.)

Silicon chloride, Si_4Cl_{10}.

(Besson, C. R. 1909, **149.** 36.)

Si_5Cl_2. "Perchlorsilicobutane." Decomp. by H_2O. Fumes in the air. (Besson.)

Si_6Cl_{14}. "Perchlorsilicohexane." Decomp. by H_2O. (Besson, C. R. 1909, **148.** 841.)

Silicon *tri*chloride ammonia, Si_2Cl_6, $5NH_3$.

Slowly decomp. by H_2O. (Besson, C. R. **110.** 516.)

Silicon *tetra*chloride ammonia, $SiCl_4$, $6NH_3$.

Decomp. by H_2O. (Persoz, A. ch. **44.** 319.)

Silicon *tetra*chloride hydrazine, $SiCl_4$, $4N_2H_4$.

Extremely hygroscopic and quickly decomp. by H_2O. (Lay, Dissert. **1910.**)

Silicon chlorobromide, $SiCl_3Br$.

Decomp. by H_2O. (Friedel and Ladenburg, A. **145.** 187.)

$SiCl_2Br_2$. As above. (Friedel and Ladenburg.)

$SiBr_3Cl$. Decomp. by H_2O. (Reynolds, Chem. Soc. **51.** 590.)

Silicon chlorobromide ammonia, $2SiCl_3Br$, $11NH_3$.

Decomp. by H_2O. (Besson, C. R. **112.** 788.)

$SiCl_2Br_2$, $5NH_3$. As above. (B.)

$2SiClBr_3$, $11NH_3$. As above. (B.)

Silicon chlorohydrosulphide, $SiCl_3SH$.

Decomp. by H_2O or alcohol. (Pierre, A. ch. (3) **24.** 286.)

Silicon chloroiodide, $SiCl_3I$.

Decomp. by H_2O. (Besson, C. R. **112.** 611.)

$SiCl_2I_2$. As above. (B.)

$SiClI_3$. As above. (B.)

Silver chloroiodide ammonia, $2SiCl_3I$, $11NH_3$. (Besson.)

$SiCl_2I_2$, $5NH_3$.

Silicon chloronitride, $Si_5N_6Cl_2$.

(Schützenberger, C. R. **92.** 1508.)

Silicon chlorosulphide, $Si_2Cl_2S_2$.

Decomp. violently by H_2O. Sol. in CCl_4. (Besson, C. R. **113.** 1040.)

$SiSCl_2$. Violently decomp. by H_2O; sol. in CS_2. (Blix, B. 1903, **36.** 4223.)

Silicon *di*fluoride, SiF_2(?).

Decomp. by H_2O or NH_4OH+Aq. (Troost and Hautefeuille, A. ch. (5) **7.** 464.)

Silicon *tetra*fluoride, SiF_4.

Abundantly absorbed by H_2O with decomp.

100 pts. H_2O absorb 140.6 pts. SiF_4 in 24 hours (Berzelius); 124.1 pts. SiF_4 in 24 hours (Davy).

Absorbed abundantly by HNO_3+Aq. (Kuhlmann, A. **39.** 319.)

Absorbed abundantly by alcohol, without separation of silicic acid, if the alcohol contains less than 8% of water.

Sol. in conc. HF+Aq. Absorbed by ether. Sl. sol. in naptha, and oil of turpentine.

Silicon hydrogen fluoride, H_2SiF_6.

See **Fluosilicic acid.**

Silicon fluoride *with* MF.

See **Fluosilicate, M.**

Silicon fluoride ammonia, SiF_4, $2NH_3$.

Decomp. by H_2O. (Davy.)

Silicon hydride, SiH_4.

Insol. in H_2O. Decomp. by KOH+Aq. Not changed by NH_4OH+Aq, H_2SO_4+Aq, or HCl+Aq.

Si_2H_2. "Silicoacetylene."

Sol. in 20% NaOH+Aq. with evolution of H. (Bradley, C. N. 1900, **82.** 149.)

Si_2H_6. "Silicoethane." (Lebeau, C. R. 1909, **148.** 44.)

Sl. sol. in H_2O. Best solvent is ethyl orthosilicate. (Moissan, Bull. Soc. 1903, (2) **29.** 443.)

Silicon nitrogen hydride, SiHN.

Decomp. by H_2O and NaOH. (Ruff, B. 1905, **38.** 2241.)

Silicon hydroxide, SiO_2, xH_2O.

See **Silicic acid.**

$Si_2H_2O_4$. *See* **Silicooxalic acid.**

$Si_2H_2O_3$. *See* **Silicoformic anhydride.**

$Si_4H_4O_3$. *See* **Silicone.**

Silicon imide, $(Si(NH)_2$.

Decomp. by H_2O. (Vigouroux, C. R. 1903, **136.** 1671.)

Silicon*di*imide, $Si(NH)_2$.

Decomp. by H_2O with evolution of much heat. (Blix, B. 1903, **36.** 4224.)

Silicon imide hydrochloride, $Si(NH_2)_2$, 2HCl.

Rather stable in air. (Blix, B. 1903, **36.** 4225.)

Silicon *di*iodide, SiI_2.

Insol. in CS_2, $CHCl_3$, C_6H_6, and $SiCl_4$. (Friedel and Ladenburg, A. **203.** 247.)

Silicon *tri*iodide, Si_2I_6.

Decomp. with H_2O even at 0°.

100 pts. CS_2 dissolve 19 pts. Si_2I_6 at 19°; 26 pts. Si_2I_6 at 27°. (Friedel and Ladenburg, Bull. Soc. (2) **12.** 92.)

$HSiI_3$. *See* **Silicoiodoform.**

Silicon *tetra*iodide, SiI_4.

Decomp. by H_2O. Acts on alcohol and ether.

1 pt. CS_2 dissolves 2.2 pts. SiI_4 at 27°. (Friedel, A. **149.** 96.)

Silicon nitride, SiN.

Partially decomp. by boiling with conc. H_2SO_4.

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalies+Aq. (Weiss, Z. anorg. 1910, **65.** 89.)

Si_2N_3. Partially decomp. by boiling with conc. H_2SO_4.

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalies+Aq. (Weiss, Z. anorg. 1910, **65.** 89.)

Si_3N_4. Not attacked by H_2O.

Partially decomp. by boiling with conc. H_2SO_4.

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalies+Aq. (Weiss, Z. anorg. 1910, **65.** 89.)

Silicon nitrimide, Si_2N_3H.

"Silicam."

Sol. in HF, and rapidly in KOH+Aq. (Schutzenberger, C. R. **92.** 1508.)

Decomp. by cold, more rapidly by hot H_2O and much more rapidly by alkalies. Sol. in HF+Aq. Not attacked by HNO_3. Decomp. by conc. H_2SO_4. (Lay, Dissert. **1910.**)

Not decomposed by H_2O.

Sol. in hot alkalies+Aq with decomp. (Blix, B 1903, **36.** 4227)

Silicon *sub*oxide, Si_3O_2.

(Honigschmid, M. 1909, **30.** 509.)

Silicon *mon*oxide, SiO.

Much less easily sol. in HF+Aq but more easily sol. in alkalies+Aq than SiO_2. (Potter, C. C. **1907,** II. 1952)

Silicon *di*oxide, SiO_2.

See also **Silicic acid.**

(*a*) *Crystalline.* Min. *Quartz, Tridymite.*

Insol. in H_2O, and acids, except HF.

Sl. sol. in boiling K_2CO_3+Aq, and KOH+Aq; see below.

Insol. in cold KOH+Aq; extremely slowly sol. in boiling KOH+Aq. (Fuchs.)

Sol. in HF with formation of SiF_4 and H_2O.

Insol. in sugar+Aq, contrary to assertion of Verdeil and Rissler. (Petzholdt, J. pr. **60.** 368)

(*b*) *Amorphous.* Min. *Opal,* etc.

Insol. in H_2O, and acids except HF.

100 pts. H_2O containing CO_2 dissolve 0.078 pt. amorphous SiO_2 (Maschke); 0.0136 pt (Struckmann).

100 pts. cold HCl+Aq of 1.088 sp. gr. dissolve 0.017 pt. SiO_2. (Struckmann.) 100 pts. HCl+Aq of 1.115 sp. gr. dissolve in the cold 0.009 pt. SiO_2, and 0.018 pt. on boiling. 100 pts. NH_4OH+Aq (containing 10% NH_3) dissolve 0.017 pt. quartz and 0.38 pt. ignited SiO_2. (Pribram, Z. anal. **6.** 119.)

Sol. in boiling K_2CO_3 or Na_2CO_3+Aq, separating out on cooling as a gelatinous mass. (Pfaff, Schw. J. **29.** 383.) The different forms of SiO_2 have different degrees of solubility in K_2CO_3+Aq. Unignited amorphous SiO_2 from SiF_4 dissolves most readily, then come opal, ignited amorphous SiO_2, fused SiO_2, and tridymite; quartz powder is the most difficultly soluble. (Rose.) A similar behaviour is shown to KOH+Aq.

Opal is much more sol. in KOH+Aq than quartz, and hyalite is the least sol. of the varieties of opal. (Fuchs.)

Opal is easily sol. in KOH+Aq, even after ignition. (Schaffgotsch, Pogg. **68.** 147.)

Rammelsberg (Pogg. **112.** 177) made the following experiments on the solubility of SiO_2 in KOH+Aq. The KOH+Aq used contained 1 pt. KOH to 3 pts. H_2O. 1 pt. of the powdered mineral was boiled half an hour in a silver dish with such an amount of the KOH+Aq that 20 pts. KOH were present.

7.75% of milky white quartz was dissolved by repeating the above process three times.

12.8–15% of gray hornstone was dissolved by twice boiling; 2.43% of moderately finely powdered agate of 2.661 sp. gr. was dissolved by once boiling; 9.7% of unignited hyalite remained undissolved after thrice boiling;

21% of ignited hyalite remained undissolved after thrice boiling; 7.21% of semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 18.5-19.2% of impure semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 79.9% of chalcedony of 2.624 sp. gr. remained undissolved after thrice boiling; 6.12% of chalcedony of 2.567 sp. gr. remained undissolved after fourth boiling; 14.4% chrysophrase of 2.623 sp. gr. remained undissolved after once boiling; 49.41% of chrysophrase of 2.635 sp. gr. remained undissolved after thrice boiling; 6.62% of flint of 2.606 sp. gr. remained undissolved after twice boiling; 38.1% of fire-opal of 2.625 sp. gr. remained undissolved after fourth boiling; 26.6% of fire-opal of 2.625 sp. gr. remained undissolved after fifth boiling.

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

The solubility of crystals of quartz on different faces in HF has been determined by Lebrun. (Belg. Acad. Bull. **1913,** 953.)

Silicon thorium oxide.
See **Silicate, thorium.**

Silicon zirconium oxide.
See **Silicate, zirconium.**

Silicon oxychloride, Si_2OCl_6.

Decomp. by H_2O and alcohol. Miscible with CS_2, $SiCl_4$, CCl_4, $CHCl_3$, or ether. (Friedel and Ladenburg, A. **147.** 355.)

$Si_4O_3Cl_{10}$; $Si_4O_4Cl_8$; $Si_8O_{10}Cl_{12}$; $(Si_2O_3Cl_2)n$.

$Si_4O_7Cl_2$. Sol. in above oxychlorides. (Troost and Hautefeuille, Bull. Soc. (2) **35.** 360.)

Silicon oxyfluorhydrin, $Si_2O_3{}^{OH}_{F}$.

(Landolt, A. Suppl. **4.** 27.)

Silicon selenide, $SiSe_2$.

Decomp. by H_2O or KOH+Aq. (Sabatier, C. R. **113.** 132.)

Silicon sulphide, SiS_2.

Sol. in H_2O with decomp. Acts on alcohol or ether in the cold. (Fremy, A. ch. (3) **38.** 314.)

SiS. Decomp. by H_2O; easily sol. in dil. alkalies. (Schützenberger, Bull. Soc. (2) **38.** 56.)

Silicon sulpho*di*amide, $SiS(NH_2)_2$.

Slowly decomp. in the air. Insol. in cold liquid NH_3. (Blix, B. 1903, **36.** 4219.)

Silicon sulphobromide.
See **Silicon bromosulphide.**

Silicon sulphochloride.
See **Silicon chlorosulphide.**

Silicon sulphourea, $SiS(NH_2)_2$.

Slowly decomp. in air.
Decomp. by H_2O.
Insol. in cold liquid NH_3. (Blix, B. 1903, **36.** 4219.)

Silicone, $Si_4H_4O_3$.

Insol. in H_2O, but gives off hydrogen when warmed therewith. Not attacked by chlorine or nitric or sulphuric acids even on heating, but is gradually sol. in HF. Decomp. by alkalies, even by the most dil. NH_4OH+Aq, with greatest violence and evolution of heat and hydrogen gas. Insol. in alcohol, $SiCl_4$, PCl_3, or CS_2. (Wöhler, A. **127.** 257.)

$H_3Si_3O_2$. Decomp. by H_2O and by dil. acids. Violently decomp. by fuming HNO_3. Not attacked by conc. H_2SO_4. Very slowly decomp. by conc. HCl, rapidly by alkalies+Aq and by pyridine. (Honigschmid, M. 1909, **30.** 509.)

Insol. in H_2O, alcohol. $SiCl_4$, PCl_3, and CS_2. Not attacked by acids except HF. (Donath and Liesner, C. C. **1909,** II. 1707.).

$H_{12}Si_{10}O_8$. Scarcely attacked by acids, but easily decomp. by hot H_2O, NaOH+Aq etc. but not by NH_4OH+Aq. (Kolb, Z. anorg. 1909, **64,** 353.)

$H_{10}Si_{10}O_8$. (Kolb.)

$H_8Si_8O_{13}$. As $H_{12}Si_{10}O_8$. (Kolb.)

Silico*meso*xalic acid, $Si(OH)_2(SiO.OH)_2$.

Insol. in cold H_2O, decomp. by hot H_2O. (Gattermann, B. 1899, **32.** 1116.)

Silicooxalic acid, $Si_2H_2O_4=Si_2O_2(OH)_2$.

Decomp. by bases with evolution of hydrogen. Takes up HNO_3 to form compound, but not HCl or H_2SO_4. (Troost and Hautefeuille, A. ch. (5) **7.** 463.)

Silicophosphoric acid, SiO_2, P_2O_5.

Slowly decomp. by H_2O. Unchanged by alcohol. Exists also in two modifications which are not attacked by H_2O. (Hautefeuille and Margottet, C. R. **99.** 789.)

SiO_2, $2P_2O_5+4H_2O$. Decomp. by moist air. Sol. in H_2O at 0°, but decomp. by warming to ordinary temp. (Hautefeuille and Margottet, C. R. **104.** 56.)

Calcium silicophosphate.
See **Phosphate silicate, calcium.**

Silicostannic acid.

Calcium silicostannate, $Ca(Si,Sn)O_3$.

Not attacked by acids, $KHSO_4$, or alkalies +Aq. (Bourgeois, Bull. Soc. (2) **47. 297.**)

Silico*deci*tungstic acid, $H_8W_{10}SiO_{36}+3H_2O = 4H_2O, SiO_2, 10WO_3+3H_2O$.

Sometimes sol. in H_2O, but usually separates out gelatinous silica. (Marignac, A. ch. (4) **3.** 55.)

See also **Silico*duodeci*tungstic acid**.

Ammonium silico*deci*tungstate, $(NH_4)_8W_{10}SiO_{36}+8H_2O$.

Sol. in 4.5 pts. H_2O at 18°. Very sol. in hot H_2O. (Marignac, A. ch. (4) **3.** 59.)

$(NH_4)_6H_2W_{10}SiO_{36}+9H_2O$. (Marignac.)

Ammonium potassium ——, $(NH_4)_3K_4HSiW_{10}O_{36}+15H_2O$. (Marignac.)

Barium ——, $Ba_4SiW_{10}O_{36}+22H_2O$.

Precipitate. Insol. in H_2O. (Marignac.)

Potassium ——, $K_8SiW_{10}O_{36}+17H_2O$.

Sol. in H_2O. (Marignac.)

$K_4H_4SiW_{10}O_{36}+8H_2O$. Sol. in H_2O. (Marignac.)

Potassium —— silicotungstate (?), $K_8SiW_{11}O_{39}+14H_2O$.

$K_4H_4SiW_{11}O_{39}+10H_2O$. (Marignac.)

Silver ——, $Ag_8W_{19}SiO_{36}+3H_2O$.

Not appreciably sol. in cold H_2O. (Marignac, A. ch. (4) **3.** 65.)

Silicotungstic acid or Silico*duodeci*tungstic acid, $H_8SiW_{12}O_{42}$.

($H_4SiW_{10}O_{40}$, according to Copaux. (Bull. Soc. 1908, (4) **3.** 101.)

$+20H_2O$. Sol. in H_2O; very sol. in alcohol; behaves with ether as the acid with $22H_2O$ (Marignac, A. ch. (4) **3.** 10.)

$+22H_2O$. Solubility as acid with $29H_2O$. 100 pts. deliquesce with 13 pts. ether. To this mixture 20–25 pts. of ether can be added, but a further quantity no longer mixes with, but floats above the mixture. Ethereal solution is miscible with H_2O. Ether is taken up by a saturated aqueous solution with evolution of heat, until the volume has become doubled; more ether floats on the mixture. By warming the latter a liquid separates out which forms a layer between the two original layers. Alcoholic solution of the acid mixes with an equal vol. of ether, but on adding more ether a conc. ethereal solution separates as a syrupy layer. (Marignac, A. ch. (4) **3.** **3.** 10.)

$+29H_2O$. Efflorescent. Sol. in H_2O. Saturated solution at 18° contains 1 pt. crystallized acid to 0.104 pt. H_2O, and has 2.843 sp. gr. Melts in crystal H_2O. Easily sol. in absolute alcohol and anhydrous ether.

$+xH_2O$. (Drechsel, B. 1887, **20.** 1452.)

Aluminum silicotungstate, $Al_4H_{12}(SiW_{12}O_{42})_3+75H_2O$.

Not deliquescent; very sol. in H_2O. (Marignac).

$Al_4(SiW_{12}O_{40})_3+60H_2O$. (Wyrouboff. Chem. Soc. 1897, **72,** (2) 174.)

$+87H_2O$. (Wyrouboff.)

$+93H_2O$. Very efflorescent. (Wyrouboff.)

Aluminum ammonium ——, $Al_4(NH_4)_{18}(SiW_{12}O_{43})_3+75H_2O$.

Sol. in H_2O. (Marignac.)

Ammonium ——, basic, $(NH_4)_4SiW_{12}O_{40}$ $4NH_4OH+14H_2O$.

(Wyrouboff, Chem. Soc. 1897, **72.** (2) 174.)

Ammonium ——, $(NH_4)_8SiW_{12}O_{42}+16H_2O$.

Very sol. in hot H_2O. (Marignac, A. ch. (4) **3.** 17.)

$(NH_4)_4H_4SiW_{12}O_{42}+6H_2O$. Less soluble in H_2O than the preceding salt. (Marignac.)

$(NH_4)_4SiW_{12}O_{40}+8H_2O$. (Wyrouboff, Chem. Soc. 1897, **72.** (2) 174.)

Barium ——, $Ba_2H_4SiW_{12}O_{42}+14H_2O$.

Sol. in H_2O.

$+22H_2O$. Gradually efflorescent. (Marignac.)

Sol. in cold H_2O, 1 : 0.7 pts. (Copaux, Bull. Soc. Min. 1906, **29.** 80.)

Sol. in 4 pts. cold H_2O. (Wyrouboff, Bull. Soc. Min. 1896, **19.** 278.)

$Ba_4SiW_{12}O_{42}+27H_2O$. Nearly insol. in cold, sl. sol. in hot H_2O. (Marignac.)

$Ba_2SiW_{12}O_{40}+16H_2O$. (Wyrouboff.)

Barium potassium ——, $Ba_2K_2SiW_{12}O_{40}+17H_2O$.

(Wyrouboff, Chem. Soc. 1897, **72.** (2) 176.)

Barium sodium ——, $Na_4Ba_3SiW_{12}O_{42}+28H_2O$.

H_2O gradually dissolves out sodium silicotungstate.

Cadmium ——, $Cd_2SiW_{12}O_{40}+23H_2O$, and $+27H_2O$.

(Wyrouboff.)

$4CdO, 3(SiO_2, 12WO_3)+4H_2O$. (Wyrouboff.)

Cæsium ——, $Cs_8SiW_{12}O_{42}$.

100 pts. H_2O dissolve only 0.005 pt. at 20°; 0.52 pt. at 100°.

Completely insol. in alcohol, and HCl+Aq. Somewhat sol. in dil. NH_4OH+Aq. (Godeffroy, B. **9.** 1363.)

Cadmium hydrogen ——, $2Cd_2SiW_{12}O_{40}$, $H_4SiW_{12}O_{40}+42H_2O$.

(Wyrouboff.)

Calcium silicotungstate, $Ca_2H_4SiW_{12}O_{42}+20H_2O$.

Not deliquescent. Extremely easily sol. in H_2O. (Marignac.)

$Ca_2SiW_{12}O_{40}+18$, 24 and $27H_2O$. (Wyrouboff.)

Calcium silicotungstate nitrate, $Ca_2SiW_{12}O_{40}$, $Ca(NO_3)_2+15H_2O$.

(Wyrouboff.)

Cerous ——, $Ce_2SiW_{12}O_{40}+27H_2O$.

(Wyrouboff.)

$Ce_2SiW_{12}O_{40}$, $CeH_2SiW_{12}O_{40}+34H_2O$. (Wyrouboff.)

Chromium ——, $Cr_4(SiW_{12}O_{40})_3+60$, 87 and $93H_2O$.

(Wyrouboff.)

Cupric ——, $Cu_2SiW_{12}O_{40}+18$, 27 and $29H_2O$.

Very efflorescent. (Wyrouboff.)

Didymium ——, $Di_2SiW_{12}O_{40}+26$ and $27H_2O$.

(Wyrouboff.)

$Di_2SiW_{12}O_{40}$, $DiH_2SiW_{12}O_{40}+34H_2O$. (Wyrouboff.)

Gallium ——, $Ga_4(SiW_{12}O_{40})_3+60$, 87, and $93H_2O$.

(Wyrouboff.)

Glucinum ——, $Gl_4(SiW_{12}O_{40})_3+45$, 87 and $93H_2O$.

(Wyrouboff.)

Indium ——, In_2O_3, H_2O, $2(SiO_2$, $12WO_3)+40H_2O$.

(Wyrouboff.)

$2In_2O_3$, $3(SiO_2$, $12WO_3)+63$ and $93H_2O$. (Wyrouboff.)

Iron (ferric) ——, $Fe_4(SiW_{12}O_{40})_3+60$ and $93H_2O$.

(Wyrouboff.)

Lanthanum ——, $La_2SiW_{12}O_{40}+27H_2O$.

Efflorescent. (Wyrouboff.)

$La_2SiW_{12}O_{40}.LaH_2SiW_{12}O_{40}+34H_2O$. (Wyrouboff.)

Lead ——, basic, $Pb_2SiW_{12}O_{40}$, $2PbO+20H_2O$.

Sl. sol. in H_2O. (Wyrouboff.)

Lead ——, $Pb_2SiW_{12}O_{40}+21\ H_2O$.

Sol. in H_2O. (Wyrouboff.)

Lithium ——, Li_2O, SiO_2, $12WO_3+14$ and $24H_2O$.

(Wyrouboff.)

Magnesium ——, $Mg_2H_4SiW_{12}O_{42}+16H_2O$.

Stable on the air. (Marignac.)

Mercurous silicotungstate, basic, $Hg_4SiW_{12}O_{40}$, $2Hg_2O+5H_2O$.

Insol. in H_2O. Insol. in dil. HNO_3. Slowly sol. in conc. warm. HNO_3. (Wyrouboff.)

Mercurous ——, $Hg_8SiW_{12}O_{42}$.

Insol. in H_2O. Scarcely sol. in dil. HNO_3+Aq. (Marignac, A. ch. (4) **3.** 43.)

Mercuric ——, $Hg_2SiW_{12}O_{40}+15H_2O$.

Very sol. in H_2O. Solution decomp. on boiling. (Wyrouboff.)

Potassium ——, basic, $K_4SiW_{12}O_{40}$, $4KOH+12H_2O$.

1 pt. is sol. in 10 pts. H_2O at 18°. (Wyrouboff.)

Potassium ——, $K_8SiW_{12}O_{42}+14H_2O$.

Sol. in 10 pts. H_2O at 18°, and less than 3 pts. at 100°. (Marignac.)

$+20H_2O$. Much less sol. in cold than hot H_2O. Extremely sol. in hot H_2O. More sol. than above comp. (Marignac.)

$K_4H_4SiW_{12}O_{42}+7H_2O$. Solubility as preceding salt.

$K_4H_4SiW_{12}O_{42}+16H_2O$. Sol. in 3 pts. H_2O at 20°.

$K_6H_{19}(SiW_{12}O_{42})_2+25H_2O$. Decomp. by dissolving in H_2O. (Marignac.)

$K_4SiW_{12}O_{40}+6$ and $15H_2O$. (Wyrouboff.)

$K_4SiW_{12}O_{40}$, $K_2H_2SiW_{12}O_{40}+29H_2O$. (Wyrouboff.)

Rubidium ——, $Rb_8SiW_{12}O_{42}$.

Sol. in 145–150 pts. H_2O at 20° and in 19–20 pts. at 100°. Insol. in alcohol; difficultly sol. in acidified, but extremely easily in ammoniacal H_2O. (Godeffroy, B. **9.** 1363.)

$Rb_2H_2SiW_{12}O_{40}+5H_2O$. (Wyrouboff.)

$Rb_4SiW_{12}O_{40}$, $Rb_2H_2SiW_{10}O_{40}+22H_2O$. (Wyrouboff.)

Silver ——, $Ag_4H_4SiW_{12}O_{42}+7H_2O$.

Very sl. sol. in H_2O; sol. in dil. HNO_3+Aq. (Marignac.)

Sl. sol. in H_2O. (Wyrouboff.)

Sodium ——, basic, $Na_4SiW_{12}O_{40}$, $4NaOH+5H_2O$.

(Wyrouboff.)

Sodium ——, $Na_8SiW_{12}O_{42}+7H_2O$.

The saturated solution at 19° contains 0.21 pt. H_2O to 1 pt. of the salt dried at 100°, and has sp. gr. = 3.05. (Marignac.)

$Na_4H_4SiW_{12}O_{42}+11H_2O$. Stable on air.

$+18H_2O$. Efflorescent. (Marignac.)

$Na_2H_6SiW_{12}O_{42}+14H_2O$. Decomp. by dissolving in H_2O. (Marignac.)

$Na_4SiW_{12}O_{40}+14$, 16 and $20H_2O$. (Wyrouboff.)

Sodium silicotungstate nitrate, $3Na_4H_4SiW_{12}O_{42}$, $4NaNO_3+39H_2O$.
Slightly deliquescent. (Marignac.)

Strontium ——, $Sr_2SiW_{12}O_{40}+16$, 17 23 and $27H_2O$.
(Wyrouboff.)

Thallium ——, $Tl_2H_2SiW_{12}O_{40}+9H_2O$.
(Wyrouboff.)

Thorium ——, **basic.**
Insol. in H_2O. (Wyrouboff.)

Thorium ——, $Th_2SiW_{12}O_{40}+27H_2O$.
Very sol. in H_2O. (Wyrouboff.)
$Th_2SiW_{12}O_{40}$, $2H_4SiW_{12}O_{40}+45H_2O$. (Wyrouboff.)

Uranium ——.
Thirteen salts are described by Wyrouboff.

Uranyl ——.
Seven salts are described by Wyrouboff.

Zinc ——, $Zn_2SiW_{12}O_{40}+18$, 27 and $29H_2O$.
(Wyrouboff.)

Silicovanadiomolybdic acid.

Ammonium silicovanadiomolybdate, $3(NH_4)_2O$, SiO_2, V_2O_5, $9MoO_3+20H_2O$.
Sp. gr. of sat. solution containing 0.32016 g. salt in 1 ccm. at 18° = 1.21322. (Friedheim, B. 1900, **33.** 1624.)
$3(NH_4)_2O$, SiO_2, V_2O_5, $10MoO_3+21H_2O$. Sp. gr. of sat. solution containing 0.35026 g. of salt in 1 ccm. at 18° = 1.25275. (Friedheim.)
$3(NH_4)_2O$, V_2O_5, SiO_2, $11MoO_3+27H_2O$. Sp. gr. of sat. solution containing 0.38086 g. salt in 1 ccm. at 18° = 1.29266. (Friedheim.)
$3(NH_4)_2O$, V_2O_5, SiO_2, $15MoO_3+24H_2O$. Sp. gr. of sat. solution containing 0.48997 g. salt in 1 ccm. at 18° = 1.43761. (Friedheim.)

Ammonium potassium ——, $(NH_4)_2O$, $2K_2O$, SiO_2, V_2O_5, $9MoO_3+20H_2O$.
Sp. gr. of sat. solution containing 0.24021 g. salt in 1 ccm. at 18° = 1.17031. (Friedheim.)
$(NH_4)_2O$, $2K_2O$, SiO_2, V_2O_5, $10MoO_3+21H_2O$. Sp. gr. of sat. solution containing 0.25914 g. salt in 1 ccm. at 18° = 1.19184. (Friedheim.)
$(NH_4)_2O$, $2K_2O$, SiO_2, V_2O_5, $11MoO_3+12H_2O$. Sp. gr. of sat. solution containing 0.27914 g. salt in 1 ccm. at 18° = 1.21378. (Friedheim.)

Ammonium zinc ——, $4(NH_4)_2O$, $2ZnO$, $2SiO_2$, $3V_2O_5$, $18MoO_3+15H_2O$.
Sl. sol. in H_2O. (Blum, Dissert. **1904.**)

Silicovanadiotungstic acid.

Ammonium silicovanadiotungstate, $3(NH_4)_2O$, SiO_2, V_2O_5, $9WO_3+24H_2O$.
Can be cryst. from H_2O. (Friedheim, B. 1902, **35.** 3244.)
$(NH_4)_7SiV_2W_{10}O_{40}+21H_2O$. 1 cc. of sat. solution in H_2O at 17.5° contains 0.6652 g. of the hydrated salt. Sp. gr. of this solution = 1.4505. Decomp. by conc. acid and alkali. (Friedheim.)

Ammonium barium potassium ——, $(NH_4)_2K_2BaSiV_2W_{10}O_{40}+25H_2O$.
Sl. sol. in H_2O. Decomp by conc. acids and alkalies. (Friedheim.)

Ammonium potassium ——, $(NH_4)K_6SiV_2W_{10}O_{40}+23H_2O$.
1 ccm. of sat. solution at 17.5° contains 0.5072 g. of the salt. Sp. gr. of the solution at 20° = 1.3462. Can be cryst from H_2O. Decomp. by conc. acids and alkalies. (Friedheim.)

Barium ——, $Ba_3SiV_2W_{10}O_{40}+28H_2O$.
1 ccm. of the sat. solution in H_2O at 17.5° contains 0.0384 g. of the salt. Sp. gr. of the solution = 1.0307. Decomp. by conc. acids and alkalies. (Friedheim, B. 1902, **35.** 3245.)
$6BaO$, $2SiO_2$, $3V_2O_5$, $18WO_3+50H_2O$. Sl. sol. in H_2O. (Friedheim.)
$7BaO$, $2SiO_2$, $3V_2O_5$, $18WO_3+83H_2O$. Sl. sol. in H_2O. (Friedheim.)

Potassium ——, $K_6SiV_2W_{10}O_{40}+22H_2O$.
Sol. in H_2O. Can be cryst. from H_2O without decomp. Decomp. by conc. acids and alkalies. (Friedheim.)
$6K_2O$, $2SiO_2$, $3V_2O_5$, $18WO_3+31H_2O$. Sol. in H_2O. (Friedheim.)
$7K_2O$, $2SiO_2$, $3V_2O_5$, $18WO_3+42H_2O$. Sol. in H_2O. (Friedheim.)

Sodium ——, $Na_6SiV_2W_{10}O_{40}+29H_2O$.
Very sol. in H_2O. Decomp. by conc acids and alkalies. (Friedheim.)

Silundum, Si_xC_y.

Not attacked by hot Cl or conc. acids. (Amberg, Z. Elektrochem. 1909, **15.** 725.)

Silver, Ag.

Not attacked by H_2O. Absolutely insol. in HCl or $HC_2H_3O_2$+Aq. (Lea, Sill. Am. J. **144.** 444.) Easily sol. in HNO_3+Aq on warming, if not too conc. Only a minute trace is dissolved in an hour by cold dil. HNO_3+Aq (1 pt. HNO_3+Aq of sp. gr. 1.40 : 10 pts. H_2O). (Lea.) Sol. in hot conc. H_2SO_4 with evolution of SO_2. Sl. sol. in dil. H_2SO_4+Aq (1 : 4), but with more dil. H_2SO_4+Aq the different forms of Ag behave differently. (Lea.)
Sol. in HI+Aq at ordinary temperature.

Sol. in KI+Aq with access of air. Sol. in hot KCN+Aq. (Christomanos, Z. anal. **7.** 301.)

Sol. in chromic, iodic, chloric and bromic acids. Dil. H_2SO_4 alone is incapable of dissolving finely divided Ag, and the seeming solvent action is due to the oxygen of the air, oxygen dissolved in the acid, or derived from some external source. (Hendrixson, J. Am. Chem. Soc. 1903, **25.** 637.)

Boiling H_2SO_4 dissolves pure Ag only when concentration equals 60° B. More dil. acid dissolves only the impure metal. (Pannani, Gazz. ch. it. 1909, **39.** (2) 234.)

Slowly decomp. into AgCl by alkali chlorides+Aq; also by $CuCl_2$, etc.+Aq.

Somewhat sol. in NH_4OH+Aq in presence of O. (Lea, Sill. Am. J. **144.** 444.)

Sol. in $KMnO_4$+dil. H_2SO_4+Aq. (Friedheim, B. **20.** 2554.)

Sol. in $Fe_2(SO_4)_3$+Aq, especially on heating, but completely insol. in $FeSO_4$+Aq. (Vogel.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Allotropic forms—(α). Very sol. in H_2O. Solution is pptd. by saline solutions or almost any neutral substance. Alkali sulphates, nitrates, and citrates ppt. it in a sol. form, while $MgSO_4$, $CuSO_4$, $FeSO_4$, $NiSO_4$, $K_2Cr_2O_7$, $K_4Fe(CN)_6$, $Ba(NO_3)_2$, and even $AgNO_3$+Aq ppt. it in an insol. form, which, however, may be made sol. again by treatment with many substances, as $Na_2B_4O_7$, K_2SO_4, or Na_2SO_4+Aq. $NaNO_2$+Aq ppts. the Ag from its solution in a perfectly insol. form.

(β). The ppt. from aqueous solution by salts is sol. in NH_4OH+Aq. (Lea, Sill. Am. J. **137.** 476.)

Many other allotropic forms exist. (Lea.)

Pure colloidal silver is also sol. in alcohol. Schneider, B. **25.** 1164.)

Entirely sol. in H_2O, even when dry. (Schneider, Z. anorg. 1894, **7.** 339.)

Silver acetylide, Ag_2C_2.

Sol. in KCN+Aq with evolution of C_2H_2. Decomp. by HCl+Aq. (Arth, C. R. 1897, **124.** 1535.)

Silver amide, $AgNH_2$.

Ppt.; sol. in ammonium salts+Aq and in excess of potassium amide. Sol. in liquid NH_3. Insol. in Ag salts+Aq. (Franklin, J. Am. Chem. Soc. 1905, **27.** 833.)

Sol. in excess of KNH_2. (Franklin, Z. anorg. 1905, **46.** 16.)

Silver antimonide, Ag_2Sb or Ag_4Sb.

Min. ***Discrasite.*** Sol. in HNO_3+Aq. Ag_3Sb. Insol. in HCl+Aq; decomp. by HNO_3+Aq. (Christofle.)

Silver azoimide, AgN_3.

Insol. in hot or cold H_2O or dil. acids; sol. in conc. mineral acids. Sol. in NH_4OH+Aq. (Curtius, B. **23.** 3023.)

Silver bromide, AgBr.

Insol. in H_2O, or H_2O acidulated with HNO_3, H_2SO_4, or $HC_2H_3O_2$ between 0° and 33°. If flocculent or pulverulent, it is sensibly sol. therein above 33°, but if granular only above 50°, and then very slightly. (Stas, A. ch. (5) **3.** 289.) Ag can be detected as AgBr in 10,000,000 pts. H_2O. (Stas.)

Calculated from the electrical conductivity of AgBr+Aq, AgBr is sol. in 1,971,658 pts. H_2O at 20.2°, and 775,400 pts. at 38°. (Holleman, Z. phys. Ch. **12.** 133.)

By same method Kohlrausch and Rose calculate that 1 l. H_2O dissolves 0.4 mg. AgBr at 18°. (Z. phys. Ch. **12.** 240.)

Solubility in H_2O = 0.109 mg. per l. (Prudhomme, J. chim. Phys. **9.** 519.)

Solubility in $H_2O = 6.6 \times 10^{-7}$ at 25°. (Goodwin, Z. phys. Ch. 1894, **13.** 645.)

Solubility of AgBr in H_2O at 25° equals 8.1×10^{-7} g. mols. per l. (Thiel, Z. anorg. **1900. 24.** 57.)

Aq. solution sat. at 21.1° contains 0.57×10^{-6} gr. equiv. per litre. (Kohlrausch, C. C. **1901,** II. 1299.)

1 l. H_2O dissolves 0.000137 g. AgBr at 25°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

0.84×10^{-4} g. are dissolved per liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O dissolves 0.107 mg. AgBr at 21°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

3.7 mg. AgBr are contained in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1906, **56.** 93.)

1 mg. in 1 l. of sat. solution at 21°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Solubility in $H_2O = 8.8 \times 10^{-7}$ g. mol. per litre at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, **30.** 74.)

Boiling H_2O dissolves 0.000003502 of its weight of AgBr. HNO_3+Aq (1% HNO_3) dissolves 0.00000543 of its weight of AgBr at 100° with sl. decomposition. The solution is pptd. by $AgNO_3$+Aq or HBr (or MBr)+Aq, but not completely. 1 pt. of AgBr in solution requires 3 pts. of Br as MBr (or HBr), or of Ag as $AgNO_3$ in order to be wholly precipitated. (Stas.)

Not attacked by boiling HNO_3+Aq; sl. sol. in conc. HBr or HCl+Aq (Löwig). Boiling conc. H_2SO_4 decomposes it (Balard), hardly acts on it (Dumas), dissolves a small quantity, which is repptd. by H_2O (Berzelius.)

Very sl. sol. in dil., easily in conc. NH_4OH+Aq. 100 pts. NH_4OH+Aq (0.986 sp. gr.) dissolve 0.51 pt. AgBr (dried at 100°) at 80°, and about double that amount of freshly pptd. AgBr. (Pohl, W. A. B. **41.** 267.)

1 g. freshly pptd. AgBr is sol. in 250 ccm. 10% NH_4OH+Aq, but insol. in an ammoniacal solution of AgCl. (Seiner, Pharm. J. Trans. (3) **14.** 1.)

1 g. AgBr dissolves in 8779.4 g. 5% NH_4OH+Aq (sp. gr. = 0.998) at 12°, and in 288.5 g.

10% NH_4OH+Aq (sp. gr.=0.96) at 12°. (Longi, Gazz. ch. it. **13.** 87.)

Solubility of AgBr in NH_4OH+Aq at 15°.
G. mols. per l.

NH_3	AgBr	Sp. gr. 15.5°
1.085	0.0011	0.9932
2.365	0.0031	0.9853
3.410	0.0050	0.9793
4.590	0.0074	0.9720
5.725	0.0101	0.9655

(Bodländer, Z. phys. Ch. 1892, **9.** 734.)

Solubility in NH_4OH+Aq at 0°.

10 ccm. of the solution contain g. NH_3 and mg. Ag Br.

g. NH_3	Mg. AgBr	g. NH_3	Mg. AgBr
0.307	8.0	2.627	106.7
0.488	9.6	3.126	156.8
0.669	17.2	3.389	198.7
0.829	21.2	3.652	266.9
1.151	34.9	3.722	288.8
1.532	55.7	3.770	293.0
1.809	72.2	3.926	289.2
1.953	74.1	3.995	285.0

(Jarry, A. ch. 1899, (7) **17.** 364.)

Solubility of AgBr in NH_4OH+Aq at 25°.
G. mols. per l.

NH_3	AgBr	NH_3	AgBr
0.1932	0.00060	1.965	0.00692
0.3849	0.00120	3.024	0.01163
0.7573	0.00223	5.244	0.02443

(Bodländer and Fittig, 1902, Z. phys. Ch. **39.** 597.)

Solubility in NH_4OH+Aq at 25°.

g. at. Ag per l.	Mols. NH_3 per l.
0.00170	0.450
0.00159	0.497
0.000941	0.268
0.00107	0.273
0.000391	0.115
0.000386	0.118
0.000276	0.0764
0.000264	0.0777

(Whitney and Melcher, J. Am. Chem. Soc. 1903, **25.** 79.)

Sol. in hot NH_4Cl+Aq. Very sl. sol. in NH_4 carbonate, sulphate, or succinate+Aq, and still less in nitrate. (Wittstein.) Not very easily sol. in $Na_2S_2O_3$+Aq when suspended in much H_2O, and is separated out again by KBr+Aq. (Field, C. N. **3.** 17.)

Sol. in KCN+Aq. Sl. sol. in conc. KCl, KBr, NaCl, NaBr, NH_4Cl, or NH_4Br+Aq; but insol. when dilute.

Traces only dissolve in alkali nitrates+Aq. (Fresenius, Quant. Anal.)

Abundantly sol. in $Hg(NO_3)_2$+Aq. 100 ccm. H_2O containing 10 ccm. normal $Hg(NO_3)_2$+Aq dissolve 0.0383 g. AgBr. (Stas.)

Solubility of AgBr in $Hg(NO_3)_2$+Aq at 25°.
G. mols. per l.

$Hg(NO_3)_2$ HNO_3	AgBr	$Hg(NO_3)_2$ HNO_3	AgBr
1	0.03660	0.025	0.00459
0.10	0.00873	0.0125	0.00329
0.05	0.00639	0.0100	0.00306

HNO_3 was present in all cases, and it was found that there was no difference in solubility of AgBr with concentrations between 0.1N and 2N HNO_3. Cryst. and amorphous AgBr showed the same solubility. (Morse, Z. phys. Ch. 1902, **45.** 708.)

Difficultly sol. in hot conc. $AgNO_3$+Aq. (Risse, A. **111.** 39.)

100 ccm. of a 3–N solution of $AgNO_3$ dissolve 0.04 g. AgBr at 25°. Much less sol. in $AgNO_3$+Aq than AgI. (Hellwig, Z. anorg. 1900, **25.** 176.)

Solubility in $AgNO_3$+Aq.

Volumetric measurements

$AgNO_3$	N/10 KBr ccm.	Opal-escent at	G. AgBr retained per 100 g. $AgNO_3$
10 g. made up to 32 g. per 100 g. of solution	0.65	22°	0.129
	0.72	35	0.144
	0.8	44	0.159
	0.9	62	0.178
	1.0	67	0.188
	1.1	77	0.207
	1.2	79	0.226
10 g. made up to 70 g. per 100 g. of solution	6.0	37	1.13
	8.0	53	1.50
	10.0	67	1.88
	11.25	72	2.12
	12.0	74	2.26
	12.75	79	2.40
	13.5	82	2.54
	15.5	85.5	2.92
	17.5	90	3.29

Gravimetric measurements at 14.5°

G. $AgNO_3$	ccm. H_2O	Strength of $AgNO_3$ %	G. AgBr retained per 100 g. $AgNO_3$
7.326	9.32	44	0.144
8.290	7.65	52	0.185
7.255	4.84	60	0.283
7.35	3.95	65	0.365

(Lowry, Roy. Soc. Proc. 1914, **91.** A, 65.)

100 g. KBr in conc. KBr+Aq dissolve 3019 mg. AgBr at 15°; 95 g. NaCl+10 g. KBr dissolve only 75 mg. AgBr at 15°. (Schierholz, W. A. B. **101, 2b.** 4.)

Solubility in KBr+Aq at 25°.

Mol. KBr in 1 litre	G. AgBr in 1 litre
4.864	26.44
4.44	17.95
4.18	13.50
3.68	7.50
2.81	2.34
2.76	2.20

(Hellwig, Z. anorg. 1900, **25.** 183.)

Sol. in conc. KBr or NaBr+Aq (Lowig), but less than AgI in KI+Aq (Field).

100 g. NaCl in conc. NaCl+Aq dissolve 474 mg. AgBr at 15°; 100 g. NaCl in 21% NaCl+Aq dissolve 188 mg. AgBr at 15°. (Schierholz, W. A. B. **101, 2b.** 4.)

Solubility of AgBr in Na_2SO_3+Aq at 25°. G. formula weights per l.

SO_3	Ag	SO_3	Ag
0.232	0.0025	0.466	0.0053
0.406	0.0023	0.474	0.0055
0.448	0.0023	0.675	0.0084

(Luther and Leubner, Z. anorg. 1912, **74.** 393.)

Solubility of AgBr in Na_2SO_3 at (?)°. (g. salts per l. of solution.)

Na_2SO_3	AgBr	Na_2SO_3	AgBr
83.75	0.790	2.08	0.0159
70.75	0.570	1.13	0.0086
38.2	0.265	0.59	0.0045
17.65	0.116	0.3	0.0039
9.47	0.0526	0.17	0.0022
4.85	0.0329	0.08	0.00075

(Mees and Piper, Photog. J. 1912, **36.** 234.)

Solubility in $Na_2S_2O_3$+Aq at 35.°

g. $Na_2S_2O_3$ in 1 liter	g. AgBr corresponding to each g. $Na_2S_2O_3$.
100	0.376
200	0.390
300	0.397
500	0.427

(Richards and Faber, Am. Ch. J. 1899, **21.** 169.)

$(NH_4)_2S_2O_3$+Aq. dissolves AgBr more rapidly than does $Na_2S_2O_3$+Aq. (Lumiére and Seyewitz, C. C. **1908,** II. 1138.)

Solubility in salts+Aq.

Solvent	% Conc.	Grams AgBr sol. in 100 grams solvent	
Sodium thiosulphate	1	0.35	20°
" " "	5	1.90	
" " "	10	3.50	
" " "	15	4.20	
" " "	20	5.80	
Sodium sulphite	10	0.04	25°
" "	20	0.08	
Ammonium sulphite	10	Traces	
Potassium cyanide	5	6.55	20°
Ammonium sulphocyanide	5	0.21	
" " "	10	2.04	
" " "	15	5.30	
Potassium " "	10	0.73	25°
Calcium " "	10	0.53	
Barium " "	10	0.35	
Aluminum " "	10	4.50	
Thiocarbamide	10	1.87	
Thiosinamine	1	0.08	
"	5	0.35	
"	10	0.72	

(Valenta, M. 1894, **15.** 250.)

Solubility of AgBr in salts+Aq at (?)°. (G. AgBr sol. in 1 l. of 1% solution of salts.)

NaSCN	2.06
NH_4SCN	0.03
$(NH_4)_2CO_3$	0.004
Na_2SO_4	0.055

(Mees and Piper, Photog. J., 1912, **36.** 234.)

In a solution of $NaC_2H_3O_2$+Aq, containing 10 ccm. of sat. $NaC_2H_3O_2$+Aq at 15° and 20 ccm. normal $HC_2H_3O_2$+Aq mixed with 970 ccm. H_2O, about double the amt. of flocculent AgBr is dissolved in the cold that is dissolved by boiling H_2O from granular AgBr. This solution required 3 pts. of Ag or Br to ppt. the AgBr in solution. Pulverulent or granular AgBr are wholly insol. in dil. or conc. acetates+Aq. (Stas.)

Sol. in $Hg(C_2H_3O_2)_2$+Aq.

100 ccm. H_2O containing 10% of normal $Hg(C_2H_3O_2)_2$+Aq dissolves 0.0122 g. AgBr at 20°. (Schierholz.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Solubility in 10 cc. methylamine+Aq of different concentrations at 11.5.°

g. NH_2CH_3	4.844	4.311	3.562	3.258
mg. AgBr	289	127	73	55
g. NH_2CH_3	1.797	1.513	1.317	1.101
mg. AgBr	28	16	12	7

(Jarry, A. ch. 1899, (7) **17.** 378.)

Solubility in methylamine+Aq at 25°.

G. mol. per l.	
CH_3NH_2	AgBr
0.02	0.00026
0.04	0.00034
0.074	0.000395
0.0947	0.00041
0.1950	0.00045

(Wuth, B. 1902, **35.** 2416.)

Solubility of AgBr in methylamine+Aq at 25°.

G. mol. per l.			
CH_3NH_2	AgBr	CH_3NH_2	AgBr
1.017	0.0025	0.102	0.00026
0.508	0.0013	0.051	0.00012
0.203	0.00049		

(Bodländer and Eberlein, B. 1903, **36.** 3948.)

Solubility in ethylamine+Aq at 25°.

G. mol. per l.	
$C_2H_5NH_2$	AgBr
0.01272	0.0000867
0.03942	0.000137
0.05512	0.000193
0.06572	0.000258
0.10300	0.000711

(Wuth, B. 1902, **35.** 2416.)

At 25°, 1 l. ethylamine+Aq containing 0.483 g. mol. $C_2H_5NH_2$ dissolves 0.00231 g. mol. AgBr; 0.200 g. mol. $C_2H_5NH_2$, 0.0097 g. mol. AgBr. (Bodländer and Eberlein, B. 1903, **36.** 3948.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Insol. in acetone. (Eidmann, C. C. **1899,** II, 1014); (Naumann, B. 1904, **37.** 4329.)
Sol. in alcoholic thiourea. (Reynolds, Chem. Soc. 1892, **61.** 251.)
Insol. in methyl acetate. (Bezold, Dissert. **1906**); (Naumann, B. 1909, **42.** 3790.) ethyl acetate. (Hamers, Dissert. **1906**); (Naumann B. 1910, **43.** 314.)
1.49 g. AgBr is dissolved in 1 l. of 1% thiocarbamide+Aq. (Mees and Piper, Photog. J. 1912, **36.** 239.)
Insol. in warm pyridine.
Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, **15.** 16.)
Min. *Bromyrite, Bromite.*

Silver bromide ammonia, AgBr, NH_3.
(Joannis and Crozier, C. R. 894, **118.** 1150.)
AgBr, $1\frac{1}{2}NH_3$. (Jarry, A. ch. 1899, (7) **17.** 356.)
2AgBr, $3NH_3$. (Joannis and Crozier.)
AgBr, $3NH_3$. Decomp. by H_2O. Sl. sol. in liquid NH_3. (Jarry.)
AgBr, $5NH_3$. (Jarry, C. R. 1898, **126.** 1141.)

Silver carbide, Ag_4C.
(Gay-Lussac.)
Ag_2C(?). Sol. in HNO_3+Aq with residue of C (Liebig, A. 38. 129.)
Ag_2C_2. Sol. in HNO_3+Aq with residue of C. (Regnault, A. **19.** 153.)

Silver subchloride, Ag_4Cl_3.
NH_4OH+Aq dissolves the greater part, the residue (20%) being sol. in HNO_3+Aq. KCN dissolves the greater part; H_2SO_4 dissolves about 2%; acetic acid and KOH are without action. (Bibra, J. pr. 1875, (2) **12.** 52.)

Argentous chloride, Ag_2Cl.
Obtained in a pure state by Guntz (C. R. **112.** 861). Dil. HNO_3+Aq does not attack but warm conc. HNO_3+Aq decomp. Easily sol. in KCN+Aq. (Guntz, C. R. **112.** 1212.)
The following data are for a more or less impure Ag_2Cl.

Boiling conc. HCl+Aq, NaCl+Aq, or NH_4OH+Aq dissolve out AgCl, and leave Ag. (Scheele, Wetzlar, Dulk, Wöhler.)
According to Berthollet, wholly sol. in NH_4OH+Aq. Sol. for the most part in NH_4OH+Aq, and the residue is sol. in HNO_3+Aq (=Ag+AgCl). (v. Bibra, B. 7. 741.)

Silver chloride, AgCl.
Nearly insol. in H_2O.
When AgCl is left in contact for some hours with pure H_2O at 20-22°, and especially at 75°, traces go into solution; more Cl is dissolved than Ag. When 1 pt. Ag is pptd. as AgCl in presence of 1 million pts. H_2O a slight bluish milkiness is observed; but in order to have a distinct ppt. 4 pts. Ag should be present.
Dil. HNO_3+Aq does not increase the solubility of AgCl, but AgCl is not absolutely insol. in stronger HNO_3+Aq. (Mulder.)
1 pt. $AgNO_3$, when mixed with HCl+Aq in presence of 120,000 (Pfaff), 240,000 (Harting), pts. H_2O, causes an opalescence.
1 pt. Ag gives a slight turbidity with HCl+Aq in presence of 200,000 pts. H_2O, a scarcely opalescent cloudiness with 400,000 pts. H_2O, and the same after the lapse of 15 minutes in presence of 800,000 pts. H_2O. (Lassaigne.)
1 pt. Ag can be detected as AgCl in 1 million parts H_2O at ordinary temp., but not in 2 million parts. In $NaNO_3$+Aq containing 0.79 pt. $NaNO_3$ in 200,000 pts. H_2O, 1 pt. Ag can be detected as AgCl. This dissolves at 75°, and is visible again on cooling.
If the same liquid contains 1574 pts. $NaNO_3$, the AgCl remains in solution after cooling.

In 100 ccm. H_2O containing 0.787 g. $NaNO_3$, 13 drops of NaCl and silver solution, each drop of which contains 0.05 mg. Ag, cause a precipitate at 5°, 20 drops at 15-17°, 60 drops at 45-55°.

AgCl is somewhat less sol. in HNO_3+Aq than in $NaNO_3$+Aq when the amount of H_2O remains the same.

Therefore, if HCl is used instead of NaCl, about 1/7 less AgCl remains in solution.

In 100,000 pts. of H_2O, which contain HNO_3 and an amount of HCl corresponding to the amount of Ag salt, 1.596 pts. AgCl dissolve at 25°. The solution is precipitated by either $AgNO_3$ or HCl. (Mulder, Silber Probirmethode, Leipzig, **1859.** 62.)

(For further older data, see Storer's Dictionary.)

White flaky AgCl is appreciably sol. in hot H_2O, 1000 ccm. boiling H_2O dissolving about 2 mg. AgCl. Far less sol. in H_2O containing $AgNO_3$, being practically insol. in H_2O containing 0.1 g. $AgNO_3$ in a litre. Solubility is also diminished one-half by addition of HCl. (Cooke, Sill. Am. J. (3) **21.** 220.)

Solubility in H_2O rapidly diminishes as the temp. falls. (Cooke, *l. c.*)

Not completely insol. in H_2O. According to Stas (C. R. **73.** 998) there are four modifications: (1) gelatinous; (2) cheesy-flocculent; (3) pulverulent; (4) granular, crystalline, or fused. (4) is almost absolutely insol. in H_2O at the ordinary temp., but the solubility increases with the temp., and is considerable at 100°; (2), which is formed by the precipitation of a cold dilute Ag solution, has the greatest solubility in pure H_2O, and it changes its solubility by standing, or if made pulverulent by shaking with H_2O; (3) is also sol. in H_2O; the solution of (2) or (3) in pure H_2O, or H_2O acidified with HNO_3, is precipitated by $AgNO_3$ or NaCl+Aq.

In order to ppt. 1 pt. AgCl in above solution 3 pts. of Cl as chloride or Ag as nitrate are necessary; the pptn. is then complete.

Solubility of granular variety in boiling H_2O is proportionately large, and pptn. is brought about by 3 pts. Cl or Ag as above, but the pptn. in this case is not complete.

The salts formed simultaneously with the AgCl have no influence on the solubility of the AgCl. Presence of HNO_3 does not increase the solubility of (2), but has that effect on (3) in proportion to the amt. of HNO_3 present. (Stas, C. R. **73.** 998.)

Further determination by Stas are as follows:—

Between 0° and 30° granular AgCl is insol. in pure H_2O, or H_2O acidulated with HNO_3.

Between 0° and 30° the flocculent and pulverulent forms of AgCl dissolve without alteration in pure H_2O, in acidulated H_2O, in alkali acetates+Aq, and in $Hg(C_2H_3O_2)_2$ +Aq containing an alkali acetate. Their degree of solubility is a function of the state of the chloride, of the temp., and of the nature and quantity of the solvent within these limits of temp. (0°-30°). These solvents, if they contain either Ag in the state of an Ag salt, or Cl as chloride or HCl in an amount *three times* that which they can dissolve as AgCl, exercise no solvent action on any of the modifications of AgCl. And reciprocally sat. AgCl+Aq is pptd. instantly by a decinormal solution of $AgNO_3$ or MCl (or HCl). The AgCl is wholly pptd. when the quantity of the Ag or Cl thus added is equal to three times the quantity of the Ag or Cl dissolved as AgCl.

Between 50° and 100°, however, decinormal solutions of Ag or chlorides, which cause instant ppts. in solutions sat. with any of the modifications of AgCl, do not eliminate all the dissolved AgCl. At 100°, they only ppt. 60% of the amt. dissolved. (Stas, A. ch. (5) **3.** 323.)

Calculated from electrical conductivity of AgCl +Aq, AgCl is sol. in 715,800 pts. H_2O at 13.8°, and 384,100 pts. at 26.5°. (Holleman, Z. phys. Ch. **12.** 132.)

Calculated in the same way, 1. l. H_2O dissolves 0.76 mg. at 2°; 0.97 mg. at 10°; 1.52 mg. at 18°; 2.24 mg. at 26°; 3.03 mg. at 34°; 4.05 mg. at 42°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 242.)

Solubility in $H_2O = 1.25 \times 10^{-5}$ mol./l. at 25°. (Goodwin, Z. phys. Ch. 1894, **13.** 645.)

Solubility of AgCl in H_2O at 25° is 1.41×10^{-5} (in normality). (Thiel, Z. anorg. 1900, **24.** 57.)

2.16×10^{-5} moles are sol. in 1 liter H_2O at 25°. (Noyes and Kohr, Z. phys. Ch. 1903, **42.** 341.)

1.53×10^{-3} g. per liter are dissolved in sat. aq. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O dissolves 1.6 mg. AgCl at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

21.8 milligrams are dissolved in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1906, **56.** 93.)

1.34 mg. are contained in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

1 l. sat. solution at t° contains mg. AgCl.

t°	mg. AgCl	t°	mg. AgCl
1.55	0.56	17.51	1.31
4.68	0.66	25.86	1.935
9.97	0.89	34.12	2.74

(Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Solubility in $H_2O = 1.6 \times 10^{-5}$ g.-mol. per litre at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, **30.** 74.)

1 l. H_2O dissolves 0.00154 g. AgCl at 21°; 0.0217 g. at 100°. (Whitby, Z. anorg. 1910, **67.** 108.)

Calculated from electrical conductivity of AgCl+Aq, 1 l. H_2O dissolves:

0.0105 milli-equivalents AgCl at 18°.
0.0365 " " " " 50°.
0.147 " " " " 100°.

(Melcher, J. Am. Chem. Soc. 1910, **32.** 55.)

1 l. H_2O dissolves 1.02×10^{-5} g. equiv. at 18°; 1.429×10^{-5} g. equiv. at 25°. (van Rossen, C. C. **1912,** I. 1539.)

The most probable average value for solubility of AgCl in H_2O is 1.04×10^{-5} g. equiv. per l. at 18°, and 1.43×10^{-5} g. equiv. per l. at 25°. (van Rossen, C. C. **1912,** II. 1807.)

1.20×10^{-5} g. AgCl are sol. in 1 l. H_2O at 18°. (Glowczynski, C. A. **1915,** 741.)

More sol. in H_2O than AgSCN. (Normand, Chem. Soc. 1912, **101.** 1853.)

Sol. in conc. HCl+Aq, and also when not very conc.; thus the solution of 1 pt. $AgNO_3$+Aq in 15,000 pts. H_2O is clouded by a little HCl+Aq, but clears up by the addition of more. (Reinsch, J. pr. **13.** 133.)

1 pt. AgCl dissolves in 200 pts. conc. HCl+Aq and in 600 pts. HCl+Aq diluted with 2 pts. H_2O. (Pierre, J. Pharm. (3) **12.** 237.)

Somewhat sol. in hot alcohol, to which HCl has been added, but is precipitated on cooling. (Erdmann, J. pr. **19.** 341.)

100 pts. sat. HCl+Aq (sp. gr. 1.165) dissolve 0.2980 pt. AgCl, or AgCl is sol. in 336 pts. HCl+Aq at ord. temp.; 100 pts. HCl+Aq (sp. gr. 1.165) at b.-pt. dissolve 0.56 g. AgCl, or AgCl is sol. in 178 pts. HCl+Aq.

Solubility of AgCl in dil. HCl+Aq. 100 ccm. HCl+Aq (sp. gr. 1.165), to which the given amt. H_2O has been added, dissolve g. AgCl.

ccm. HCl	ccm. H_2O	g. AgCl	Pts. HCl which dissolve 1 pt. AgCl
100	10	0.056	1,785
100	20	0.018	5,555
100	30	0.0089	11,235
100	50	0.0035	18,571

(Vogel, N. Rep. Pharm. **23.** 335.)

If HCl is added to a solution in which $^1/_{1,000,000}$ pt. Ag is suspended, the milkiness disappears. Solubility in HCl+Aq increases with the temp., the AgCl separating out on cooling. (Mulder.)

The amounts of AgCl which dissolve in HCl+Aq are directly proportional to the volumes of acid (of fixed concentration) used. (Barlow, J. Am. Chem. Soc. 1906, **28.** 1448.)

1 l. 1% HCl dissolves 0.0002 g. AgCl at 21°.
1 l. 5% HCl dissolves 0.0033 g. AgCl at 21°.
1 l. 10% HCl dissolves 0.0555 g. AgCl at 21°.
(Whitby, Z. anorg. 1910, **67.** 108.)

Solubility in HCl+Aq at 25°.

HCl g.-equivalents per l.	Ag $\times 10^{-3}$ g.-equivalents per l.
0.649	0.032
1.300	0.126
1.911	0.266
2.149	0.374
2.569	0.610
2.975	0.814
3.576	1.358
4.182	2.147
4.735	3.168
5.508	4.126

(Forbes, J. Am. Chem. Soc. 1911, **33.** 1941.)

Solubility in 20% HCl +Aq.

HCl	N/10 $AgNO_3$ ccm.	Opalescent at t°	G. AgCl to 100 g. anhydrous HCl
20 g. of 20% acid	1.0	...	...
	1.1	0.0	0.39
	2.0	29.5	0.72
	3.0	51.5	1.076
	3.75	70.0	1.346
	4.25	82.0	1.525
	4.75	90.0	1.74
	5.80	107.0	2.08

(Lowry, Roy, Soc. Proc. 1914, **91.** A. 62.)

Sl. sol. in conc. HBr+Aq. (Löwig.)

Insol. in HNO_3+Aq. (Wackenroder.)

Entirely unacted upon by HNO_3 of 1.43 sp. gr. (Wurtz, Am. J. Sci. (2) **25.** 382.)

Solubility in dil. HNO_3+Aq is the same as solubility in H_2O, *i. e.* $^1/_{2,000,000}$ pt. of Ag cannot be detected in H_2O with or without HNO_3, but $^1/_{1,000,000}$ pt. can be detected in both cases. (Mulder.)

1 pt. Ag in the form of AgCl dissolves at 25° in 83,000 pts. H_2O containing free HNO_3 and 0.33 pt. of HCl. (Mulder.)

100,000 pts. conc. HNO_3+Aq dissolve about 2 pts. AgCl, and solubility is not sensibly affected by lower nitrogen oxides. (Thorpe, Chem. Soc. (2) **10.** 453.)

Solubility of AgCl in HNO_3+Aq at 25°.

G. per liter			
HNO_3	AgCl	HNO_3	AgCl
0.0315	0.001647	18.9	0.00225
0.063	0.001705	94.5	0.0245
0.630	0.00176		

(Glowczynski, Kolloidchem. Beih. 1914, **6.** 147.)

Insol. in cold conc. H_2SO_4, but on boiling is in part decomp. and in part dissolved, and does not separate on cooling.

AgCl is not more sol. in dil. H_2SO_4+Aq than in dil. HNO_3+Aq.

Unacted upon by cold H_2SO_3+Aq, and but slightly decomp. on heating. (Vogel.)

Abundantly sol. in H_2PtCl_4+Aq without decomp. (Birnbaum, Z. Ch. **1867.** 520.)

Insol. in cold dil. caustic alkalies+Aq but decomp. by hot conc. solutions. (Gregory.)

Decomp. by K_2CO_3+Aq.

Sl. sol. in cold K_2CO_3+Aq.

Easily sol. even in dil. NH_4OH+Aq.

1 pt. AgCl dissolves in 1288 pts. NH_4OH+Aq of 0.89 sp. gr. (Wallace and Lamont, Chem. Gaz. **1893.** 137.)

100 pts. NH_4OH+Aq of 0.986 sp. gr. dissolve at 80° 1.492 pts. AgCl, dried at 100°. (Pohl, W. A. B. **41.** 627.)

1 l. NH_4OH+Aq of 0.949 sp. gr. dissolves 51.6 g. Ag as freshly precipitated AgCl, and 47.6 g. when diluted with 1 l. H_2O.

1 l. NH_4OH+Aq of 0.924 sp. gr. dissolves 58 g. Ag as freshly precipitated AgCl; 1 l. NH_4OH+Aq of 0.899 sp. gr. dissolves 49.6 g.; 0.5 l. NH_4OH+Aq (of 0.049 sp. gr.)+0.5 l. saturated NaCl+Aq dissolves 20.8 g.; 0.5 l. NH_4OH+Aq (of 0.949 sp. gr.)+0. 5 l. saturated KCl+Aq dissolves 20.4 g.; 0.5 l. NH_4OH+Aq (of 0.949 sp. gr.)+0.5 l. saturated NH_4Cl+Aq dissolves 22.4 g. Ag as freshly pptd. AgCl. (Millon and Commaille, C. R. **56.** 309.)

1 g. AgCl dissolves in 428.64 g. 5% NH_4OH+Aq (sp. gr. 0.998) at 12°; 1 g. AgCl dissolves in 12.76 g. 10% NH_4OH+Aq(sp. gr. 0.96) at 18°. (Longi, Gazz. ch. it. **13.** 87.)

1 g. freshly pptd. AgCl is sol. in 17 ccm. 10% NH_4OH+Aq. Solubility is diminished by presence of AgBr. (Senier, Pharm. J. Trans. (3) **14.** 1.)

Solubility in NH_4OH+Aq at 0°.

G. per 100 g. solution.

NH_3	AgCl	NH_3	AgCl
1.45	0.49	28.16	5.69
1.94	1.36	29.80	7.09
5.60	3.44	30.19	7.25
6.24	4.00	32.43	5.87
11.77	4.68	34.56	4.77
16.36	5.18	37.48	3.90

(Jarry, A. ch. 1899, (7) **17.** 342.)

Solubility in NH_4OH+Aq increases with the temp. (Jarry.)

Solubility in NH_4OH+Aq at 25°.

g. at. Ag per l.	Mols. NH_3 per l.	g. at. Ag per l.	Mols. NH_3 per l.
0.151	2.042	0.0140	0.253
0.149	2.017	0.0140	0.253
0.149	2.013	0.0140	0.252
0.147	1.991	0.0139	0.252
0.0616	0.961	0.00621	0.118
0.0583	0.916	0.00621	0.118
0.0584	0.909	0.00619	0.118
0.0572	0.903	0.00625	0.118
0.0569	0.896	0.00304	0.0590
0.0555	0.873	0.00297	0.0589
0.0541	0.863	0.00300	0.0585
0.0514	0.818	0.05149	0.0288
0.0249	0.428	0.00143	0.0287
0.0240	0.416	0.00142	0.0285
0.0235	0.411	0.00141	0.0282
0.0227	0.397	......	......

(Whitney and Melcher, J. Am. Chem. Soc. 1903, **25.** 78.)

Solubility of AgCl in NH_4OH+Aq at 25°.

Ag=g. at. Ag in 1000 g. H_2O.
NH_3=g. mol. NH_3 in 1000 g. H_2O.
Conc.=Molecular concentration of free NH_3.

Ag	NH_3	Conc.	Solid phase
0.023	0.437	0.391	AgCl
0.025	0.428	0.378	"
0.1197	1.700	1.461	"
0.1308	1.688	1.426	"
0.372	3.782	3.038	"
0.378	3.945	3.181	"
0.574	5.10	3.95	"
0.609	5.33	4.11	"
0.633	5.545	4.279	"
0.745	6.26	4.77	AgCl+2AgCl, $3NH_3$
0.754	6.27	4.76	"
0.757	6.25	4.74	"
0.760	6.25	4.73	"
0.775	6.52	4.97	2AgCl, $3NH_3$
0.848	8.28	6.58	"
0.968	11.19	9.25	"
0.980	11.78	9.82	"
0.978	12.23	10.27	"
0.965	12.26	10.33	"
1.03	12.68	10.62	"
1.09	12.96	10.78	"
1.049	14.34	12.24	"
1.039	14.47	12.39	"

(Straub, Z. phys. Ch. 1911, **77.** 332.)

Easily (Brett), difficultly (Wittstein), sol in NH_4Cl+Aq, but not in other NH_4 salts.

Solubility in NH_4Cl+Aq at 15°.

% NH_4Cl	% AgCl
10.0	0.0050
14.29	0.0143
17.70	0.0354
19.23	0.0577
21.98	0.110
25.31	0.228
28.45	0.340*
Sat.	0.177

*24.5°.

(Schierholz, W. A. B., 1890, **101**. 2b. 8.)

Solubility in NH_4Cl+Aq (25.31%) at t°.

t°	% AgCl
15	0.276
40	0.329
60	0.421
80	0.592
90	0.711
100	0.856
110	1.053

(Schierholz.)

At 25°, 1 l. NH_4Cl+Aq containing 0.00053 g. NH_4Cl dissolves 0.001604 g. AgCl; 0.00530 g. NH_4Cl, 0.002379 g. AgCl. (Glowczynski, Kolloidchem. Beih. 1914, **6**. 147.)

See also Forbes, page 826.

1 l. $KClO_3$+Aq dissolves 1.8 mg. (Guye, J. Chim. Phys. **10**. 145.)

Sl. sol. in conc. KCl+Aq, NaCl+Aq, and certain other chlorides.

NaCl, KCl, NH_4Cl, $CaCl_2$, $ZnCl_2$+Aq, etc., dissolve appreciable quantities of AgCl, especially if hot and concentrated, but it separates out for the most part on cooling.

Sol. in solutions of all the metallic chlorides which are sol. in H_2O, thus NaCl, KCl, $CaCl_2$, $SrCl_2$, and $BaCl_2$+Aq all dissolve AgCl, especially if hot. $MgCl_2$, NH_4Cl, and $HgCl_2$ (least) also dissolve AgCl. (Mulder.)

Sol. in conc. $CaCl_2$+Aq. (Wetzlar.)

Sol. in roscocobaltic chloride+Aq. (Gibbs and Genth.)

Insol. in $SnCl_4$, $HgCl_2$, $CuCl_2$, $ZnCl_2$, $CdCl_2$, $NiCl_2$, or $CoCl_2$+Aq. (Vogel.)

Solubility of AgCl in sat. solutions of chlorides at ordinary temperatures.

Salt	100 pts. sat. solution dissolve pts. AgCl	Pts. solution required to dissolve 1 pt. AgCl
$BaCl_2$	0.0143	6,993
$SrCl_2$	0.0884	1,185
$CaCl_2$	0.0930	1,075
NaCl	0.0950	1,050
KCl	0.0475	2,122
NH_4Cl	0.1575	634
$MgCl_2$	0.1710	584
HCl	0.2980	336

(Vogel, N. Rep. Pharm. **23**. 335.)

Experiments by Hahn give different results from those of Vogel as follows:—

Solubility in various salts+Aq.

Salt	% salt	Sat. at t°	% AgCl
KCl	24.95	19.6	0.0776
NaCl	25.96	"	0.1053
NH_4Cl	28.45	24.5	0.3397
$CaCl_2$	41.26	"	0.5713
$MgCl_2$	6.35	"	0.5313
$BaCl_2$	27.32	"	0.0570
$FeCl_2$	...	...	0.1686
$FeCl_3$	...	...	0.0058
$MnCl_2$	...	24.5	0.1996
$ZnCl_2$	...	...	0.0134
$CuCl_2$	...	24.5	0.0532
$PbCl_2$	...	"	0.0000

(Hahn, Wyandotte Silver Smelting Works, **1877**.)

1 l. 4-N KCl+Aq dissolves 0.915 g. KCl at 25°. (Hellwig, Z. anorg. 1900, **25**. 166.)

Solubility in KCl+Aq at t°.

t°	G. equiv. per l.	
	Ag×10^{-3}	KCl
1.0	1.734	3.325
25.0	2.415	3.083
35.0	2.786	2.955

(Forbes, J. Am. Chem. Soc. 1911, **33**. 1937.)

Solubility in KCl+Aq at 25°.
G. per liter.

KCl	AgCl	KCl	AgCl
0.00236	0.00184	0.01491	0.00305
0.00471	0.00218	0.02984	0.00321

(Glowczynski, Kolloidchem. Beih. 1914, **6**. 147.)

Solubility in $CaCl_2$+Aq.

t°	G. equiv. per l.	
	Ag×10^3	$\frac{CaCl^2}{2}$
1.0	0.964	3.512
25.0	1.514	3.320
35.0	1.806	3.221

(Forbes, l. c.)

Sat. $CuCl_2$+Aq at 0° dissolves 2.835 g. AgCl per l; at 100°, 8.147 g. Solubility in sat. $MgCl_2$+Aq is still greater. (Hahn, Eng. Min. J. **65**. 434.)

More sol. in $HgCl_2$+Aq than in H_2O. (Finzi, Gazz. ch. it. 1902, **32.** (2) 324.)

At 15°, 100 g. NaCl in 280 ccm. H_2O dissolve 485 mg. AgCl; 100 g. KCl in 300 ccm. H_2O dissolve 334 mg.; 100 g. NH_4Cl in 280 ccm. H_2O dissolve 1051 mg.

The solubility decreases with dilution rapidly at first until about an equal vol. of H_2O has been added, and then much more slowly to a minimum quantity, when the dilution is 1 : 10 for NaCl and KCl, and 1 : 20 for NH_4Cl.

100 g. NaCl in 280 ccm. H_2O dissolve 2170 mg. AgCl at 109°; 100 g. NH_4Cl in 280 ccm. H_2O dissolve 4000 mg. AgCl at 110°; 100 g. NaCl in 620 ccm. H_2O (14% solution) dissolve 15 mg. AgCl at 15°, and 774 mg. at 104°. (Schierholz, W. A. B. **101, 2b.** 4.)

The solubility of AgCl in NaCl+Aq decreases with diminishing concentration of NaCl+Aq. (Barlow, J. Am. Chem. Soc. 1906, **28.** 1448.)

Solubility in NaCl+Aq.

Gravimetric measurements, 15°

Strength of salt solution	G. AgCl retained per 100 g. NaCl
15% NaCl	0.063
20% NaCl	0.134
28% NaCl	0.279

Volumetric measurements

NaCl	N/10 $AgNO_3$ ccm.	Opalescent at t°	G. AgC retained per 100 g. NaCl
20 g. of 15% solution	0.25	28	0.119
	0.4	40	0.191
	0.7	64	0.335
	1.0	78	0.478
	1.25	89	0.598
	1.7	102.5	0.812
20 g. of 20% solution	0.43	17.0	0.156
	0.65	26.0	0.234
	0.82	37.0	0.295
	1.2	51.5	0.430
	1.6	67.0	0.524
	2.12	79.5	0.765
	2.52	88.5	0.910
	3.08	97.0	1.10
	3.52	105.0	1.27
20 g. of 28% solution	2.25	36.5	0.675
	2.75	45.0	0.704
	3.5	56.0	0.896
	4.5	69.0	1.153
	5.5	84.0	1.411
	6.5	94.0	1.664
	7.75	107.5	1.958

(Lowry, Roy, Soc. Proc. 1914, **91.** A, 61.)

Solubility in salts+Aq at 25°.

C = concentration of the salt in salt solution in g.-equivalents per litre.

Salt	C	$Ag \times 10^{-3}$ g.-equivalents per l.
NaCl	0.933	0.086
	1.190	0.130
	1.433	0.184
	1.617	0.245
	1.871	0.348
	2.094	0.446
	2.272	0.570
	2.449	0.684
	2.658	0.851
	2.841	1.040
	3.000	1.194
	3.270	1.583
	3.471	1.897
	3.747	4.462
	3.977	2.879
	4.170	3.335
	4.363	3.810
	4.535	4.298
	5.039	6.039
$\frac{CaCl_2}{2}$	1.748	0.289
	2.201	0.501
	2.741	0.900
	3.264	1.463
	3.737	2.182
	4.033	2.802
	4.538	4.175
	5.005	5.823
NH_4Cl	0.513	0.042
	0.926	0.113
	1.141	0.172
	1.574	0.365
	2.143	0.842
	2.566	1.425
	2.918	2.160
	3.162	2.795
	3.510	4.029
	4.363	9.353
	4.902	14.92
	5.503	24.04
	5.764	30.17
$\frac{SrCl_2}{2}$	0.550	0.033
	0.989	0.092
	1.359	0.173
	1.572	0.236
	1.698	0.284
	1.818	0.348
	2.140	0.510
	2.476	0.747
	2.992	1.252
	3.494	2.018
	4.152	3.594
	5.216	8.174
	5.775	12.04

Solubility in salts+Aq. at 25°—*Continued.*

Salt	C	$Ag \times 10^{-3}$ g.-equivalents per l.
KCl	1.111	0.141
	1.425	0.235
	1.713	0.391
	2.022	0.616
	2.396	1.050
	2.628	1.390
	2.850	1.845
	3.081	2.435
	3.424	3.602
	3.843	5.725
$\frac{BaCl_2}{2}$	1.248	0.186
	1.610	0.339
	2.676	1.274
	3.260	2.366

(Forbes, J. Am. Chem. Soc. **1911**, *33*, 1940).

Sol. in $NaNO_3$, KNO_3, $Ca(NO_3)_2$, $Mg(NO_3)_2$, and NH_4NO_3+Aq; sl. sol. at ord. temp., but solubility is much increased by heat.

Solubility in $NaNO_3$+Aq at 15-20°.

ccm. H_2O	g. $NaNO_3$	mg. AgCl dissolved
100	0.787	1.33
200	0.787	1.93
300	2.361	3.99
100	2.787	2.53

Solubility increases with ascending temp.

Temp.	ccm. H_2O	g. $NaNO_3$	mg. AgCl dissolved
5°	100	0.787	0.86
15–17°	100	0.787	1.33
18°	100	0.787	1.46
30°	100	0.787	2.33
45-55°	100	0.787	3.99

(Mulder.)

At 25°, 100,000 pts. H_2O containing a little free HNO_3 and 0.787 g. $NaNO_3$ dissolve 2.128 mg. AgCl. By adding 2 g. more $NaNO_3$ to above solution, 2.5269 mg. ($^1/_5$ more) AgCl are dissolved. (Mulder.)

Solubility in H_2O is not appreciably influenced by $^1/_{10}$ N to N–KNO_3 or NH_4NO_3+Aq. (van Rossen, C. C. **1912**, II. 1807.)

In presence of $NaNO_3$ and excess of HCl, 1 l. H_2O dissolves 0.03 mg. AgCl. (Richards and Wells.)

$Hg(NO_3)_2$+Aq dissolves considerable quantities of AgCl, but the other nitrates do not. (Mulder.)

Much more sol. in hot than in cold $Hg(NO_3)_2$+Aq, and much more sol. therein than in NH_4NO_3+Aq. NaCl ppts. AgCl from this solution; much less sol. therein in presence of $NaC_2H_3O_2$ or NH_4OH+Aq. AgCl is pptd. from above solution by $NaC_2H_3O_2$+Aq. (Mulder.)

Sol. in $Hg(NO_3)_2$+Aq (Wackenroder, A. **41.** 317); in considerable amount (Liebig, A. **81.** 128); and is precipitated by HCl, NH_4Cl, NaCl, $KC_2H_3O_2$ (Debray, C. R. **70.** 849); incompletely precipitated by $AgNO_3$ and not by HNO_3 (Wackenroder).

Solubility of AgCl in $Hg(NO_3)_2$+Aq at 25°.

(G. mols. per l.)

$Hg(NO_3)_2$ HNO_3	AgCl	$Hg(NO_3)_2$ HNO_3	AgCl
0.0100	0.00432	0.050	0.00914
0.0125	0.00499	0.100	0.01395
0.025	0.00690	1.000	0.04810

HNO_3 was present in all cases, and it was found that there was no difference in solubility of AgCl with concentrations between 0.1N and 2N HNO_3. (Morse, Z. phys. Ch. 1902, **45.** 708.)

Not sol. to appreciable extent in $Cu(NO_3)_2$, $Fe_2(NO_3)_6$, $Mn(NO_3)_2$, $Co(NO_3)_2$, $Zn(NO_3)_2$, or $Ni(NO_3)_2$+Aq; insol. or exceedingly sl. sol. in $Pb(NO_3)_2$+Aq. (Mulder.)

Imperfectly sol. in $AgNO_3$+Aq. (Wackenroder.)

Conc. $AgNO_3$+Aq dissolves AgCl perceptibly.

Less sol. in $AgNO_3$+Aq than AgBr. (Risse, A. **111.** 39.)

Solubility in 0.02N $AgNO_3$+Aq $=0.15 \times 10^{-7}$ g. mols. per l. (Böttger.)

100 ccm. of 3–N solution of $AgNO_3$ dissolve 0.08 g. AgCl at 25°. More dil. solutions dissolve very slight amounts of AgCl. (Hellwig, Z. anorg. 1900, **25.** 177.)

Solubility in 2–N $AgNO_3$+Aq at ord. temp. $=0.03 \times 10^{-3}$ g. equiv. AgCl. (Forbes, J. Am. Chem. Soc. 1912, **33.** 1946.)

Solubility in $AgNO_3$+Aq at t°.

(Det. by volumetric method.)

$AgNO_3:H_2O = 2:1$

G. $AgNO_3$	n/10 NaCl ccm.	t°	g. AgCl retained per 100 g. $AgNO_3$
6	2	57	0.478
7	2	45	0.410
8	2	40	0.359
9	2	35	0.319
11	2	30	0.261
7	1	26	0.205
10	1	22	0.143
10	4	65	0.572
10	5	86	0.715

Solubility in $AgNO_3$+Aq at t°.—*Continued.*

$AgNO_3:H_2O = 1:1$			
5	1	94	0.286
6	1	84	0.239
7	1	75	0.205
8	1	66	0.179
9	1	58	0.159
5.5	0.5	48	0.130
6.5	0.5	40	0.110
12	0.5	23	0.060
$AgNO_3:H_2O = 1:2$			
6	0.5	104	0.120
7	0.5	92	0.103
8	0.5	85	0.090
10	0.5	73	0.072
12	0.5	61	0.060
8	0.25	45	0.045
12	0.25	28	0.030

(Lowry, Roy, Soc. Proc. 1914, **91.** A. 58.)

Solubility in $AgNO_3$+Aq at 20°.
(Det. by gravimetric method.)

g. $AgNO_3$	g. H_2O	g. AgCl retained per 100 g. $AgNO_3$
220	110	0.1372
220	165	0.1009
220	220	0.0722
220	330	0.0402
220	440	0.0294

(Lowry, Roy. Soc. Proc. 1914, **91.** A, 56.)

Insol. in Na_2SO_4+Aq.

Solubility of AgCl in Na_2SO_3+Aq at 25°.
G. formula weights per l.

SO_3	Ag	SO_3	Ag
0.080	0.011	0.483 *	0.059 *
0.106	0.017	0.470	0.070
0.220	0.033	0.652	0.103
0.234	0.036	0.890	0.140
0.478 *	0.057 *	0.937	0.142

* In presence of 0.05 Cl.

(Luther and Leubner, Z. anorg. 1912, **74.** 393.)

Easily sol. in $Na_2S_2O_3$ or KCN+Aq.

When freshly pptd., very sol. in solutions of soluble thiosulphates, and especially in conc $Na_2S_2O_3$+Aq, which dissolves AgCl almost as readily as H_2O dissolves sugar. $K_2S_2O_3$+Aq, even when very dil., also dissolves AgCl; also SrS_2O_3+Aq. (Herschel, **1819.**)

Sol. in $KAsO_2$+Aq. (Reynoso.)

Cold $NaHSO_3$+Aq dissolves a considerable amount of AgCl. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 78.)

Sol. in cold sat. $(NH_4)_2S_2O_3$+Aq. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 103.)

Solubility in Na thiosulphate+Aq at 16°.

g. $Na_2S_2O_3, 5H_2O$ in 100 cc. water	g. dissolved AgCl experimental	g. dissolved AgCl calculated
2.08	0.29	0.80
4.16	0.64	1.60
6.24	0.88	2.40
8.35	1.26	3.21
16.70	2.54	6.42
20.83	3.28	7.99

(Abney, Z. phys. Ch. 1895, **18.** 65.)

A solution of $Na_2S_2O_3$+Aq containing 200 g. $Na_2S_2O_3$ per liter, dissolves 0.454 g. AgCl per g. of $Na_2S_2O_3$ at 35°. (Richards and Faber, Am. Ch. J. 1899, **21.** 170.)

Solubility in salts+Aq.

Solvent	% Conc.	Grams AgCl sol. in 100 grams solvent	
Sodium thiosulphate	1	0.40	
" " "	5	2.00	
" " "	10	4.10	
" " "	20	6.10	20°
Ammonium thiosulphate	1	0.57	
" " "	5	1.32	
" " "	10	3.92	
Sodium sulphite	10	0.44	
" "	20	0.95	
Ammonium sulphite	10	Trace	
" carbonate	10	0.05	
Ammonia+Aq	3	1.40	25°
"	15	7.58	
Magnesium chloride	50	0.50	
Potassium cyanide	5	2.75	
Ammonium sulphocyanide	5	0.08	
" " "	10	0.54	20°
" " "	15	2.88	
Potassium " "	10	0.11	
Calcium " "	10	0.15	
Barium " "	10	0.20	
Aluminum " "	10	2.02	25°
Thiocarbamide	10	0.83	
Thiosinamine	1	0.40	
"	5	1.90	
"	10	3.90	

(Valenta, M. 1894, **15.** 250.)

Solubility in salts+Aq.

31.71 cc. of a solution of sodium thiosulphate containing 31.869 g. $Na_2S_2O_3$ per liter (i. e. 5 g. of the hydrate in 100 cc. of the solution) dissolve 0.6124 g. AgCl.

21.88 cc. of a solution of ammonium thiosulphate containing 50 g. $(NH_4)_2S_2O_3$ per liter dissolve 0.7024 g. AgCl.

27.34 cc. of a solution of potassium cyanide containing 49.511 g. KCN per liter dissolve

1.4926 g. AgCl. (Cohn, Z. phys. Ch. 1895, **18.** 63.)

Solubility of AgCl in sodium thiosulphate and potassium cyanide solutions may be determined without reference to experimental date. (Cohn.)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in moderately dil. $Pb(C_2H_3O_2)_2$+Aq.

10 ccm. normal $Hg(C_2H_3O_2)_2$+Aq containing 0.1 g. Hg dissolve 0.01892 g. AgCl at 15°. (Stas.)

100 ccm. of a solution of a mixture of Na and Hg acetates dissolve 0.00175 g. AgCl. (Stas, A. ch. (5) **3.** 145.)

Only sl. sol. in liquid NH_3.

Solubility curve for AgCl, AgCl, $3NH_3$, AgCl, $5NH_3$. (Jarry, A. ch. 1899, **17.** 342.)

Insol. in alcoholic ammonia (Bodländer, Z. phys. Ch. 1892, **9.** 731.)

Nearly insol. in ether. (Mylius and Hüttner, B. 1911, **44.** 1316.)

Perceptibly sol. on warming with solution of tartaric acid, but nearly the whole is deposited on cooling.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); insol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in methyl acetate. (Bezold, Dissert. **1906**; Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Hamers, Dissert. **1906**; Naumann, B. 1910, **43.** 314.)

Sol. in methylamine+Aq. (Wurtz, A. ch. (3) **30.** 453.)

Solubility of AgCl in methylamine at 11.5°.

% CH_3NH_2	% AgCl	% CH_3NH_2	% AgCl
1.78	0.16	13.70	3.29
4.44	0.62	18.69	5.43
5.51	0.83	36.69	9.93
7.66	1.32		

(Jarry, A. ch. 1899, (7) **17.** 342.)

Solubility in methylamine+Aq at 25°.
G. mols. per l.

CH_3NH_2	AgCl
0.0200	0.000300
0.0400	0.000370
0.0740	0.000424
0.0947	0.000447
0.1950	0.000481

(Wuth, B. 1902, **35.** 2416.)

Solubility in methylamine+Aq at t°.
G. mols. per l.

t°	CH_3NH_2	Ag
18	0.93	0.0315
25	0.93	0.0338
25	0.93	0.0335

(Euler, B. 1903, **36.** 2880.)

At 25°, 1 l. methylamine+Aq, containing 1.017 g. mols. CH_3NH_2, dissolves 0.0387 g. mol. AgCl; 0.508 g. mol. CH_3NH_2, 0.0178 g. mol. AgCl. (Bodländer and Eberlein, B. 1903, **36.** 3948.)

Solubility in ethylamine+Aq at 25°.
G. mols. per l.

$C_2H_5NH_2$	AgCl
0.01272	0.000114
0.02942	0.000156
0.05512	0.000235
0.06572	0.000312
0.10300	0.000824

(Wuth, B. 1902, **35.** 2416.)

Solubility in ethylamine+Aq at t°.
G. mols. per l.

t°	$C_2H_5NH_2$	Ag
18	0.094	0.00458
25	0.093	0.00474
25	0.094	0.00478
18	0.236	0.0132
25	0.234	0.0136
18	0.462	0.0251

(Euler, B. 1903, **36.** 2880.)

At 25°, 1 l. ethylamine+Aq, containing 0.483 g. mol. $C_2H_5NH_2$, dissolves 0.0314 g. mols. AgCl; 0.200 g. mol. $C_2H_5NH_2$, 0.0115 g. mol. AgCl; 0.100 g. mol. $C_2H_5NH_2$, 0.0062 g. mol. AgCl. (Bodländer and Eberlein.)

Sol. in amylamine+Aq, but less than in NH_4OH+Aq.

Sol. in caprylamine+Aq.

Easily sol. on warming in ethylene diamine +Aq. (Kurnakow, Z. anorg. 1898, **17.** 220.)

Easily sol. in alcoholic solution of thiacetamide. (Kurnakow, J. pr. 1895, (2) **51.** 251.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Solubility in pyridine at t°.

t°	g. AgCl sol. in 100 g. pyridine	Solid phase
−52	0.70	AgCl, $2C_5H_5N$
−49	0.77	"
−35	0.99	"
−30	1.36	"
−25	1.80	"
−22	2.20	"
transition point	2.75	
−20	3.71	AgCl, C_5H_5N
−18	3.85	"
−10	4.35	"
− 5	5.05	"
− 1	5.60	"

Solubility in pyridine at t°.—*Continued.*

t°	g. AgCl sol. in 100 g. pyridine	Solid phase
transition point	...	
0	5.35	AgCl
10	3.17	AgCl
20	1.91	AgCl
30	1.20	AgCl
40	0.80	AgCl
50	0.53	AgCl
60	0.403	AgCl
70	0.32	AgCl
80	0.25	AgCl
90	0.22	AgCl
100	0.18	AgCl
110	0.12	AgCl

(Kahlenberg, J. phys. Chem. 1909, **13.** 423.)

Easily sol. in warm piperidine. (Varet, C. R. 1892, **115.** 335.)
Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, **15.** 16.)
Quinoline dissolves traces of AgCl. (Varet, C. R. 1893, **116.** 60.)
As sol. in coniine+Aq as in NH_4OH+Aq. (Blyth, Chem. Soc. **1.** 350.)
Sol. in sinamine, and thiosinamine+Aq.
Min. *Cerargyrite.*

Silver chloride ammonia, AgCl, $2NH_3$.

Decomp. by H_2O. (Terreil, A. Phys. Beibl. **7.** 149.)
2AgCl, $3NH_3$. Decomp. on air and in H_2O to AgCl. Sol. in conc. NH_4OH+Aq, from which it can be crystallised. (Rose.)
Insol. in alcohol. (Bodländer, Z. phys. Ch. **9.** 730.)
AgCl, $3NH_3$. More easily decomp. than 2AgCl, $3NH_3$.
Sl. sol. in liquid NH_3. (Jarry, A. ch. 1899, (7) **17.** 343.)
AgCl, $5NH_3$. Sl. sol. in liquid NH_3. (Jarry, A. ch. 1899, (7) **17.** 336.)

Silver chlorobromoiodides.

(Rodwell, Proc. Roy. Soc. **25.** 292.)

Silver *sub*fluoride (argentous fluoride), Ag_2F.

Decomp. by H_2O into Ag and AgF. (Guntz, C. R. **110.** 1337.)
Decomp. by H_2O.
Insol. in abs. alcohol, ether, acetone and xylene. (Wöhler and Rodewald, Z. anorg. 1909, **61.** 63.)
Decomp. by H_2O until the solution contains 64.5% AgF, independent of temp. (Guntz, C. R. 1913, **157.** 981.)

Silver fluoride, AgF.

Extremely deliquescent. (Gore.)
Sol. in 0.55 pt. H_2O at 15.5° with evolution of heat. Sp. gr. of sat. solution at 15.5° = 2.61. (Gore.)

Solubility of AgF in H_2O at t°.
G. per 100 g. H_2O.

t°	AgF	Solid phase
−14.2	60	Ice+AgF, $4H_2O$
+18.5	165	AgF, $4H_2O$
18.65	169.5	" +AgF, $2H_2O$
20	172	AgF, $2H_2O$
24	178	"
25	179.5	"
28.5	215	"
32	193	"
39.5	222	AgF, $2H_2O$+AgF
108	205	AgF

(Guntz, A. ch. 1914, (9) **2.** 101.)

Sp. gr. AgF+Aq at 18°.

% AgF	Sp. gr.
7.20	1.07
29.60	1.38
49.20	1.82
56.40	2.09
66.20	2.62

(Guntz, A. ch. 1914, (9) **2.** 104.)

Data on solubility of AgF in HF+Aq are given by Guntz (*l. c.*).
Sl. sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)
+H_2O. Deliquescent. Sol. in H_2O. (Guntz, A. ch. 1914, (9) **2.** 101.)
+$2H_2O$. Deliquescent. Sol. in H_2O. (Guntz.)
+$4H_2O$. Not deliquescent. Sol. in H_2O. (Guntz.)
+$^5/_8$ H_2O. Unstable in the presence of crystals of AgF+$2H_2O$. (Guntz, A. ch. 1914, (9) **2.** 101.)

Silver hydrogen fluoride, AgF, HF.

(Guntz.)
AgF, 3HF. Very unstable.
Sol. in HF. (Guntz, Bull. Soc. 1895, (3) **13.** 114.)

Silver stannic fluoride.

See **Fluostannate, silver.**

Silver tungstyl fluoride.

See **Fluoxtungstate, silver.**

Silver, fulminating.

See **Silver nitride.**

Silver hydride, AgH.

Not decomp. by H_2O. (Bartlett, Am. Ch. J. 1896, **19.** 52.)

Argentous hydroxide, $Ag_4O_2H_2$.

Sol. in H_2O. Known only in solution. (Weltzein, A. **142.** 105.)

Silver hydroxide, AgOH.

Decomp. into Ag_2O and H_2O above −40°.
See **Silver oxide.**

Argentous iodide, Ag_2I.

(Guntz, C. R. **112.** 861.)

Silver imidosulphamide, $AgN(SO_2NH_2)_2+1\frac{1}{2}H_2O$.

Decomp. slowly in the air. Somewhat sol. in hot, more sol. in boiling H_2O, from which it cryst. unchanged on cooling. In aqueous solution is stable toward alkali. Decomp. by acids. Difficultly sol. in dry pyridine; easily sol. in pyridine+Aq. (Hantzsch, B. 1905, **38.** 1035.)

$(SO_2)_3N_5H_6Ag_3+5\frac{1}{2}H_2O$. Nearly insol. in hot H_2O. (Ephraim and Michel, B. 1909, **42.** 3845.)

$(SO_2)_4N_7H_8Ag_5+4H_2O$. (Ephraim and Michel.)

$(SO_2)_4N_5HAg_6+1\frac{1}{2}$, 11, and 28 H_2O.

Easily sol. in HNO_3 and NH_4OH+Aq. Sl. sol. in pyridine. Very sol. in pyridine containing pyridine nitrate and can be recryst. therefrom. (Ephraim and Michel.)

$(SO_2)_4N_5Ag_7+8H_2O$. (Ephraim and Michel.)

Silver iodide, AgI.

Insol. in H_2O.

Calculated from electrical conductivity of AgI+Aq, AgI is sol. in 1,074,040 pts. H_2O at 28.4°, and 420, 260 pts. at 40°. (Holleman, Z. phys. Ch. **12.** 130.)

1 l. H_2O dissolves 0.1 mg. AgI at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Solubility in $H_2O = 1\times10^{-8}$N. (Rolla.)

Solubility in $H_2O = 0.97\times10^{-8}$ g. mols. per l. at 25°. (Goodwin, Z. phys. Ch. 1894, **13.** 645.)

Solubility of AgI in H_2O at 25° is 1.05×10^{-8} (in normality). (Thiel, Z. anorg. 1900, **24.** 57.)

A sat. aq. solution at 20.8° contains 0.0020×10^{-6} g. equiv. per l. (Kohlrausch, C. C. **1901,** II. 1299.)

1 l. H_2O dissolves 0.0035 mg. AgI at 21°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

1 l. H_2O dissolves 0.00253 mg. AgI at 60°. (Sammet, Z. phys. Ch. 1905, **53.** 644.)

Solubility in $H_2O = 1.23\times10^{-8}$ g.-mol. per litre at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, **30.** 74.)

0.003 mg. are contained in 1 l. of sat. solution at 21°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Insol. in dil. HNO_3+Aq or H_3PO_4+Aq. Decomp. by hot. conc. HNO_3+Aq or H_2SO_4. Easily sol. in conc. HI+Aq.

1 pt. AgI dissolves in 2510 pts. NH_4OH+Aq of 0.96 sp. gr. (Martini, Schw. J. **56.** 154); in 2493 pts. of 0.89 sp. gr. (Wallace and Lamont, Ch. Gaz. **1859.** 137).

1 g. AgI dissolves in 26,300 g. 10% NH_4OH+Aq (sp. gr.=0.96) at 12°. Insol. in 5% NH_4OH+Aq. (Longi, Gazz. ch. it. **13.** 87.)

Coefficient of solubility in NH_4OH+Aq (density, 0.926) is found lower than previously obtained and of the order of $^1/_{60000}$ at 16°. (Baubigny, Bull. Soc. 1908, (4) **3.** 772.)

According to Field, insol. in cold conc. KCl or NaCl+Aq, and only in traces on boiling, and separates out on cooling.

100 g. NaCl in conc. NaCl+Aq dissolve 0.95 mg. AgI at 15°; 100 g. NH_4Cl in conc. NH_4Cl+Aq dissolve 2.9 mg. AgI at 15°; 95 g. NaCl+10 g. KBr in conc. solution dissolve 1.2 mg. AgI at 15°; 100 g. KBr+225 g. H_2O dissolve 430 mg. AgI at 15°; 100 g. KBr in conc. KBr+Aq dissolve 525 mg. AgI at 15°; 100 g. KI+69 g. H_2O dissolve 89.8 g. AgI at 15°; 100 g. KI+92 g. H_2O dissolve 54.0 g. AgI at 15°; 100 g. KI+366 g. H_2O dissolve 7.25 g. AgI at 15.° (Schierholz, W. A. B. **101, 2b** 4.)

Sol. in conc. KI+Aq, from which it is precipitated by H_2O. (Field, C. N. **3.** 17.)

KI gives a ppt. with $AgNO_3$ in presence of 30,000 pts. H_2O. (Harting.)

Solubility in KI+Aq at 15°.

% KI	% AgI	% KI	% AgI
59.16	53.13	33.3	7.33
57.15	40	25.0	2.75
50.0	25.0	21.74	1.576
40.0	13.0	20	0.80

(Schierholz, W. A. B. 1890, **101. 2b.** 10.)

Solubility in KI+Aq at 25°.

Mol. KI per l.	g. AgI per l.
1.937	46.42
1.6304	24.01
1.482	15.46
1.406	12.55
1.018	3.47
1.008	3.32
0.734	1.032
0.586	0.512
0.335	0.0853

Hellwig, Z. anorg. 1900, **25.** 180.)

Solubility in KI+Aq.

t=50°		
% AgI	% KI	Solid phase
2.5	24.8	AgI
16.0	33.8	"
28.0	36.7	"
39.0	38.1	"
51.8	36.2	"
53.5	36.5	"
53.5	36.6	AgI+AgI, KI
53.5	37.1	AgI, KI
53.4	37.6	KI+AgI, KI
50.4	40.2	KI
45.0	43.2	"
38.0	47.1	"
22.8	55.5	"
10.7	59.1	"

t = 30°

% AgI	% KI	Solid phase
0.1	10.2	AgI
10.0	31.4	"
29.4	37.6	"
42.8	38.8	"
49.7	38.6	AgI+AgI, 2KI
49.6	39.5	AgI, 2KI
47.7	40.9	"
46.3	41.4	"
44.1	43.2	AgI, 2KI+KI
42.8	43.9	KI
35.8	46.9	"
16.0	55.5	"
0	60.35	"

t = 0°

% AgI	% KI	Solid phase
0.2	9.8	AgI
1.5	20.5	"
6.5	26.1	"
26.6	34.6	"
28.1	36.4	"
38.0	41.3	AgI+AgI, KI
37.9	42.0	AgI, KI
37.6	42.7	"
37.9	44.0	AgI, KI+KI
31.3	46.6	KI
21.7	50.5	"
18.0	51.2	"
9.0	53.0	"
0	56.1	"
27.5	48.7	AgI, 2KI+KI
21.0	50.3	AgI, 2KI

(Van Dam and Donk, Chem. Weekbl. 1911, **8.** 848.)

Very sol. in KI_3+Aq. (Muth, Dissert. **1895.**)

Very sol. in H_2O in presence of NaI. (Kurnakow, Ch. Z. 1900, **24.** 60.)

Solubility in KI+Aq at 15°.

Composition of the sat. solution in mols. per 1000 mols. H_2O		Solid phase
Mols. Na_2I_2	Mols. Ag_2I_2	
35.63	8.14	AgI
40.54	10.94	"
61.55	25.15	"
80.55	38.19	"
94.25	47.79	"
107.52	57.52	AgI+AgI, NaI, 3½H_2O
117.96	51.70	AgI, NaI, 3½H_2O
134.40	46.82	"
135.83	46.36	AgI, NaI, 3½ H_2O+NaI
133.81	43.03	NaI
129.02	34.85	"
122.56	22.82	"
117.11	11.93	"
111.52	...	"

(Krym, J. Russ. Phys. Chem. Soc. 1909, **41.** 382.)

Traces are dissolved by alkali nitrates+Aq. Easily sol. in hot KOH+Aq, from which it is pptd. by H_2O or alcohol. Not decomp. by boiling KOH+Aq. (Vogel, N. Rep. Pharm. **20.** 129.)

100 pts. of $AgNO_3$+Aq sat. at 11° dissolve 2.3 pts. AgI in the cold, and 12.3 pts. on boiling. (Schnauss.)

Solubility of AgI in $AgNO_3$+Aq at 25°.

Mol. $AgNO_3$ in 1 l.	g. AgI in 1 l.	Solid phase
0.20	0.0680	AgI
0.25	0.080	AgI
0.30	0.090	AgI
0.35	0.125	AgI
0.40	0.167	AgI
0.45	0.224	AgI
0.50	0.299	AgI
0.55	0.400	AgI
0.60	0.528	AgI
0.65	0.672	AgI
0.70	0.850	AgI
1.215	3.08	Ag_2INO_3
1.63	6.26	Ag_2INO_3
2.04	10.90	Ag_2INO_3
2.54	16.1	$Ag_3I(NO_3)_2$
3.115	22.7	$Ag_3I(NO_3)_2$
3.75	33.2	$Ag_3I(NO_3)_2$
4.055	40.0	$Ag_3I(NO_3)_2$
4.69	53.2	$Ag_3I(NO_3)_2$
5.90	85.0	$Ag_3I(NO_3)_2$

(Hellwig, Z. anorg. 1900, **25.** 171.)

Solubility of AgI in 25% $AgNO_3$+Aq reaches a maximum at about 60° and at the point of maximum solubility the quantity dissolved amounts to about 5 g. AgI per 100 g. $AgNO_3$. (Lowry, Roy. Soc. Proc. 1914, **91,** A, 66.)

Sol. in hot $Hg(NO_3)_2$+Aq, from which it crystallizes on cooling.

Solubility of AgI in $Hg(NO_3)_2$+Aq at 25°.

Mols. $Hg(NO_3)_2$ per l.	g. AgI per l.	Mols. $Hg(NO_3)_2$ per l.	g. AgI per l.
0.010	0.800	0.050	1.737
0.0125	0.841	0.100	2.730
0.025	1.118	1.000	25.160

Solubility is not affected by presence of 0.1 to 2N HNO_3.

(Morse, Z. phys. Ch. 1902, **41.** 708.)

Sol. in KCN+Aq.

Sl. sol. in $Na_2S_2O_3$+Aq when suspended in much H_2O, but separates again on addition of KI+Aq. (Field.)

Insol. in $Na_2S_2O_3$+Aq. (Fogh, C. R. 1890, **110.** 711.)

Solubility in salts+Aq.

Solvent	% Conc.	grams AgI sol. in 100 grams solvent	
Sodium thiosulphate	1	0.03	
" " "	5	0.15	
" " "	10	0.30	20
" " "	15	0.40	
" " "	20	0.60	
Sodium sulphite	10	0.01	
" "	20	0.02	
Ammonium sulphite	10	Traces	25
Potassium cyanide	5	8.23	
Ammonium sulphocyanide	5	0.02	
" " "	10	0.08	20
" " "	15	0.13	
Potassium " "	10		
Calcium " "	10	0.03	
Barium " "	10	0.02	
Aluminum " "	10	0.02	
Thiocarbamide	10	0.79	25
Thiosinamine	1	0.008	
"	5	0.05	
"	10	0.09	

(Valenta, M. 1894, **15.** 250.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829; Jarry, A. ch. 1899, (7) **17.** 370.)

Easily sol. in liquid NH_3. (Ruff and Geisel, B. 1905, **38.** 2662.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014); (Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Bezold, Dissert. **1906**); (Naumann, B. 1909, **42.** 3790.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Much less sol. in hot alcoholic thiourea than AgCl and AgBr. (Reynolds, Chem. Soc. 1892, **61.** 253.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Slowly sol. in piperidine at 100°. (Varet, C. R. 1892, **115.** 336.)

0.10 pts. is sol. in 100 pts. pyridine at 10°.
8.60 pts. are sol. in 100 pts. pyridine at 121°. (Laszczynski, B. 1894, **27.** 2288.)

Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, **15.** 16.)

Min. *Iodyrite.*

Silver hydrogen iodide, 3AgI, $HI+7H_2O$.

(Berthelot, C. R. **91.** 1024.)

Silver sodium iodide, 2AgI, NaI.

Very sol. in acetone. (Marsh, Chem. Soc. 1913, **103.** 784.)

AgI, $NaI+3\frac{1}{2}H_2O$. (Krym, J. Russ. Phys. Chem. Soc. 1909, **41.** 382.)

See AgI+NaI under AgI.

Silver iodide ammonia, AgI, NH_3.

Sol. in liquid NH_3. (Jarry, A. ch. 1899, (7) **17.** 371.)

2AgI, NH_3. (Rammelsberg, Pogg. **48.** 170.)

Composition is AgI, NH_3. (Longi, Gazz. ch. it. **13.** 86.)

Sol. in liquid NH_3. (Jarry, A. ch. 1899, (7) **17.** 371.)

AgI, $2NH_3$. (Terreil, C. R. **98.** 1279.)

Silver nitride, Ag_3N.

Berthollet's "knallsilber." Very explosive. Insol. in H_2O. Sol. in KCN+Aq. Slowly sol. in NH_4OH+Aq. (Raschig, A. **233.** 93.) (Angeli, Chem. Soc. 1894, **66.** (2) 93.)

Argentous oxide, Ag_4O

Insol. in H_2O. Decomp. by acids into argentic oxide and silver Insol. in NH_4OH+Aq or $HC_2H_3O_2$. (v. der Pfordten, B. **20.** 1458.)

Contains H, and is a hydroxide Ag_4,H_2O. (v. der Pfordten, B. **21.** 2288.)

The above substance is a mixture, according to Friedheim (B. **20.** 2557.)

Silver oxide, Ag_2O.

Somewhat sol. in H_2O. (Bucholz.)

Sol. in 3000 pts. H_2O. (Bineau, C. R. **41.** 509); sol. in 96 pts. H_2O. (Abl.)

Sol. in 15,360 pts. H_2O. (Levi, Gazz. ch. it. 1901, **31.** (1) 1.)

Solubility in H_2O at 25° = 2.16×10^{-4} mols. AgOH per litre. (Noyes, J. Am. Chem. Soc. 1902, **24.** 1147.)

1 liter sat. aqueous solution at 19.96° contains 2.14×10^{-2} g.; at 24.94° contains 2.5×10^{-2} g. Ag_2O. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O at 25° dissolves 1.8×10^{-4} gram—atoms of silver. Determined from its solubility in NH_3. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

1 l. H_2O dissolves 0.0215 g. Ag_2O at 20°. (Whitby, Z. anorg. 1910, **67.** 108.)

The solubility of Ag_2O in H_2O varies with the method of preparation.

Solubility of Ag_2O (prepared by action of NaOH, freshly prepared by the solution of Na in H_2O, on a dil. solution of $AgNO_3$) = 2.16×10^{-4} g-mol. in 1 l. H_2O at 25°; 2.97×10^{-4}g.-mol. at 50°.

Solubility of Ag_2O (prepared by action of aqueous barium hydroxide on $AgNO_3$) = 2.23×10^{-4} g.-mol. in 1 l. H_2O at 25°; 3.09×10^{-4} g.-mol. in 1 l. H_2O at 50°.

Solubility of Ag_2O (prepared by action of conc. NaOH+Aq on moist, freshly pptd. AgCl) = 2.32×10^{-4} g.-mol. in 1 l. H_2O at 25°; 3.55×10^{-4} g.-mol. at 50°.

Solubility of Ag_2O (prepared by action of conc. NaOH+Aq. on moist, freshly pptd. Ag_2CO_3) = 2.95×10^{-4} g.-mol. in 1 l. H_2O at 25°; 3.89×10^{-4} g.-mol. at 50°. (Rebière, Bull. Soc. 1915, (4) **7.** 311.)

Sol. in acids, NH_4OH, and $(NH_4)_2CO_3$+Aq. Decomp. by alkali chlorides, bromides,

and iodides+Aq. Sol. in alkali cyanides, and thiosulphates+Aq. Sl. sol. in nitrates+Aq; insol. in sulphates+Aq. When freshly pptd., sol. in NH_4SCN+Aq. Sl. sol. in NH_4NO_3+Aq. Abundantly sol. in $Ba(NO_3)_2$ +Aq without pptn. of BaO_2H_2. Sol. in boiling $Mn(NO_3)_2$, $Ni(NO_3)_2$, $Co(NO_3)_2$, $Cu(NO_3)_2$, and $Ce_2(NO_3)_6$+Aq with pptn. of oxides. (Persoz.)

Insol. in KOH, and NaOH+Aq. Sl. sol. in BaO_2H_2+Aq. (Berzelius (?).

Solubility in NH_4OH+Aq at 25°.

G. at. Ag per l.	Mol. NH_3 per l.
0.0654	0.214
0.0658	0.220
0.134	0.458
0.140	0.469
0.205	0.671
0.205	0.684
0.225	0.720
0.224	0.733
0.251	0.811
0.248	0.827
0.242	0.830
0.257	0.876
0.278	0.899
0.276	0.915
0.299	0.999
0.343	1.147
0.454	1.498
0.470	1.522

(Whitney and Melcher, J. Am. Chem. Soc. 1903, **25.** 78.)

Insol. in liquid NH_3. (Franklin, Am. ch. J. 1898, **20.** 829.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014); (Naumann, B. 1904, **37.** 4329.)

Insol. in ethyl acetate. (Hamers, Dissert. **1906**; Naumann, B. 1910, **43.** 314.)

Sl. sol. in amylamine+Aq, easily in methylamine+Aq (Wurtz, A. ch. **30.** 453); also in ethylamine, and thiosinamine+Aq.

Solubility in methylamine+Aq. at 18°. G. mols. per l.

CH_3NH_2	Ag
0.1	0.0221
0.5	0.118
1.0	0.228

(Euler, B. 1903, **36.** 2879.)

Solubility in ethylamine+Aq at 18°. G. mols. per l.

$C_2H_5NH_2$	Ag
0.1	0.0322
0.5 (interpolated)	0.160
1.0 "	0.314
0.561	0.180
0.927	0.291

(Euler.)

Silver *peroxide*, Ag_2O_2.

Sol. in conc. H_2SO_4 (Rose), and in pure HNO_3+Aq without decomp. Sol. in NH_4OH +Aq. (Schönbein, J. pr. **41.** 321.)

Sol. in HNO_3 and H_2SO_4 with decomp. (Mulder, R. t. c. 1898, **17.** 151.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Silver oxide ammonia.

See **Silver nitride.**

Silver oxybromide, Ag_7OBr_7.

Insol. in H_2O. Insol. in HNO_3. Sol. in hot ammonia and in NaOCl+Aq. (Seyewetz, C. R. 1912, **154.** 357.)

Silver oxyfluoride, AgF, AgOH.

Decomp. by H_2O with separation of Ag_2O. (Pfaundler.)

Silver *per*oxyfluoride, $2Ag_3O_4$, AgF.

(Tanatar, Z. anorg. 1901, **28.** 335.)

$4Ag_3O_4$, 3AgF. (Tanatar, Z. anorg. 1901, **28.** 335.)

Silver oxyiodide, Ag_2O, Ag_5I_7.

(Seyewitz, Bull. Soc. 1894, (3) **11.** 452.)

Silver phosphide, AgP_2.

Sol. in HNO_3. Attacked by aqua regia. (Granger, C. R. 1897, **124.** 897.)

Ag_4P_6. Insol. in HCl+Aq; easily sol. in HNO_3+Aq. (Schrötter, J. B. **1849.** 247.)

Ag_2P_5. (Hackspill, C. R. 1913, **157.** 720.)

Ag_3P (?). (Fresenius and Neubauer, Z. anal. **1.** 340.)

Silver phosphoselenide, Ag_2Se, P_2Se.

Insol. in H_2O or HCl+Aq. Sol. in HNO_3+Aq. Insol. in cold, decomp. by hot alkalies+Aq. (Hahn, J. pr. **93.** 436.)

$2Ag_2Se$, P_2Se_3. Insol. in H_2O, HCl, or HNO_3+Aq; slowly sol. in red fuming HNO_3. (Hahn, J. pr. **93.** 440.)

$2Ag_2Se$, P_2Se_5. Sol. only in fuming HNO_3. (Hahn.)

Silver phosphosulphide, $2Ag_2S$, P_2S.

Ag_2S, P_2S. (Berzelius, A. **46.** 254.)

$2Ag_2S$, P_2S_3. Easily sol. in HNO_3+Aq without separation of P. (Berzelius.)

$Ag_4P_2S_7$. (Berzelius.)

Ag_4PS_8. Easily attacked by hot conc. HCl. Sl. decomp. Insol. in hot HNO_3. Decomp. by aqua regia. (Ferrand, A. ch. 1899, (7) **17.** 413.)

Silver selenide, Ag_2Se.

Sol. in boiling HNO_3+Aq as Ag_2SeO_3, which separates out by dilution with H_2O. (Berzelius.)

Insol. in $Hg_2(NO_3)_2$+Aq. (Wackenroder, A. **41.** 327.)

Min. *Naumannite.* Insol. in dil., but sol. in conc. HNO_3+Aq.

Silver sulphamide (silver thionyl amide), $SO_2(NHAg)_2$.

Insol. in pyridine. (Hantzch and Holl, B 1901, **34.** 3436.)

$+H_2O$. (Ephraim and Gurevitsch, B. 1910, **43.** 146.)

Argentous sulphide, Ag_4S.

Easily sol. in warm dil. HNO_3+Aq, and in conc. H_2SO_4 without separation of S. Sol. in conc. KCN+Aq. (v. der Pfordten, B. **20.** 1458; Guntz, C. R. **112.** 861.)

Silver sulphide, Ag_2S.

Less sol. in H_2O than AgI. (Lucas, Z. anorg. 1904, **41.** 210.)

1 l. H_2O dissolves about 4×10^{-11} g. at. Ag as Ag_2S at 18°. (Bernfeld, Z. phys. Ch. 1898, **25.** 72.)

1 l. H_2O dissolves 0.8×10^{-6} g mols. at 16–18°. (Biltz, Z. phys. Ch. 1907, **58.** 291.)

1 l. H_2O dissolves 0.552×10^{-6} g. mols. Ag_2S at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Sol. in conc. HNO_3+Aq with separation of S. Sol. in hot conc. HCl+Aq. Not decomp. by $CuCl_2$+Aq, but by $CuCl_2$+NaCl +Aq. Insol. in NH_4OH+Aq. Insol. in H_2SO_3+Aq, or in $Hg(NO_3)_2$+Aq.

Insol. in H_2O, dil. acids, alkalies, and alkali sulphides+Aq. (Fresenius.)

Sol. in HCN+Aq. (Hahn, C. C. **1870.** 240.)

Pptd. Ag_2S is very sol. in HNO_3 containing more than 5% HNO_3. (Gruener, J. Am. Chem. Soc. 1910, **32.** 1032.)

Only very sl. sol. in $AgNO_3$+Aq, even at 100°. (Lowry, Roy. Soc. Proc. 1914, **91,** A. 70.)

Sol. in KCN+Aq. (Hahn, C. C. **1870.** 240.)

Difficultly sol. in KCN+Aq; less difficultly if Ag_2S is pptd. from a very dil. solution. Amt. of KCN present also has influence on the solubility. Ag_2S dissolved in conc. KCN +Aq separates out on dilution. (Béchamp, J. pr. **60.** 64.)

Insol. in NH_4Cl or NH_4NO_3+Aq. (Brett.)

Min. *Argentite. Acanthite.* Sol. in conc. HNO_3+Aq with separation of S.

Sol. in citric acid+Aq with addition of KNO_3. (Bolton, C. N. **37.** 48.)

Silver *di*sulphide, Ag_2S_2.

Sol. in H_2O with decomp.; also sol. with decomp. in HCl, HNO_3. CS_2 does not dissolve out S. (Hantzsch, Z. anorg. 1898, **19.** 105.)

Silver sodium sulphide, $3Ag_2S, Na_2S+2H_2O$.

Sol. in conc. Na_2S+Aq with decomp.; sol. in H_2O with decomp. (Ditte, C. R. 1895, **120.** 93.)

Silver zinc sulphide, $Ag_2S, 3ZnS$.

(Schneider, J. pr. (2) **8.** 29.)

Silver sulphimide (silver thionyl imide), SO_2NAg.

Very sl. sol. in cold, more sol. in hot H_2O. Very sol. in dil. HNO_3. (Traube, B. 1892, **25.** 2474.)

Silver sulphophosphide.

See **Silver phosphosulphide.**

Silver telluride, Ag_2Te.

Min. *Hessite.* Sol. in warm HNO_3+Aq.

Sodammonium, $Na_2(NH_3)_2$.

100 g. liq. NH_3 dissolve 60.5 g. at −23°; 56.4 g. at 0°; 56 g. at +5°; 55 g. at 9°. (Joannis A. ch. 1906, (8) **7.** 41.)

Sodium, Na_2.

Violently decomposes H_2O, alcohol, etc. Insol. in hydrocarbons. Easily sol. in acids with violent action.

Solubility in fused NaOH.

G. sol. in 100 g. fused NaOH at temp.

t°	G. per 100 g. NaOH
480	25.3
600	10.1
610	9.9
670	9.5
760	7.9
800	6.9

(Hevesy, Z. Elektrochem. 1909, **15.** 531.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

1 gram atom dissolves:—

at +22° in 6.14 mol. liquid NH_3.
" 0° " 5.87 " " "
" −30° " 5.52 " " "
" −50° " 5.39 " " "
" −70° " 5.20 " " "
" −105° " 4.98 " " "

(Ruff, B. 1906, **39.** 839.)

½ ccm. oleic acid dissolves 0.0449 g. Na in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Insol. in ethylamine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, **29.** 1561.)

Sodium acetylide acetylene, Na_2C_2, C_2H_2.

Very deliquescent. Decomp. by H_2O and by absolute alcohol. Insol. in ether, ligroin, etc. (Moissan, C. R. 1898, **127.** 915.)

Sodium amalgam.

$NaHg_6$. Stable in contact with the liquid amalgam from 0°–40.5°. Can be cryst. from Hg without decomp. at any temp. between these limits.

$NaHg_5$. Stable in contact with the liquid amalgam from 40.5°–150°. Can be cryst. from Hg without decomp. at any temp. between these limits. (Kerp, Z. anorg. 1900, **25.** 68.)

Sodium amide, $NaNH_2$.

Decomp. by H_2O and alcohol.

Sodium amidochloride, Na_2NH_2Cl.

Sol. in H_2O with decomp. (Joannis, C. R. **112.** 392.)

Sodium arsenide, Na_3As.

Decomp. H_2O. (Lebeau, C. R. 1900, **130.** 504.)

Sodium arsenide ammonia, Na_3As, NH_3.

Easily sol. in liquid NH_3. (Lebeau, C. R. 1900, **130.** 502.)

Sl. sol. in liquid NH_3. (Hugot, C. R. 1898, **127.** 554.)

Sodium azoimide, NaN_3.

Not hygroscopic. Sol. in H_2O. Insol. in alcohol and ether. (Curtius, B. **24.** 3344.)

40.16 pts. are sol. in 100 pts. H_2O at 10°.
40.7 " " " " 100 " H_2O " 15.2.
41.7 " " " " 100 " H_2O " 17.0°.

0.3153 pt. is sol. in 100 pts. abs. alcohol at 16°.

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 279.

Sodium bromide, NaBr, and $+2H_2O$.

Not deliquescent. Solubility in H_2O differs according as NaBr or $NaBr+2H_2O$ is used. The following data for anhydrous NaBr were found.

Pts. NaBr dissolved by 100 pts. H_2O at t°.

t°	Pts. NaBr	t°	Pts. NaBr	t°	Pts. NaBr
44.1	115.6	74.5	118.4	97.2	119.9
51.5	116.2	80.5	118.6	100.3	120.6
55.1	116.8	86.0	118.8	110.6	122.7
60.3	117.0	90.5	119.7	114.3	124.0
64.5	117.3	...	...	...	...

Solubility is represented by a straight line of the formula $S=110.34+0.1075t$.

Below 50° the salt usually crystallizes with $2H_2O$, of which the solubility in 100 pts. H_2O was found to be as follows:

t°	Pts. NaBr	t°	Pts. NaBr	t°	Pts. NaBr
—21	71.1	+5	82.0	30	97.3
—20	71.4	10	84.5	35	101.3
—15	73.1	15	87.3	40	105.8
—10	75.1	20	90.3	45	110.6
— 5	77.1	25	93.8	50	116.0
0	79.5	...	...	..	...

(Coppet, A. ch. (5) **30.** 420.)

If solubility S = pts. NaBr in 100 pts. solution, $S=40.0+0.1746t$ from -20° to +40°; $S=52.3+0.0125t$ from 50° to 150°. (Étard, C. R. **98.** 1432.)

100 pts. H_2O dissolve: at 0°, 77.5 pts. NaBr; at 20°, 88.4 pts.; at 40°, 104.2 pts.; at 60°, 111.1 pts.; at 80°, 112.4 pts.; at 100°, 114.9 pts. (Kremers.)

Sat. solution boils at 121°. (Kremers, Pogg. **97.** 14.)

Sat. NaBr+Aq contains at:

—22°	—10°	+140°	163°	
40.1	42.5	56.5	57.5% NaBr,	
180°	180°	210°	212°	230°
59.5	59.0	60.9	61.0	62.0% NaBr.

(Étard, A. ch. 1894, (7) **2.** 539.)

100 g. sat. NaBr+Aq at 16.4° contain 47 g. NaBr. (Greenish, Pharm. J. 1900, **65.** 190.)

Solubility of $NaBr+2H_2O$ in H_2O at 30° = 65.5% anhydrous NaBr. (Cocheret, Dissert. **1911.**)

Sp. gr. of NaBr+Aq at 19.5° containing:

5	10	15	20	25	% NaBr,
1.040	1.080	1.125	1.174	1.226	
30	35	40	45	50	% NaBr.
1.281	1.334	1.410	1.483	1.565	

(Gerlach, Z. anal. **8.** 285.)

NaBr+Aq containing 17.15% NaBr has sp. gr. 20°/20° = 1.1473.

NaBr+Aq containing 22.72% NaBr has sp. gr. 20°/20° = 1.2060.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

Sp. gr. of NaBr+Aq at 20.5°.

Normality of NaBr+Aq	g. NaBr in 100 g. of solution	Sp. gr. 20.5°/4°
4.33	33.57	1.3284
3.00	25.10	1.2284
1.99	17.77	1.1526
0.98	9.41	1.0750

(Oppenheimer, Z. phys. Ch. 1898, **27.** 452.)

Sp. gr. at 20° of NaBr+Aq containing M g. mols. NaBr per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.000732	1.002177	1.004074	1.005972

M	0.10	0.25	0.50	0.75
Sp. gr.	1.00788	1.01964	1.03908	1.05811

M	1.0	1.5	2.0
Sp. gr.	1.07632	1.11963	1.15240

(Jones and Pearce, Am. Ch. J. 1907, **38.** 728.)

Sol. in H_2SO_4. (Walden, Z. anorg. 1902, **29.** 384.)

100 pts. NaBr+Aq sat. at 18–19° contain 46.05 pts. NaBr; 100 pts. NaBr+NaCl+Aq sat. at 18–19° contain 46.59 pts. of the two salts; 100 pts. NaBr+NaI+Aq sat. at 18–19° contain 63.15 pts. of the two salts; 100 pts. NaBr+NaCl+NaI+Aq sat. at 18–19° contain 63.20 pts. of the three salts. (v. Hauer, J. pr. **98.** 137.)

Solubility of NaBr in NaOH+Aq at 17°.

(G. per 100 g. H_2O.)

NaOH	NaBr	NaOH	NaBr
0.0	91.38	22.35	59.60
3.26	79.86	24.74	55.03
9.24	68.85	28.43	48.00
13.43	64.90	36.61	38.41
17.17	63.06	46.96	29.37
19.12	62.51	54.52	24.76

(Ditte, C. R. 1897, **124.** 30.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Very sl. sol. in alcohol.

$NaBr+2H_2O$ is sol. in 1.10 pts. H_2O at 15°; in 159 pts. absolute alcohol at 15°; in 1200 pts. absolute ether at 15°. (Eder, Dingl. **221.** 89.)

$NaBr+2H_2O$ is sol. in 2.25 pts. 60% alcohol, and 7 pts. 90% alcohol. NaBr is sol. in 3 pts. 60% alcohol, and 10 pts. 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 17.35 pts. at 19.5.° (de Bruyn, Z. phys. Ch. **10.** 783.)

100 g. $NaBr+CH_3OH$ contain 0.9 g. NaBr at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

At room temp., 1 pt. NaBr by weight is sol. in:

4.6 pts. methyl alcohol D^{15} 0.7990.
14.0 " ethyl " D^{15} 0.8100.
49.7 " propyl " D^{15} 0.8160.

(Rohland, Z. anorg. 1898, **18.** 325.)

Solubility in ethyl alcohol at 30°.

Wt. %		Solid phase
Alcohol	NaBr	
0	59.4	$NaBr, 2H_2O$
11.72	42.90	"
31.78	32.12	"
43.22	26.79	"
54.59	20.83	"
65.51	16.08	"
72.36	13.41	"
76.92	12.03	$NaBr, 2H_2O+NaBr$
87.35	7.44	NaBr
97.08	3.01	"

(Cocheret, Dissert. **1911.**)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NaBr in 10 ccm of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0.00	0.293	0.8189
4.37	0.365	0.8265
10.40	0.404	0.8273
41.02	0.724	0.8593
80.69	1.251	0.9079
84.77	1.286	0.9104
91.25	1.432	0.9235
100.00	1.440	0.9238

(Herz and Kuhn, Z. anorg. 1908, **60.** 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NaBr in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	1.440	0.9238
11.11	1.243	0.9048
23.8	1.053	0.8887
65.2	0.442	0.8390
91.8	0.147	0.8153
93.75	0.126	0.8144
100	0.074	0.8093

(Herz and Kuhn, Z. anorg. 1908, **60.** 156.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NaBr in 10 ccm. of the solution.
S = Sp. gr. of the sat solution.

P	G	S 25°/4°
0	0.293	0.8189
8.1	0.249	0.8147
17.85	0.247	0.8145
56.6	0.190	0.8107
88.6	0.111	0.8116
91.2	0.083	0.8083
95.2	0.082	0.8090
100	0.074	0.8093

(Herz and Kuhn, Z. anorg. 1908, **60.** 159.)

2.05 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 276.)

Sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

100 g. 95% formic acid dissolve 22.3 g. NaBr at 18.5°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314); benzonitrile. (Naumann, B. 1914, **47.** 1370.)

The composition of the hydrates formed by NaBr at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by NaBr and of the conductivity and sp. gr. of NaBr+Aq. (Jones, Am. Ch. J. 1905, **34.** 303.)

Sodium stannic bromide.

See **Bromostannate, sodium.**

Sodium uranous bromide, Na_2UBr_6.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Sodium zinc bromide, NaBr, $ZnBr_2+H_2O$.

Hygroscopic. (Ephraim, Z. anorg. 1908, **59.** 63.)

2NaBr, $ZnBr_2+5H_2O$. Hygroscopic. (Ephraim.)

Sodium carbide, Na_2C_2.

Insol. in all neutral solvents; decomp. on heating and by H_2O. (Matignon, C. R. 1897, **125.** 1034.)

Sodium carbonyl, $Na_2C_2O_2$.

Decomp. by H_2O with explosion. (Joannis, C. R. **116.** 1518.)

Sodium *sub*chloride, Na_4Cl_2.

Decomp. by H_2O into NaCl and NaOH+Aq. (Kreutz, B. 1897, **30.** 403.)

Sodium chloride, NaCl.

Sol. in H_2O.

100 pts. H_2O at t° dissolve pts. NaCl.

t°	Pts. NaCl	Authority
0	More than at 13.89°	
13.89	35.81	Gay-Lussac, A. ch. (2) **11.** 310.
16.90	35.88	
59.93	37.14	
109.73	40.38	
12	35.91	Fehling, A. **77.** 382.
100	39.92	
18.75	37.731	Bischof.
10–15	35.42	Bergmann.
106+	42.86	Griffiths, **1825.**
20	35.9	Schiff, A. **109.** 326.
All temps.	37	Fuchs and Reichenbach **1826.**
25	35.7	Kopp, A. **34.** 262.
18.75	36.53	C. J. B. Karsten, **1840.**
1	36.121	
18.75	36.724	G. Karsten.
100	41.076	
1.25	36.119	
Boiling	39.324	Unger, J. pr. **8.** 285.
18.75	35.40	Karsten (?), cited by Unger, *l.c.*
100	36.95	
15.56	34.2–35.42	
100	36.16	Ure's Dict.
15	35.837	Michel and Krafft.

1 pt. NaCl is sol. in 2.789 pts. H_2O at 15° (Gerlach); in 3 pts. H_2O at 18.75° (Abl); in 2.8235 pts. H_2O at ord. temp. (Bergmann); in 2.7647 pts. boiling H_2O (Bergmann); in 2.857 pts. hot or cold H_2O (Fourcroy).

Not deposited from boiling aqueous solution unless the vessel containing it is open to the air. (Unger, *l. c.*)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
1.5	33.6	70	38.1
13.75	35.8	108.5	39.4

(Nordenskjöld, Pogg. **136.** 315.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
13.89	35.8	59.93	37.1
16.90	35.9	109.73	40.4

(Gay-Lussac, A. ch. **11.** 296.)

Solubility of NaCl at various pressures. The figures represent pts. NaCl in 100 pts. sat. NaCl+Aq at t° and A pressure in atmospheres.

A	0°	9°	12°	15°	20°	25°	30°
1	26.25	26.32	26.35	26.30	26.35	26.37	26.47
20	26.35	26.38	..	26.39	26.37	26.47	26.53
40	26.44	..	..	26.40	..	..	..

(Müller, Pogg. **117.** 386.)

100 pts. H_2O dissolve at t°.

t°	Pts. NaCl	t°	Pts. NaCl
−15	32.73	40	36.64
−10	33.49	50	36.98
− 5	34.22	60	37.25
0	35.52	70	37.88
5	35.63	80	38.22
9	35.74	90	38.87
14	35.87	100	39.61
25	36.13	109.7	40.35

(Poggiale, A. ch. (3) **8.** 649.)

100 pts. H_2O dissolve at:

0°	9°	12°	15°	
35.59	35.72	35.77	35.68	pts. NaCl,

20°	25°	30°	
35.77	35.81	36.00	pts. NaCl.

(Müller, Pogg. **122.** 337.)

100 pts. H_2O dissolve 35.76-36.26 pts. NaCl at 15.6°, and the sp. gr. of sat. solution = 1.204. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

100 pts. NaCl+Aq sat. at 18–19° contain 26.47 pts. NaCl. (v. Hauer, J. pr. **98.** 137.)

Solubility of NaCl in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
0	35.7	30	36.3	60	37.3
1	35.7	31	36.3	61	37.3
2	35.7	32	36.3	62	37.4
3	35.7	33	36.4	63	37.4
4	35.7	34	36.4	64	37.5
5	35.7	35	36.4	65	37.5
6	35.7	36	36.5	66	37.6
7	35.7	37	36.5	67	37.7
8	35.7	38	36.5	68	37.7
9	35.7	39	36.6	69	37.8
10	35.8	40	36.6	70	37.9
11	35.8	41	36.6	71	37.9
12	35.8	42	36.7	72	38.0
13	35.8	43	36.7	73	38.0
14	35.8	44	36.8	74	38.1
15	35.9	45	36.8	75	38.2
16	35.9	46	36.8	76	38.2
17	35.9	47	36.9	77	38.2
18	35.9	48	36.9	78	38.2
19	36.0	49	36.9	79	38.3
20	36.0	50	37.0	80	38.4
21	36.0	51	37.0	81	38.4
22	36.0	52	37.0	82	38.5
23	36.1	53	37.1	83	38.6
24	36.1	54	37.1	84	38.6
25	36.1	55	37.1	85	38.7
26	36.1	56	37.2	86	38.7
27	36.2	57	37.2	87	38.8
28	36.2	58	37.2	88	38.9
29	36.2	59	37.3	89	39.0

Solubility of NaCl in 100 pts. H_2O at t°.—*Continued.*

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
90	39.1	97	39.5	104	40.0
91	39.1	98	39.6	105	40.1
92	39.2	99	39.7	106	40.1
93	39.3	100	39.8	107	40.2
94	39.3	101	39.8	108	40.3
95	39.4	102	39.9	109	40.3
96	39.4	103	40.0	109.7	40.4

(Calculated by Mulder from his own and other observations, Scheik. Verhandel. **1864.** 37.)

Solubility in 100 pts. H_2O at:

0-4°	20°	40°	60°	80°
35.630	35.825	36.32	37.06	38.00

(Andreae, J. pr. (2) **29.** 456.)

Solubility in 100 pts. H_2O from most careful experiments.

0°	20°	60°	80°
35.571	35.853	37.091	38.046

(Raupenstrauch, M. Ch. **6.** 563.)

Solubility of NaCl in 100 pts. H_2O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
−14.0	32.5	44.75	36.64
−13.8	32.15	52.5	37.04
− 6.25	34.22	55.0	36.99
− 5.95	34.15	59.75	37.31
0	35.7	71.3	37.96
3.6	35.79	74.45	37.96
5.3	35.8	82.05	38.41
14.45	35.94	86.7	38.47
20.85	35.63	93.65	38.90
25.45	35.90	101.7	40.76
38.55	36.52	...	...

Solubility above 20° is represented by the formula $S=34.359+0.0527t$. (Coppet, A. ch. (5) **30.** 426.)

Solubility of NaCl in 100 pts. H_2O at high temp.

t°	Pts. NaCl	t°	Pts. NaCl
118	39.8	160	43.6
140	42.1	180	44.9

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Sat. NaCl+Aq contains % NaCl at t°.

t°	% NaCl	t°	% NaCl
−21	23.7	77	28.0
−21	23.4	90	28.2
−18	23.5	115	29.1
−17	23.3	135	28.9
− 7	25.5	140	28.8
0	25.8	150	29.6
+15	26.7	180	30.2
55	26.8	215	31.6

(Étard, A. ch. 1894, (7) **2.** 532.)

100 g. H_2O dissolve 0.616 gram-equivalent NaCl at 25°. (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, **49.** 315.)

Solubility of NaCl in H_2O at t°.

Most careful experiments.

t°	g. NaCl per 100 g. H_2O	Sp. gr.	t°	g. NaCl per 100 g. H_2O	Sp. gr.
0.35	35.75	1.2090	61.70	37.28	1.1823
15.20	35.84	1.2020	75.65	37.82	1.1764
30.05	36.20	1.1956	90.50	38.53	1.1701
45.40	36.60	1.1891	107	39.65	1.1631

(Berkeley, Phil. Trans. Roy. Soc. 1904, **203.** A. 189.)

Sat. NaCl+Aq. at 25° contains 26.5% NaCl. (Foote, Am. Ch. J. 1906, **35.** 239.)

100 g. H_2O dissolve 35.80 g. NaCl at 25°. (Cameron, Bell and Robinson, J. phys. Ch. 1907, **11.** 396.)

100 g. NaCl+Aq. sat. at 15° contains 26.3 g. NaCl; at 30°, 26.47 g. (Schreinemakers, Arch. neér. Sc. 1910, (2) **15.** 81.)

5.456 g. mol. are contained in 1 l. NaCl+Aq sat. at 25°. (Herz, Z. anorg. 1911, **73.** 274.)

5.40 g. mol. are contained in 1 l. NaCl+Aq sat. at 30°. (Masson, Chem. Soc. 1911, **99.** 1136.)

26.47 g. NaCl are contained in 100 g. NaCl+Aq. sat. at 30°. (Cocheret, Dissert. **1911.**)

35.79 g. NaCl are sol. in 100 g. H_2O at room temp. (Frankforter, J. Am. Chem. Soc. 1914, **36.** 1106.)

100 mol. H_2O dissolve at:

19.3°	29.7°	40.1°	54.5°
11.04	11.06	11.15	11.35 mol. NaCl.

(Sudhaus, Miner. Jahrb. Beil. Bd. 1914, **37.** 18.)

Solubility of NaCl in H_2O at 24.5° at varying pressures.

S = g. NaCl in 100 g. solvent.
P = pressure in atmospheres.

P	S	100 g. of solution contains g. NaCl
1	35.90	26.42
250	36.25	26.61
500	36.55	26.77
1000	37.02	27.02
1500	37.36	27.20

(Cohen, Inouye and Euwen, Z. phys. Ch. 1910, **75.** 257.)

Sp. gr. of NaCl+Aq containing 15% NaCl is 1.109 at 15° (Francœur); 1.116 at 15° (Soubeiran); 1.1107 at 15° (Coulier); 1.111 at 15° (Baudin, C. R. **68.** 932).

Sp. gr. of NaCl+Aq saturated at 15° is 1.20715 (Michel and Krafft); at 17.5° is 1.2046 (Karsten); at 8° is 1.205 (Anthon).

Sp. gr. of NaCl+Aq.

% NaCl	Sp. gr.	% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.037	15	1.112	25	1.192
10	1.074	20	1.154	26.43	1.204

(Dahlmann, J. B. **7.** 321.)

Sp. gr. of NaCl+Aq at 20°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1.0066	15	1.1090
2	1.0133	16	1.1168
3	1.0201	17	1.1247
4	1.0270	18	1.1327
5	1.0340	19	1.1408
6	1.0411	20	1.1490
7	1.0483	21	1.1572
8	1.0556	22	1.1655
9	1.0630	23	1.1738
10	1.0705	24	1.1822
11	1.0781	25	1.1906
12	1.0857	26	1.1990
13	1.0934	27	1.2075
14	1.1012	..	...

(Schiff, A. **110.** 76.)

Sp. gr. of NaCl+Aq at 19.5°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
6.402	1.0460	22.631	1.1712
12.265	1.0895	26.530	1.2036
17.533	1.1303	...	...

(Kremers, Pogg. **95.** 120.)

Sp. gr. of NaCl+Aq at 15°.

% NaCl	Sp. gr.	% NaCl	Sp.gr.
1	1.00725	15	1.11146
2	1.01450	16	1.11938
3	1.02174	17	1.12730
4	1.02899	18	1.13523
5	1.03624	19	1.14315
6	1.04366	20	1.15107
7	1.05108	21	1.15931
8	1.05851	22	1.16755
9	1.06593	23	1.17580
10	1.07335	24	1.18404
11	1.08097	25	1.19228
12	1.08859	26	1.20098
13	1.09622	26.395	1.20433
14	1.10384	. .	. . .

(Gerlach, Z. anal. **8.** 279.)

Sp. gr. of NaCl+Aq at 18°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.0345	25	1.1898
10	1.0707	26	1.1982
15	1.1087	26.4	1.2014
20	1.1477	. . .	. . .

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of NaCl+Aq at 20°, containing n mols. H_2O to 1 mol. NaCl.

n	Sp. gr.	n	Sp. gr.
12.5	1.15292	100	1.02069
25	1.08207	200	1.00965
50	1.04227	. . .	. . .

(Marignac, J. B. **1870.** 110.)

Sp. gr. of NaCl+Aq at 0°. NaCl = g. NaCl to 100 g. H_2O; d° = sp. gr. at 0°; d^T = maximum sp. gr.; T = temp. of maximum.

G. NaCl	d°	d^T	T
0	1.00000	1.000130	+ 4°
0.5	1.003925	1.003988	+ 3
1	1.007634	1.007666	+ 1.77
2	1.015366	1.015367	— 0.58
3	1.023530	1.023583	— 3.24
4	1.030669	1.030890	— 5.63
6	1.045975	1.046952	—11.07

(Rosetti, A. ch. (4) **17.** 382.)

Sp. gr. of NaCl+Aq at 20°. x = mols. NaCl to 100 mols. H_2O.

x	Sp gr.	x	Sp. gr.
0.5	1.01145	4.0	1.08408
1.0	1.02255	5.0	1.10276
2.0	1.04393	. . .	. . .

(Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr of NaCl+Aq at 0°. S = weight of salt in 100 g. of solution of the given sp. gr.; S_1 = No. mols. of salt contained in 100 mols. of the solution.

S	S_1	Sp. gr.
23.0821	8.627	1.1821
19.1952	6.769	1.1502
14.3415	4.898	1.1111
9.4120	3.097	1.0722
5.1536	1.644	1.0394

(Charpy, A. ch. (6) **29.** 23.)

Sp. gr. of NaCl+Aq.

G.-equivalents NaCl per liter	t°	Sp. gr. t°/t°
0.005028	18.549	1.0002119
0.01005	18.550	1.0004258
0.02005	18.538	1.000848
0.04983	18.509	1.002101
0.09873	18.525	1.004143
0.19388	18.542	1.008093
0.28999	18.559	1.012053
0.47574	18.558	1.019627
0.49860	18.06	1.02054
4.9860	17.85	1.18783
0.00259	14.07	1.0001108
0.005178	14.076	1.0002210
0.010318	14.097	1.0004401
0.12580	14.097	1.005315
0.25019	14.076	1.010505

(Kohlrausch, W. Ann. 1894, **53.** 26.)

Sp. gr. of NaCl+Aq at 18°/18°.

g.-equivalents of NaCl in 1 liter of solution	Sp. gr.
0.005	1.0002104
0.010	1.0004206
0.020	1.0008476
0.050	1.002109
0.100	1.004205

(Tammann, Z. phys. Ch. 1895, **16.** 93.)

Sp. gr. of NaCl+Aq at 18.0°, when p = per-cent strength of solution; d = observed density; and w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w.\right)$

p	d	w
25.37	1.1928	0.30263
21.25	1.1592	0.24637
17.35	1.1277	0.19503
13.25	1.0958	0.14518
9.34	1.0665	0.09960
4.810	1.0332	0.04969
2.991	1.0202	0.03052
2.593	1.0173	0.2638
1.746	1.0111	0.01765

(Barnes. J. Phys. Chem. 1898, **2.** 544.)

Sp. gr. of NaCl+Aq at 20.5°.

Normality of NaCl+Aq	G. NaCl in 100 g. of solution	Sp. gr. 20.5°/4°
3.97	20.22	1.1489
2.96	15.56	1.1124
2.01	10.90	1.0775
0.97	5.49	1.0373

(Oppenheimer. Z. phys. Ch. 1898, **27.** 451.)

Sp. gr. of NaCl+Aq at 15°.

Per cent NaCl	Sp. gr.
0	1.00000
5	1.03624
10	1.07335
15	1.11146
20	1.15107
25	1.19228
Sat. at 15°	1.20433

(H. C. Hahn, J. Am. Chem. Soc. 1898, **20.** 622.)

Sp. gr. of NaCl+Aq at 18°/4°.

g. NaCl in 100 g. of solution	Sp. gr.
0.19560	1.0001
0.097952	0.9994
0.065410	0.99918
0.048977	0.99905

(Jahn, Z. phys. Ch. 1900, **33.** 572.)

Sp. gr. 20°/4° of a normal solution of NaCl = 1.03866. (Haigh, J. Am. Chem. Soc. 1912, **34.** 1151.)

Sp. gr. of sat. NaCl+Aq at t°.

t°	g. NaCl sol. in 100 g. H_2O	Sp. gr.
—10°	32.90	1.200
0	35.63	1.210
10	35.69	1.205
20	35.82	1.202
30	36.03	1.198
40	36.32	1.193
50	36.67	1.189
60	37.06	1.184
70	37.51	1.178

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, **44.** 1565.)

Sp. gr. of dil. NaCl+Aq at 20.004°.
Conc. = g. equiv. NaCl per l. at 20.004°.
Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,004,2
0.0002	1.000,008,5
0.0005	1.000,021,3
0.0010	1.000,042,7
0.0020	1.000,085,1
0.0040	1.000,169,6
0.0050	1.000,211,7
0.0100	1.000,423,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1686.)

The saturated solution boils at 109°. (Kremers.)

NaCl+Aq containing 42.9 pts. NaCl to 100 pts. H_2O boils at 106.8° (Griffiths); containing 41.2 pts. NaCl to 100 pts. H_2O boils at 108.2° (Legrand); containing 40.38 pts. NaCl to 100 pts. H_2O boils at 109.73° (Gay-Lussac); containing 38.7 pts. NaCl to 100 pts. H_2O forms a crust at 108.3°; highest point observed, 108.8° (Gerlach, Z. anal. **26.** 426.)

Boiling-point of NaCl+Aq.

% NaCl	B.-pt. according to	
	Bischof	G. Karsten
5	101.50°	101.10°
10	103.03	102.38
15	104.63	103.83
20	106.26 .	105.46
25	107.93	107.27
29.4	107.9–108.99	. . .

% NaCl	B.-pt. according to	
	Legrand	Gerlach
5	100.80°	100.9°
10	101.75	101.9
15	103.00	103.3
20	104.60	105.3
25	106.60	107.6

B.-pt. of NaCl+Aq containing pts. NaCl to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 438; L = according to Legrand (A. ch. (2) **59.** 431).

B.-pt.	G	L	B.-pt.	G	L
100.5°	3.4	4.4	105.5°	27.5	29.8
101	6.6	7.7	106	29.5	31.8
101.5	9.6	10.8	106.5	31.5	33.9
102	12.4	13.4	107	33.5	35.8
102.5	14.9	15.9	107.5	35.5	37.7
103	17.2	18.3	108	37.5	39.7
103.5	19.4	20.7	108.4	. .	41.2
104	21.5	23.1	108.5	39.5	. . .
104.5	23.5	25.5	108.8	40.7	. . .
105	25.5	27.7	. . .	. . .	. . .

B.-pt. of NaCl+Aq containing g. NaCl in 100 g. H_2O.

g. NaCl	7.6	11.0	14.9	16.1	18.8
B.-pt.	102.2°	103	104.2	104.8	106.1

g. NaCl	22.3	24.0	26.0	28.7
B.-pt.	107.1	107.7	108.7	109.5

(Richmond, Analyst, 1893, **18.** 142.)

If NaCl is dissolved in 15 pts. H_2O, heat is absorbed if the temp. is 15°, but much less if temp. is 86°; at 100° there is neither absorption nor evolution of heat. (Berthelot, C. R. **78.** 1722.)

36 pts. NaCl mixed with 100 pts. H_2O at 12.6° lower the temp. 2.5°. (Rüdorff, B. **2.** 68.)

33 pts. NaCl with 100 pts. snow at —1° give a temp. of —21.3°. (Rüdorff, Pogg. **122.** 337.)

The freezing-point of NaCl+Aq is lowered 0.60° for every gram NaCl up to 10 g. When more conc. the freezing-point sinks proportional to NaCl, $2H_2O$, 0.342° for every gram of that salt. (Rüdorff, Pogg. **113.** 163.)

Insol. in conc. HCl+Aq.

Solubility of NaCl in HCl+Aq at 0°. NaCl = mols. NaCl (in milligrams) dissolved in 10 ccm. of liquid; HCl = mols. HCl (in milligrams) dissolved in 10 ccm. of liquid.

NaCl	HCl	Sum of mols.	Sp. gr.
53.5	1	54.5	1.2045
52.2	1.85	54.05	1.2025
48.5	5.1	53.6	1.196
44.0	9.275	53.275	1.185
37.95	15.05	53.00	1.1725
23.5	30.75	54.95	1.141
6.1	56.35	62.45	1.1159

(Engel, Bull. Soc. (2) **45.** 654.)

Solubility in HCl+Aq at 10–10.5°.

g. per 100 cc.		G. per 100 cc.	
HCl	NaCl	HCl	NaCl
0.0	35.77	26.06	30.89
9.84	33.76	94.77	20.01
12.76	33.19	102.1	19.04
15.68	32.71	120.6	16.03
20.78	31.77	. . .	. . .

(Enklaar, R. t. c. 1901, **20.** 183.)

Solubility in HCl+Aq at 30°.

Composition of the solution	
% by wt. HCl	% by wt. NaCl
0	26.47
6.93	16.16
12.50	9.35
17.35	4.52
35.60	0.11

(Schreinemakers, Z. phys. Ch. 1909, **68.** 85.)

Solubility in HCl+Aq.

Conc. = concentration of HCl. g. mol. per 1,000 g. H_2O.

NaCl = wt. NaCl dissolved in 1,000 g. H_2O.

t°	Conc.	NaCl	Molecular solubility
0	0	357.75	6.13
	0.25	341.70	5.85
	0.50	324.45	5.56
	1.00	291.20	4.99
25	0	360.80	6.18
	0.25	344.50	5.90
	0.50	329.05	5.64
	1.00	298.10	5.10

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) **84.** 127.)

Solubility in HCl+Aq at 30°.

G. mols. per l.

HCl	NaCl	Sp. gr. 30°	HCl	NaCl	Sp. gr. 30°
0.0	5.400	1.2018	3.052	2.463	1.1427
0.4575	4.932	1.1906	4.152	1.628	1.1289
0.969	4.386	1.1801	5.950	0.630	1.1188
1.786	3.589	1.1633	7.205	0.268	1.1258
2.412	2.412	1.1512			

(Masson, Chem. Soc. 1911, **99.** 1132.)

Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm.	Millimols NaCl in 10 ccm.
...	54.56
6.07	48.50
10.32	44.67
15.90	37.82
21.17	32.97
32.83	23.43

(Herz, Z. anorg. 1912, **73.** 274.)

Moderately dil. H_2SO_4 or HNO_3+Aq precipitate NaCl from NaCl+Aq. (Karsten.) Sol. in H_2SO_4. (Walden, Z. anorg. 1902, **29.** 384.)

Solubility of NaCl in NH_4OH+Aq at 30°.

(G. in 1 l. sat. solution.)

Sp. gr.	NH_3	NaCl	Sp. gr.	NH_3	NaCl
1.1735	29.535	293.38	1.1406	72.07	283.38
1.1656	40.655	292.5	1.1395	72.715	283.06
1.160	47.26	289.7	1.1301	81.855	277.49
1.1494	60.78	286.5	1.205	97.49	270.57

(Hempel and Tedesco, Z. anorg. 1911, **24.** 2467.)

Solubility of NaCl in NH_4Cl+Aq at t°.

t°	G. per 100 g. H_2O		Sp. gr.
	NH_4Cl	NaCl	
0	0	356.3	...
	146.1	286.4	1.185
15	0	357.6	1.200
	57.3	326.4	1.191
	118.9	300	1.183
	186.4	271.6	1.176
	198.8	266.8	1.175
30	0	360.3	...
	255.4	249	1.166
45	0	365	...
	322.1	233.9	...

(Fedotieff, Z. phys. Ch. 1904, **49.** 168.)

See also under NH_4Cl.

Solubility in NaOH+Aq at 0°. NaCl = mols. NaCl (in milligrams) in 10 ccm. solution; Na_2O = mols. Na_2O (in milligrams) in 10 ccm. solution.

NaCl	Na_2O	Na_2O+NaCl	Sp. gr.
54.7	0	54.7	1.207
49.375	4.8	54.175	1.221
47.212	6.725	53.937	1.225
42.375	10.406	52.781	1.236
39.55	14.78	54.33	1.249
24.95	30.5	55.45	1.295
19.3	37.875	57.175	1.314
9.408	53.25	62.66	1.362

(Engel, C. R. **112.** 1130.)

Solubility in NaOH+Aq at 20°.

G. NaOH in 1 liter	G. NaCl in 1 liter	Sp. gr.	deg. Baumé
10	308	1.200	23.5
20	308	1.210	24.0
30	306	1.215	25.5
40	302	1.225	26.4
50	297	1.230	26.9
60	286	1.235	27.4
70	277	1.240	27.9
80	269	1.245	28.4
90	261	1.250	28.8
100	253	1.250	28.8
110	244	1.252	29.0
120	236	1.252	29.0
130	229	1.260	29.7
140	221	1.265	30.2
150	213	1.270	30.6
160	205	1.275	31.1
170	197	1.275	31.1
180	189	1.280	31.5
190	181	1.285	32.0
200	173	1.290	32.4
210	165	1.295	32.8
220	159	1.295	32.8
230	152	1.300	33.3
240	146	1.303	33.5
250	139	1.305	33.7
260	134	1.310	34.2
270	129	1.315	34.6
280	124	1.320	35.0
290	118	1.325	35.4
300	112	1.330	35.8
310	107	1.333	36.0
320	101	1.335	36.2
330	96	1.340	36.6
340	90	1.345	37.0
350	85	1.350	37.4
360	80	1.355	37.8
370	76	1.360	38.2
380	71	1.365	38.6
390	66	1.370	39.0
400	61	1.375	39.4
410	56	1.380	40.0
420	52	1.385	40.2
430	48	1.390	40.6

Solubility in NaOH+Aq at 20°.—*Continued.*

G. NaOH in 1 liter	G. NaCl in 1 liter	Sp. gr.	deg. Baumé
440	45	1.395	41.0
450	42	1.400	41.5
460	39	1.405	41.9
470	37	1.410	42.0
480	34	1.415	42.3
490	32	1.420	42.6
500	30	1.425	43.0
510	28	1.430	43.5
520	27	1.435	43.7
530	27	1.440	44.0
540	26	1.445	44.3
550	26	1.450	44.6
560	25	1.450	44.6
570	24	1.455	45.0
580	23	1.460	45.5
590	23	1.465	45.9
600	22	1.470	46.2
610	21	1.475	46.5
620	20	1.480	46.8
630	19	1.485	47.0
640	18	1.490	47.5

(Winteler, Z. Elektrochem, 1900, **7.** 360.)

Solubility in Na_2O+Aq at 30°.

Composition of the solution		Solid phase
% by wt. Na_2O	% by wt. NaCl	
0	26.47	NaCl
4.47	21.49	"
12.22	13.62	"
24.48	4.36	"
29.31	2.40	"
37.85	1.12	"
41.42	0.97	NaCl+NaOH, H_2O
42	0	NaOH, H_2O

(Schreinemakers, Z. phys. Ch. 1909, **68.** 85.)

The presence of other salts increases the solubility of NaCl in H_2O.

Sol. in sat. NH_4Cl+Aq with pptn. of NH_4Cl. When the reaction is complete, the solution has sp. gr. 1.1788, and contains 32.62% mixed salts; or 100 pts. H_2O dissolve 48.42 pts. mixed salts, viz., 26.36 pts. NaCl and 22.06 pts. NH_4Cl. (Karsten.) (*See* under NH_4Cl.)

Sol. in sat. $BaCl_2$+Aq with pptn. of $BaCl_2$ until a state of equilibrium is reached, when 100 pts. H_2O at 17° dissolve 38.6 pts. of mixed salts, of which 4.1 pts. are $BaCl_2$. (Karsten.) (*See* under $BaCl_2$.)

Insol. in sat. $CaCl_2$+Aq. (Vauquelin, Ann. de Chim. **13.** 95.)

Much more sol. in hot than in cold H_2O containing $MgCl_2$ or $CaCl_2$; but NaCl is pptd. from sat. NaCl+Aq when that solution is mixed with $MgCl_2$ or $CaCl_2$+Aq. (Fuchs and G. Reichenbach, **1826.**) (*See* under $MgCl_2$.)

Less sol. in conc. $CaCl_2$+Aq than in H_2O. (Hermann.)

Solubility of NaCl+$CaCl_2$ in H_2O at 25°.
G. per 100 g. H_2O.

NaCl	$CaCl_2$	Sp. gr. 25°/25°	Solid phase
0	84	...	$CaCl_2$, $6H_2O$
1.846	78.49	1.4441	" +NaCl
1.637	58.48	1.3651	NaCl
1.799	53.47	1.3463	"
7.77	36.80	1.2831	"
10.70	30.08	1.2653	"
18.85	19.53	1.2367	"
32.48	3.92	1.2080	"
35.80	0	1.2030	"

(Cameron, Bell and Robinson, J. phys. Chem. 1907, **11** 396.)

Solubility of NaCl in $NaHCO_3$ sat. with CO_2 at t°.

t°	G. per 1000 g. H_2O	
	$NaHCO_3$	NaCl
0	6.0	356.3
"	7.7	350.1
15	0.0	357.6
"	10.0	354.6
30	0.0	360.3
"	13.9	358.1
45	0.0	356.0
"	0.23	361.5

(Fedotieff, Z. phys. Ch. 1904, **49.** 170.)

Sol. in sat. $KClO_3$+Aq; the solution can then dissolve more $KClO_3$. (Margueritte, C. R. **38.** 305.)

In solution containing Na, K, Cl and NO_3 ions, the solubility—relations between the four salts NaCl, KCl, $NaNO_3$ and KNO_3 have been studied. (Uyeda, Z. anorg. 1911, **71.** 2.)

Sol. in sat. NH_4NO_3+Aq, without causing pptn. (Karsten.)

Sol. in sat. NH_4NO_3+Aq, from which solution it is not pptd. by salts which would cause its pptn. in aqueous solution. (Margueritte, C. R. **38.** 307.)

Sol. in sat. $Ba(NO_3)_2$+Aq without causing pptn.

Insol. in $Ca(NO_3)_2$+Aq.

Sol. in $Mg(NO_3)_2$+Aq with pptn. of small portion of $Mg(NO_3)_2$.

Sol. in sat. KNO_3+Aq, the mixed solution having the power to dissolve more KNO_3, and the solubility of the KNO_3 apparently increasing in the same ratio as the amount of NaCl present. (Fourcroy and Vauquelin, Ann. de Chim. **11.** 130.)

Sol. in sat. KNO_3+Aq; the solution thus

obtained at 18.13° contains 40.34% of the mixed salts, or 100 pts. H_2O dissolve 67.72 pts. of the mixed salts, viz., 38.25 pts. NaCl and 29.45 pts. KNO_3. (Karsten.)

Solubility of NaCl in KNO_3+Aq at 25°.
KNO_3=g. KNO_3 in 100 cc. of solution.
NaCl=g. mol. per l.

KNO_3	NaCl	KNO_3	NaCl
0	5.44	12	5.28
4	5.52	16	5.21
8	5.45	20	5.15

(Ritzel, Z. Krist. 1911, **49.** 152.)
(*See also* under KNO_3.)

Solubility of NaCl in $NaNO_3$+Aq at 15.5°.

Sp. gr.	g. per 100 cc. sat. solution		
	$NaNO_3$	NaCl	H_2O
1.2025	0	31.78	88.47
1.2305	7.53	27.89	87.63
1.2580	13.24	26.31	86.25
1.2810	21.58	23.98	82.66
1.3090	28.18	22.30	80.42
1.3345	33.80	20.40	79.25
1.3465	37.88*	19.40*	77.37
1.3465	37.64*	19.67*	77.34

*Solutions sat. with both salts.
(Bodländer, Z. phys. Ch. 1891, **1.** 361.)

Sol. in sat. $NaNO_3$+Aq with pptn. of $NaNO_3$.

Solubility of NaCl in $NaNO_3$+Aq.
Conc.=concentration of $NaNO_3$ in g. mol. per 1,000 g. H_2O.
NaCl=g. NaCl dissolved in 1,000 g. H_2O.

t°	Conc.	NaCl	Molecular solubility
0	0	359.65	6.16
	0.25	355.90	6.09
	0.50	351.20	6.02
	1	342.15	5.86
25	0	362.95	6.20
	0.25	356.65	6.11
	0.50	352.30	6.03
	1	343.65	5.88
	2	325.50	5.58

(Armstrong and Eyre, Proc. R. Soc. 1910, A. **84.** 127.)
(*See also* under $NaNO_3$.)

Sol. in sat. KCl+Aq with elevation of temp. (Vauquelin.)
100 g. H_2O sat. with KCl dissolve 0.494 gram-equivalent NaCl at 25°. (Fuler, Z. phys. Ch. 1904, **49.** 315.)

Solubility in KCl+Aq at t°.

t°	Sat. solution contains	
	% NaCl	% KCl
−20	21.3	5.7
−10	21.3	6.7
0	21.3	7.7
+10	21.3	8.6
20	21.3	9.6
30	21.3	10.6
40	21.3	11.5
50	21.3	12.5
60	21.3	13.5
70	21.3	14.4
80	20.7	15.8
90	19.9	17.8
100	18.8	19.8
110	17.2	22.4
120	16.5	24.1
130	16.4	25.1
140	16.4	26.1
150	16.4	27.1
160	16.4	28.0
170	16.4	29.0
180	16.4	30.0

(Étard. A. ch. 1894, (7) **3.** 277.)
(*See under* KCl.)

100 pts. NaCl+NaI+Aq sat. at 18-19° contain 62.33 pts. of the two salts. (v. Hauer.)
Sol. in sat. $Al_2(SO_4)_3$+Aq with no pptn. (Vauquelin.)
Sol. in sat. $(NH_4)_2SO_4$+Aq with pptn. of considerable amt. of $(NH_4)_2SO_4$+Aq. (Vauquelin.)
Sol. in sat. $CuSO_4$+Aq.
100 pts. H_2O dissolve 36.71 pts. NaCl and 7.19 pts. K_2SO_4 at 15°, and solution has sp. gr. 1.24. (Page and Keightey.)
NaCl is sol. in K_2SO_4+Aq, and *vice versa*, without separation of a salt.
100 pts. H_2O dissolve 7.03 pts. K_2SO_4 and 37.60 pts. NaCl, when warmed and cooled to 14°. (Rüdorff.)

Solubility of NaCl and K_2SO_4 in H_2O at t°.
100 pts. H_2O contain pts. NaCl, K_2SO_4, and KCl.

t°	Pts. NaCl	Pts. K_2SO_4	Pts. KCl
10	33.43	8.10	3.18
20	34.01	8.90	3.06
30	34.56	9.56	2.95
40	35.16	10.38	2.81
50	35.77	11.07	2.84
60	36.40	11.93	2.72
70	36.64	12.82	3.20
80	36.04	12.26	5.06
90	35.86	12.42	6.98
100	35.63	12.56	8.79

(Precht and Wittgen, B. **15.** 1666.)

Sol. in cold sat. $NaSO_4$+Aq at first without pptn., afterwards Na_2SO_4 separates out. (Karsten.)

Solubility in Na_2SO_4+Aq containing 7.45 g. Na_2SO_4 in 100 g. of the solution.

t°	g. NaCl in 100 g. of the solution
14.80	23.30
17.90	23.33
24.85	23.45
25.60	23.485
27.75	23.525
32.18	23.55
34.28	23.68

(Marie and Marquis, C. R. 1903, **136.** 684.)
See also under Na_2SO_4.

Sol. in sat. $ZnSO_4$+Aq with separation of Na_2SO_4, $ZnSO_4$. (Karsten.)
Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)
Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)
12.2 pts. NaCl are sol. in 1 pt. hydrazine at 12.5–13°. (de Bruyn, R. t. c. 1899, **18.** 297.)
100 g. hydroxylamine dissolve 14.7 g. NaCl at 17.5°. (de Bruyn, Z. phys. Ch. 1892, **10.** 782.)
100 g. 95% formic acid dissolve 5.8 g. at 19.7°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)
Solubility in alcohol.

100 pts. alcohol of 0.900 sp. gr. dissolve 5.8 pts. NaCl; of 0.872 sp. gr. dissolve 3.67 pts. NaCl; of 0.834 sp. gr. dissolve 0.5 pt. NaCl. (Kirwan.)

100 pts. alcohol containing given % by weight of absolute alcohol dissolve pts. NaCl at 25°.

% alcohol	Pts. NaCl	% alcohol	Pts. NaCl	% alcohol	Pts. NaCl
0.0	35.70	33.4	16.08	66.9	5.95
8.4	30.49	41.8	13.28	75.2	3.75
16.7	24.84	50.2	11.28	83.6	1.59
25.1	19.30	58.5	7.96	..	..

(Kopp, A. **40.** 206.)

100 pts. alcohol of 75% by weight dissolve at:

14°	15.2°	38°	71.5°
0.661	0.700	0.736	1.033 pts. NaCl.

100 pts. alcohol of 95.5% by weight dissolve at:

15°	77.2°
0.174	0.171 pts. NaCl.

(Wagner, A. **64.** 293.)

100 pts. alcohol containing % alcohol by weight dissolve pts. NaCl at 15°, or 100 pts. solution contain % NaCl.

10	20	30	40 % alcohol,
28.53	22.55	17.51	13.25 pts. NaCl,
22.2	18.4	14.9	11.7 % NaCl,

50	60	80 % alcohol,
9.77	5.93	1.22 pts. NaCl,
8.9	5.6	1.2 % NaCl.

(Schiff, A. **118.** 365.)

Solubility of NaCl in alcohol increases with the temperature.
100 pts. (by weight) of alcohol of 0.9282 sp. gr. ([illegible].5% by weight) dissolve at:

4°	10°	13°	23°	32°
10.9	11.1	11.43	11.9	12.3 pts. NaCl,

38°	44°	51°	60°
12.5	13.1	13.8	14.1 pts. NaCl.

(Gerardin, A. ch. (4) **5.** 146.)

Solubility in alcohol at 13°.

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	Salt
1.2030	0	88.70	31.60
1.1348	11.81	78.41	23.26
1.1144	15.99	74.64	20.81
1.0970	19.39	71.45	18.86
1.0698	24.95	65.80	16.23
1.0295	32.33	57.96	12.66
0.9880	40.33	49.34	9.13
0.9445	49.28	38.54	5.93
0.9075	57.91	29.37	3.47
0.8700	63.86	21.62	1.52
0.8400	72.26	11.24	0.50

(Bodländer, Z. phys. Ch. **7.** 317.)

Solubility in ethyl alcohol+Aq at 30°.

wt. % alcohol	g. NaCl per 100 g.		wt. % alcohol	g. NaCl per 100 g.	
	solution	H_2O		solution	H_2O
0	26.50	36.05	50	9.34	20.60
5	24.59	34.29	60	6.36	16.96
10	22.56	32.57	70	3.36	12.75
20	19.05	29.40	80	1.56	7.95
30	15.67	26.53	90	0.43	4.30
40	12.45	23.70	..	...	...

(Taylor, J. phys. Ch. 1897, **1.** 723.)

Solubility in ethyl alcohol+Aq at 40°.

wt. % alcohol	g. NaCl per 100 g.		wt. % alcohol	g. NaCl+100 g.	
	solution	H_2O		solution	H_2O
0	26.68	36.38	50	9.67	21.42
5	24.79	34.69	60	6.65	17.82
10	22.90	33.00	70	3.87	13.10
20	19.46	30.20	80	1.69	8.68
30	16.02	27.25	90	0.50	5.10
40	12.75	24.37	..	..	..

(Taylor, *l. c.*)

Solubility of NaCl in ethyl alcohol+Aq at 28°.

% C_2H_5OH	% H_2O	% NaCl	% C_2H_5OH	% H_2O	% NaCl
0	73.53	26.47	45.35	45.35	9.3
3.8	71.6	24.6	56.2	37.5	6.3
7.7	69.7	22.6	67.4	28.9	3.7
16.1	64.6	19.3	78.8	19.7	1.5
25.3	58.9	15.8	89.6	10	0.4
35.0	52.5	12.5			

(Fontein, Z. phys. Ch. 1904, **73.** 212.)

Solubility of NaCl in ethyl alcohol+Aq at 25°.

Conc.=concentration of alcohol in g. mol. per 1,000 g. H_2O.

NaCl=g. in 1,000 g. H_2O.

Conc.	NaCl	Molecular solubility
0	359.65	6.16
0.25	355.15	6.08
0.50	349.65	5.98
1	337.80	5.79
3	301.60	5.16

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) **84.** 127.)

100 pts. absolute methyl alcohol dissolve 1.41 pts. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.065 pt. at 18.5°. (de Bruyn, Z. phys. Ch. **10.** 782.)

100 pts. wood-spirit of 40% (by weight) dissolve 13.0 pts. NaCl. (Schiff, A. **118.** 365.)

100 g. NaCl+CH_3OH contain 0.1 g. NaCl at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, **72.** 437.)

Solubility of NaCl in methyl alcohol+Aq. at 25°.

Conc.=concentration of alcohol in g. mol. per 1,000 g. H_2O.

NaCl=g. in 1,000 g. H_2O.

t°	Conc.	NaCl	Molecular solubility
0°	0	357.75	6.13
	0.25	355.20	6.08
	0.50	353.10	6.05
	1	347.45	5.95
25°	0	362.95	6.20
	0.25	359.40	6.14
	0.50	357.60	6.11
	1	353.20	6.04
	3	336.25	5.75

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) **84.** 127.)

Traces dissolve in propyl alcohol. (Schlamp Z. phys. Ch. 1894, **14.** 276.)

Solubility of NaCl in propyl alcohol+Aq. at 25°.

Conc.=concentration of alcohol in g. mol. per 1,000 g. H_2O.

NaCl=g. NaCl in 1,000 g. H_2O.

t°	Conc.	NaCl	Molecular solubility
0	0	357.75	6.13
	0.25	351.20	6.01
	0.50	345.55	5.91
25	0	362.95	6.20
	0.25	355.75	6.10
	0.50	350.20	6.00

(Armstrong and Eyre, Proc. R. Soc. 1910, A. **84.** 127.)

Solubility of NaCl in propyl alcohol+Aq at 23-25°.

% NaCl	% C_3H_7OH	% H_2O	% NaCl	% C_3H_7OH	% H_2O
0.55	87.7	11.75	14.38	5.39	80.23
2.23	51.57	46.20	15.42	5.11	79.47
3.55	18.99	77.46	16.38	4.47	79.14
3.90	14.78	81.32	18.08	3.83	78.09
5.27	12.77	81.96	20.12	3.27	76.61
8.04	9.49	82.47	22.35	2.64	75.01
10.49	7.79	81.72	24.50	2.13	75.37
12.20	6.57	81.23	24.90	2.3	72.80

(Frankforter and Frary, J. phys. Ch. 1913, **17.** 402.)

100 g. sat. solution of NaCl in 99.6% propy alcohol contain 0.04 g. NaCl at 25°. (Frankforter and Frary.)

Insol. in fusel oil. (Gooch, Am. Ch. J. **9.** 53.)

Solubility of NaCl in amyl alcohol+Aq. Liquid phases conjugated at 28°.

Upper layer			Lower layer		
NaCl	amyl alcohol	H_2O	NaCl	amyl alcohol	H_2O
0.05	95.45	4.5	26.36	0.22	73.42
"	94.1	5.9	19	0.4	80.4
"	92.9	7.1	12.7	0.8	86.5
"	91.6	8.4	6.2	1.5	92.3
0	90.2	9.8	0	2.3	97.7

(Fontein, Z. phys. Ch. 1910, **73.** 226.)

At room temp. 1 pt. by weight is sol. in:

75 pts. methyl alcohol D^{15} 0.7990.
566 " ethyl " D^{15} 0.8100.
3000 " propyl " D^{15} 0.8160.

(Rohland, Z. anorg. 1898, **18.** 325.)

100 g. methyl alcohol dissolve 1.31 g. NaCl at 25°.

100 g. ethyl alcohol dissolve 0.065 g. NaCl at 25°.

100 g. propyl alcohol dissolve 0.012 g. NaCl at 25°.

100 g. isoamyl alcohol dissolve 0.002 g. NaCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, **102.** 1909.)

Solubility of NaCl in ethyl+amyl alcohol at 28°.

Upper layer			Lower layer		
% NaCl	% amyl alcohol	% ethyl alcohol	% NaCl	% amyl alcohol	% ethyl alcohol
0.05	95.45	0	26.35	0.22	0
0.10	86.6	9.5	25.30	0.25	1.9
0.25	75.4	19.1	24.02	0.3	9.5
0.58	59.9	30.9	22.64	0.4	6.9
1.23	47.0	38.7	21.19	0.5	10.3
2.81	31.6	44.8	19.26	1.3	15.2
6.56	17.7	41.5	15.81	3.69	22.1

Critical solution: amyl alcohol, 10%; ethyl alcohol, 32.5%; NaCl, 11%; H_2O, 46.5%.

(Fontein, Z. phys. Ch. 1910, **73.** 244.)

Ether ppts. NaCl from NaCl+Aq. (Gmelin.)

Very sl. sol. in a mixture of equal pts. of absolute alcohol and ether. (Berzelius.)

500 mg. NaCl treated with above mixture yielded only 0.5 mg. to the liquid. (Lawrence Smith, Am. J. Sci. (2) **16.** 57.)

100 pts. of a mixture of 1 pt. 96% alcohol and 1 pt. 98% ether dissolve 0.11 pt. NaCl. (Mayer, A. **98.** 205.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184; Eidmann, C. C. **1899,** II. 1014.)

Solubility in acetone+Aq at 20°.

A = ccm. acetone in 100 ccm. of the solvent.
NaCl = millimols NaCl in 100 ccm. of the solution.

A	NaCl
0	537.9
10	464.6
20	394.8
30	330.1
32 to 87 } 2 phases	lower layer 308.5
	upper layer 7.7
88	7.3
89	5.6
90	4.3
100	. . .

(Herz and Knoch, Z. anorg. 1904, **41.** 318.)

Solubility in acetone+Aq at 20°.

% NaCl	% H_2O	% acetone
25.9	73.06	1.04
24.19	71.18	4.03
25.06	72.00	2.94
20.85	66.78	12.37
20.17	66.01	13.82
18.32	63.16	18.52
20.44	66.19	13.37
17.89	62.21	19.90
0.32	13.92	85.76
0.19	10.82	88.99
0.15	9.62	90.23
0.12	8.94	90.94

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, **36.** 1127.)

Solubility in glycol at 14.8° = 31.7%. (de Coninck, Belg. Acad. Bull. **1905.** 275.)

Sol. in glycerine. (Pelouze.)

Solubility of NaCl in glycerine+Aq at 25°.
G = g. glycerine in 100 g. glycerine+Aq.
NaCl = millimols NaCl in 100 cc. of the solution.

G	NaCl	Sp. gr.
0	545.6	1.1960
13.28	501.1	1.2048
25.98	448.4	1.2133
45.36	370.2	1.2283
54.23	333.9	1.2381
83.84	220.8	1.2696
100	167.1	1.2964

(Herz and Knoch, Z. anorg. 1905, **45.** 267.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3602.)

Solubility of NaCl in solutions of $HgCl_2$ in ethyl acetate.

100 mols. ethyl acetate dissolve			
Mols. $HgCl_2$	Mols. NaCl	Mols. $HgCl_2$	Mols. NaCl
40.0	20.0	18.0	5.1
38.1	19.6	16.4	4.3
36.0	19.2	14.1	3.8
34.9	18.5	13.2	2.9
34.8	18.3	12.4	2.3
32.1	13.8	12.0	1.6
28.0	9.1	12.2	1.3
22.8	7.0	12.9	0.8
22.9	7.0	. . .	. . .

(Linebarger, Am. Ch. J. 1894, **16.** 215.)

Solubility of NaCl in urea+Aq at 25°.

% urea	% NaCl	% urea	% NaCl
0	31.80	18	27.65
5	30.63	23	27.24
9.6	29.05	28	26.56
13	28.46	..	....

(Ritzel, Z. Kryst. Min. 1911, **49.** 152.)

Solubility of NaCl in urea+Aq at (?)°.
g=g. urea in 100 cc. of solution.
sol.=increase of solubility of NaCl in g. per 100 cc. of the solution.

g.	sol.	g.	sol.
[illegible]	0.044	30	0.709
[illegible]	0.124	35	0.910
15	0.234	40	1.134
20	0.372	45	1.370
25	0.529	50	1.602

(Fastert, N. Jahrb. Min. Beil. Bd. 1912, **23.** 286.)

Solubility of NaCl in formamide+Aq at 25°.

% $HCONH_2$	% NaCl	% $HCONH_2$	% NaCl
0	31.80	11	29.11
2.3	30.98	15	28.52
5.3	30.86	18.8	27.76
8	30.40	...	....

(Ritzel, Z. Kryst. Min. 1911, **49.** 152.)

Insol. in anhydrous and in 97% pyridine. Very sl. sol. in 95% pyridine+Aq. Sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

Insol. in oil of turpentine. (T. S. Hunt, Am. J. Sci. (2) **19.** 417.)

100 g. H_2O dissolve 236.3 g. sugar+42.3 g. NaCl at 31.25°, or 100 g. sat. aq. solution contain 62.17 g. sugar+11.13 g. NaCl. (Köhler, Z. Ver. Zuckerind, 1897, **47.** 447.)

Solubility of NaCl in glucose+Aq at 25°.
Conc.=concentration of glucose+Aq in g. mol. per 1,000 g. H_2O.
Sol.=Solubility in 1,000 g. H_2O.

Conc.	Sol.	Molecular solubility
0	361.40	6.18
0.25	364.15	6.22
0.50	364.30	6.23
1.0	369.90	6.32

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) **84.** 127.)

Min. *Halite.*

$+2H_2O$. Efflorescent below 0°; sl. deliquescent at temps. above 0°. (Fuchs, **1826.**)

The solubility in H_2O at —12.25° corresponds to 32.9 pts. of NaCl per 100 pts. H_2O. (Matignon, C. R. 1909, **148.** 551.)

Sodium stannic chloride, $2NaCl, SnCl_4+6H_2O$.

See **Chlorostannate, sodium.**

Sodium thallic chloride, $3NaCl, TlCl_3+12H_2O$.

Very sol. in H_2O. (Pratt, Am. J. Sci. 1895, (3) **49.** 404.)

Sodium uranium chloride, $2NaCl, UCl_4$.

Non volatile and not hydroscopic. (Moissan, C. R. 1896, **122.** 1089.)

Sol. in H_2O. (Colani, A. ch. 1907, (8) **12.** 59.)

Sodium uranyl chloride, $Na_2(UO_2)Cl_4$.

As K salt. (Aloy, Bull. Soc. 1899, (3) **21.** 264.)

Sodium zinc chloride, $2NaCl, ZnCl_2+3H_2O$.

Deliquescent. Easily sol. in H_2O. (Schindler, Mag. Pharm. **36.** 48.)

Sodium zirconium chloride, $2NaCl, ZrCl_4$.

(Paykull.)

Sodium chloroiodide, $NaCl_4I+2H_2O$.

Easily decomp. by alcohol or ether. (Wells and Wheeler, Sill. Am. J. **143.** 42.)

Sodium fluoride, NaF.

Very sl. sol. in cold, and not more abundantly in boiling H_2O. (Rose.)

100 pts. H_2O dissolve 4.78 pts. at 16°. (Berzelius.)

100 pts. H_2O dissolve 4 pts. at 15°. (Fremy, A. ch. (3) **47.** 32.)

Sp. gr. of aqueous solutions containing in 100 pts. H_2O:

1.1081	2.2162	3.3243	pts. NaF.
1.0110	1.0221	1.0333	

Sat. solution has sp. gr. 1.0486. (Gerlach, Z. anal. **27.** 277.)

Sp. gr. of solution sat. at 18°=1.044, containing 4.3% NaF. (Mylius and Funk, B. 1897, **30.** 1718.)

Solubility of NaF in HF+Aq at 21°.

g. per 1000 g. H_2O		g. per 1000 g. H_2O	
HF	NaF	HF	NaF
0.0	41.7	83.8	22.9
10.0	41.4	129.7	23.8
45.8	22.5	596.4	48.8
56.5	22.7	777.4	81.7

(Ditte, C. R. 1896, **123.** 1282.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46.** 2.)

Sl. sol. in conc. $KC_2H_3O_2+Aq$. (Stromeyer.)

Almost insol. in alcohol. (Berzelius, Pogg. **1.** 13.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sodium hydrogen fluoride, $NaHF_2$.

Rather difficultly sol. in cold, more easily in hot H_2O. (Berzelius, Pogg. **1.** 13.)

Sodium tantalum fluoride.

See **Fluotantalate, sodium.**

Sodium tin (stannous) fluoride, $2NaF, 3SnF_2$.

Sol. in H_2O. (Wagner, B. **19.** 896.)

Sodium tin (stannic) fluoride.

See **Fluostannate, sodium.**

Sodium tantalum fluoride.

See **Fluotantalate, sodium.**

Sodium tellurium fluoride, NaF, TeF_4.

Decomp. by H_2O. (Berzelius.)

Sodium titanium fluoride.

See **Fluotitanate, sodium.**

Sodium tungstyl fluoride.

See **Fluoxytungstate, sodium.**

Sodium uranium fluoride, NaF, UF_4 (?).

Somewhat soluble in H_2O. (Bolton.)

Sodium uranyl fluoride.

See **Fluoxyuranate, sodium.**

Sodium vanadium ***sesqui*****fluoride.**

See **Fluovanadate, sodium.**

Sodium zinc fluoride, NaF, ZnF_2.

Sol. in H_2O. (R. Wagner.)

Sodium zirconium fluoride, $5NaF, 2ZrF_4$.

See **Fluozirconate, sodium.**

Sodium fluoride vanadium ***pent*****oxide.**

See **Fluoxyvanadate, sodium.**

Sodium hydrazide, $NH_2, NHNa$.

Decomp. by H_2O with explosive violence. Decomp. by alcohol. (Schlenk, B. 1915, **48.** 670.)

Sodium hydride, NaH.

Decomp. by H_2O and by acids.

Sol. in fused Na or Na amalgam. Insol. in liquid NH_3. Insol. in CS_2, CCl_4, C_6H_6 and terebenthene. (Moissan, C. R. 1902, **134.** 73.)

Na_2H_4. Decomp. violently by H_2O.

Sodium hydrosulphide, $NaSH$.

Deliquescent. Sol. in H_2O and alcohol.

$+3H_2O$. Difficultly sol. in H_2O. (Damoiseau, C. C. **1885.** 36.)

Sodium hydroxide, $NaOH$.

Very deliquescent. 100 pts. NaOH under a bell jar with H_2O at 16–20° absorb 552 pts. in 56 days. (Mulder.)

Very sol. in H_2O with evolution of much heat. Sol. in 0.47 pt. H_2O. (Bineau, C. R. **41.** 509.)

Solubility of NaOH in H_2O.

t°	g. per 100 g. Solution	g. per 100 g. H_2O	Solid phase
−7.8	8.0	8.7	Ice
−20	16.0	19.1	"
−28	19.0	23.5	Ice + $NaOH.7H_2O$
−24	22.2	28.5	$NaOH.7H_2O + NaOH.5H_2O$
−17.7	24.5	32.5	$NaOH.5H_2O + NaOH.4H_2O$
0	29.6	42.0	$NaOH.4H_2O$
+5	32.2	47.5	$NaOH.4H_2O + NaOH.3\frac{1}{2}H_2O$
10	34.0	51.5	$NaOH.3\frac{1}{2}H_2O$
15.5	38.9	63.53	" f. pt.
5	45.5	83.5	$NaOH.3\frac{1}{2}H_2O + NaOH.2H_2O$
12	50.7	103.0	$NaOH.2H_2O + NaOH.H_2O$
20	52.2	109	$NaOH.H_2O$
30	54.3	119	"
40	56.3	129	"
50	59.2	145	"
60	63.5	174	"
64.3	69.0	222.3	" f. pt.
61.8	74.2	288	$NaOH.H_2O + NaOH$
80	75.8	313	NaOH (?)
110	78.5	365	"
192	83.9	521	"

(Pickering, Chem. Soc. 1893, **63.** 890; Mylius and Funk, W. A. B. 1900, **3.** 450. Calc. by Seidell, Solubilities, 2d Edition, p. 653.)

100 g. sat. NaOH+Aq at 15° contain 46.36 g. NaOH. (de Forcrand, C. R. **149.** 1344.)

Sp. gr. and b-pt of NaOH+Aq.

% Na_2O	Sp. gr.	B.-pt.	% Na_2O	Sp. gr.	B.-pt.
4.7	1.06	100.56°	31.0	1.44	120.00°
9.0	1.12	101.11	34.0	1.47	123.89
13.0	1.18	102.78	36.8	1.50	129.44
16.0	1.23	104.44	41.2	1.56	137.78
19.0	1.29	106.66	46.6	1.63	148.89
23.0	1.32	108.89	53.8	1.72	204.44
26.0	1.36	112.78	63.6	1.85	315.56
29.0	1.40	116.66	77.8	2.00	red heat.

(Dalton.)

Sp. gr. of NaOH+Aq at 15°.

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
0.302	1.0040	10.879	1.1630	21.154	1.3053
0.601	1.0081	11.484	1.1734	21.758	1.3125
1.209	1.0163	12.088	1.1841	21.894	1.3143
1.813	1.0246	12.692	1.1948	22.363	1.3198
2.418	1.0330	13.297	1.2058	22.967	1.3273
3.022	1.0414	13.901	1.2178	23.572	1.3349
3.626	1.0500	14.506	1.2280	24.176	1.3426
4.231	1.0587	15.110	1.2392	24.780	1.3505
4.835	1.0675	15.714	1.2453	25.385	1.3586
5.440	1.0764	16.319	1.2515	25.989	1.3668
6.044	1.0855	16.923	1.2578	26.594	1.3751
6.648	1.0948	17.528	1.2642	27.200	1.3836
7.253	1.1042	18.132	1.2708	27.802	1.3923
7.857	1.1137	18.730	1.2775	28.407	1.4011
8.462	1.1233	19.341	1.2843	29.011	1.4101
9.066	1.1330	19.954	1.2912	29.616	1.4193
9.670	1.1428	20.550	1.2982	30.220	1.4285
10.275	1.1528	..	..	..	..

(Tünnerman, N. J. Pharm. **18.** 2.)

Sp. gr. of NaOH+Aq.

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
2.07	1.02	14.73	1.16	28.16	1.30
4.02	1.04	16.73	1.18	29.96	1.32
5.89	1.06	18.71	1.20	31.67	1.34
7.69	1.08	20.66	1.22	32.40	1.35
9.43	1.10	22.58	1.24	33.08	1.36
11.10	1.12	24.47	1.26	34.41	1.38
12.81	1.14	26.33	1.28	...	..

(Richter.)

Sp. gr. of NaOH+Aq at 15°.

%	Sp. gr. if % is Na_2O	Sp. gr. if % is NaOH	%	Sp. gr. if % is Na_2O	Sp. gr. if % is NaOH
1	1.015	1.012	32	1.450	1.351
2	1.030	1.023	33	1.462	1.363
3	1.043	1.035	34	1.475	1.374
4	1.058	1.046	35	1.488	1.384
5	1.074	1.059	36	1.500	1.395
6	1.089	1.070	37	1.515	1.405
7	1.104	1.081	38	1.530	1.415
8	1.119	1.092	39	1.543	1.426
9	1.132	1.103	40	1.558	1.437
10	1.145	1.115	41	1.570	1.447
11	1.160	1.126	42	1.583	1.456
12	1.175	1.137	43	1.597	1.468
13	1.190	1.148	44	1.610	1.478
14	1.203	1.159	45	1.623	1.488
15	1.219	1.170	46	1.637	1.499
16	1.233	1.181	47	1.650	1.508
17	1.245	1.192	48	1.663	1.519
18	1.258	1.202	49	1.678	1.529
19	1.270	1.213	50	1.690	1.540
20	1.285	1.225	51	1.705	1.550
21	1.300	1.236	52	1.719	1.560
22	1.315	1.247	53	1.730	1.570
23	1.329	1.258	54	1.745	1.580
24	1.341	1.269	55	1.760	1.591
25	1.355	1.279	56	1.770	1.601
26	1.369	1.290	57	1.785	1.611
27	1.381	1.300	58	1.800	1.622
28	1.395	1.310	59	1.815	1.633
29	1.410	1.321	60	1.830	1.643
30	1.422	1.332	70	...	1.748
31	1.438	1.343	..	...	...

(Gerlach, Z. anal. **8.** 279, calculated from Schiff, A. **107.** 300.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
0.61	1.0070	4.0	1.0435
0.9	1.0105	4.32	1.0473
1.0	1.0107	4.64	1.0511
1.2	1.0141	4.96	1.0549
1.6	1.0177	5.29	1.0588
2.0	1.0213	5.58	1.0627
2.36	1.0249	5.87	1.0667
2.71	1.0286	6.21	1.0706
3.0	1.0318	6.55	1.0746
3.35	1.0360	6.76	1.0787
3.67	1.0397	7.31	1.0827

Sp. gr. of NaOH+Aq at 15°—*Continued.*

% NaOH	Sp. gr.	% NaOH	Sp. gr.
7.66	1.0868	24.81	1.2748
8.0	1.0909	25.3	1.2800
8.34	1.0951	25.8	1.2857
8.68	1.0992	26.31	1.2905
9.0	1.1030	26.83	1.2973
9.42	1.1077	27.31	1.3032
9.74	1.1120	27.8	1.3091
10.0	1.1158	28.31	1.3151
10.5	1.1195	28.83	1.2311
10.97	1.1250	29.38	1.3272
11.42	1.1294	30.0	1.3339
11.84	1.1339	30.57	1.3395
12.24	1.1383	31.22	1.3458
12.64	1.1423	31.85	1.3521
13.0	1.1474	32.47	1.3585
13.55	1.1520	33.0	1.3642
13.86	1.1566	33.69	1.3714
14.5	1.1631	34.38	1.3780
14.75	1.1662	35.0	1.3858
15.0	1.1697	35.65	1.3913
15.5	1.1755	36.25	1.3981
15.91	1.1803	36.86	1.4049
16.38	1.1852	37.47	1.4118
16.77	1.1901	38.13	1.4187
17.22	1.1950	38.8	1.4267
17.67	1.2000	39.39	1.4328
17.12	1.2050	40.0	1.4410
18.58	1.2101	40.75	1.4472
19.0	1.2148	41.41	1.4545
19.58	1.2202	42.12	1.4619
20.0	1.2250	42.83	1.4694
20.59	1.2308	43.66	1.4769
21.0	1.2361	44.38	1.4845
21.42	1.2414	45.27	1.4922
22.0	1.2462	46.15	1.5000
22.64	1.2522	46.87	1.5079
23.15	1.2576	47.60	1.5158
23.67	1.2632	48.81	1.5238
24.24	1.2687	49.02	1.531

Hager, Comm. **1883.**)

The sp. gr. increases or diminishes for each degree as follows:

% NaOH	Corr.
40–50	0.00045
30–39	0.0004
20–29	0.0003
10–19	0.0002

Hager, Comm. **1883.**)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
2.5	1.0280	20	1.2262
5	1.0568	25	1.2823
10	1.1131	30	1.3374
15	1.1790	..	...

(Kohlrausch, W. Ann. **1879.**)

Sp. gr of NaOH+Aq at 20° containing 2 mols. NaOH to 100 mols. H_2O = 1.04712. (Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of NaOH+Aq at 15°

% Na_2O	Sp. gr.	% Na_2O	Sp. gr.
5	1.069	25	1.353
10	1.139	30	1.426
15	1.210	35	1.500
20	1.281	..	...

(Hager, Adjumenta Varia, Leipsic, **1876.**)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr	% NaOH	Sp. gr.	% NaOH	Sp. gr.
0	0.999180	17	1.188707	34	1.373453
1	1.010611	18	1.199783	35	1.383815
2	1.021920	19	1.210861	36	1.394092
3	1.033109	20	1.221933	37	1.404279
4	1.044317	21	1.233062	38	1.414363
5	1.055463	22	1.244119	39	1.424353
6	1.066602	23	1.255134	40	1.434299
7	1.077733	24	1.266092	41	1.444161
8	1.088856	25	1.277063	42	1.453929
9	1.099969	26	1.287990	43	1.463623
10	1.111069	27	1.298877	44	1.473249
11	1.122165	28	1.309708	45	1.482850
12	1.133250	29	1.320496	46	1.492406
13	1.144353	30	1.331213	47	1.501927
14	1.155450	31	1.341879	48	1.511412
15	1.166538	32	1.352472	49	1.520868
16	1.177619	33	1.362991	50	1.530282

(Pickering, Phil. Mag. 1894, (5) **37.** 373.)

Sp. gr. of a N solution of NaOH+Aq at 18°/18° = 1.0418. (Loomis, W. Ann. 1896, **60.** 550.)

Sp. gr. of NaOH+Aq.

%NaOH	8.73	3.67	3.82
Sp. gr. 20°/20°	1.0968	1.0416	1.0464

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 272.)

Sp. gr. of NaOH+Aq at t°. H_2O at 4° = 1. The solutions contained a small amount of Na_2CO_3.

t°	% NaOH	% Na_2CO_3	Sp. gr.
60	22.57	0.61	1.2312
	20.04	0.48	1.2026
	17.04	0.35	1.1692
	14.16	0.38	1.1374
	10.92	0.36	1.1020
80	22.81	0.55	1.2207
	14.01	0.42	1.1232

(Wegscheider and Walter, M. 1905, **26.** 691.)

Sat. NaOH+Aq boils at 215.5°. (Griffiths.)

Sat. NaOH+Aq boils at 310°. (Gerlach, Z. anal. **26.** 427.)

NaOH+Aq of 1.500 sp. gr. contains 36.8% NaOH and boils at 1[illegible]0°.

B.-pt. of NaOH+Aq containing pts. NaOH to 100 pts. H_2O.

B.-pt.	Pts. NaOH	B.-pt.	Pts. NaOH
105°	17	210°	425.5
110	30	215	475.5
115	41	220	526.3
120	51	225	583.3
125	60.1	230	645.2
130	70.1	235	714.3
135	81.1	240	800
140	93.5	245	888.8
145	106.5	250	1000
150	120.4	255	1142.8
155	134.5	260	1333.3
160	150.8	265	1534
165	168.8	270	1739.1
170	187	275	2000
175	208.3	280	2353
180	230	285	2857
185	254.5	290	3571.4
190	281.7	300	4651.1
195	312.3	305	6451.6
200	345	310	10526.3
205	380.9	314	22222.2

(Gerlach, Z. anal. **26.** 463.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sp. gr. of Na_2CO_3+NaOH+Aq at 11.5°. H_2O at 4° = 1.

% Na_2CO_3	% NaOH	Sp. gr.
3.845	14.10	1.196
3.171	13.63	1.182
2.204	12.51	1.164
1.642	10.17	1.136
0.2686	16.64	1.186

(Wegscheider and Walter, M. 1905, **26.** 693.)

Sp. gr. of Na_2CO_3+NaOH+Aq at t°. H_2O at 4° = 1.

t°	% Na_2CO_3	% NaOH	Sp. gr.
60°	15.38	10.63	1.2621
	13.79	9.52	1.2302
	12.10	8.29	1.1952
	9.965	6.86	1.1594
	9.47	6.70	1.1521
	7.69	5.22	1.1158
80°	15.26	11.14	1.2510
	9.48	6.93	1.1417

(Wegscheider and Walter, M. 1905, **26.** 692.)

Solubility of NaOH+Na_3SbS_4 at 30°.

% NaOH	% Na_3SbS_4	Solid phase
0	27.1	Na_3SbS_4, $9H_2O$
9.9	13.	"
24.8	5.9	"
32.9	10.5	"
42.6	16.4	"
47.2	17.7	" +NaOH, H_2O
49.5	9.1	NaOH, H_2O
54.3	0	"

(Donk, Chem. Weekbl. 1908, **5.** 529, 629, 767.)

Easily sol. in alcohol or wood spirit; sol. in fusel-oil. Sol. in an aqueous solution of mannite. (Favre, A. ch. (3) **11.** 76.)

Easily sol. in glycerine.

Sol. to a certain extent in ether.

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate (Naumann, B. 1904, **37.** 3602); benzonitrile. (Naumann, B. 1914, **47.** 1370.)

+H_2O. 100 g. solution in H_2O sat. at 25° contain 42 g. Na_2O. (Schreinemakers, Arch. Néer. Sc. 1910, (2) **15.** 81.)

Mpt. 64.3°. (See above.)

+$1^1/_3H_2O$. (Cripps, Pharm. J. Trans. (3) **14.** 833.)

+$2H_2O$. See above.

+$3^1/_2H_2O$. Deliquescent. Sol. in H_2O with absorption of much heat. Melts at 6°. (Hermes.)

Mpt. 15.5°. (See above.)

+4, 5 and $7H_2O$. (See above.)

The composition of the hydrates formed by NaOH at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by NaOH and of the conductivity and sp. gr. of NaOH+Aq. (Jones, Am. Ch. J. 1905, **34.** 336.)

Sodium *per*hydroxide, NaO_2H.

"Natryl hydroxide."

Decomp. by H_2O. Sol. in cold alcoholic acetic acid. (Tafel, B. 1894, **27.** 2300.)

Sodium iodide, NaI, and +$2H_2O$.

Solubility of NaI and of NaI+$2H_2O$ in H_2O differ. Below 65°, NaI+$2H_2O$ usually separates out, and above that temp. NaI separates.

Solubility of NaI in 100 pts. H_2O at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
71.3	294.4	92.4	300.2	124.7	317.5
74.1	295.3	97.1	300.3	132.5	317.3
81.6	296.8	101.7	302.5	138.1	319.2
86.4	298.3	110.7	306.2	...	...

Solubility is represented by a straight line of the formula S=264.19+0.3978t.

Solubility of NaI+$2H_2O$ in 100 pts. at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
-17	149.4	15	173.7	45	215.6
-15	150.3	20	178.7	50	227.8
-5	155.4	25	184.2	55	241.2
0	158.7	30	190.3	60	256.8
5	163.6	35	197.0	65	278.4
10	168.6	40	205.1	..	...

(Coppet, A. ch. (5) **30.** 424.)

If solubility S=pts. NaI in 100 pts. solution, S=61.3+0.1712t from 0° to 80°; S=75+0.0258t from 80° to 160°. (Étard, C. R. **98.** 1432.)

NaI+$2H_2O$ is sol. in 0.55 pt. H_2O at 15°. (Eder, Dingl. **221.** 89.)

100 pts. NaI+Aq at 18–19° contain 62.98 pts. NaI. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O dissolve at:

0°	20°	40°	60°	
158.7	178.6	208.4	256.4	pts. NaI,
80°	100°	120°	140°	
303	312.5	322.5	333.3	pts. NaI.

(Kremers, Pogg. **97.** 14.)

Transition pt. for NaI+$2H_2O$ to NaI is 64.3°, and sat. solution containing 74.4% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, **25.** 162.)

100 g. H_2O dissolve 172.4 g. NaI at 15°, and sp. gr. of sat. solution=1.8937. (Greenish, Pharm. J. 1900, **65.** 190.)

100 g. solution of NaI+$2H_2O$ sat. at 30° contains 65.5 g. anhyd. NaI. (Cocheret, Dissert. **1910.**)

Sp. gr. of NaI+Aq at 19.5° containing:

5	10	15	20	25	30 % NaI,
1.040	1.082	1.128	1.179	1.234	1.294
35	40	45	50	55	60 % NaI.
1.360	1.432	1.510	1.60	1.70	1.81

(Gerlach, Z. anal. **8.** 285.)

Sat. solution boils at 141°.

Sol. in liquid SO_2. (Walden, B. 1899, **32.** 2864); $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in 12.0 pts. absolute alcohol; in 360 pts. ether. (Eder, Dingl. **221.** 89.)

Sol. in 3 pts. 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 77.7 pts. NaI at 22.5°; ethyl alcohol, 43.1 pts. (de Bruyn, Z. phys. Ch. **10.** 783.)

Very sol. in abs. methyl alcohol and is not pptd. therefrom on the addition of a large volume of abs. ether, while wet ether produces immediate separation. (Loeb, J. Am. Chem. Soc. 1905, **27.** 1020.)

Solubility of NaI in ethyl alcohol.
(g. NaI in 100 g. alcohol.)

t°	NaI	t°	NaI
10	43.77	200	42.3
30	44.25	220	38.5
50	44.50	230	36.2
80	45.0	240	32.7
100	45.1	250	26.2
120	45.2	255	21.0
160	45.0	260	10.8
180	44.3	261.5*	8.6

*Critical temp. of solution.

(Tyrer, Chem. Soc. 1910, **97.** 626.)

100 g. sat. solution of NaI in ethyl alcohol at 30° contains 30.9 g. (Cocheret, Dissert, **1910.**)

Solubility in ethyl alcohol+Aq at 30°.

% NaI	% alcohol	Solid phase
65.52	0	NaI, $2H_2O$
64	3.40	"
54.2	18.5	"
54	18.8	"
48.8	28.5	"
42.35	41.7	"
38.5	53.2	"
37.91	54.7	"
37.49	55.37	NaI, $2H_2O$+NaI
35.65	59.24	NaI
33.24	61.78	"
30.90	68.70	"

(Cocheret, Dissert. **1911.**)

At room temp. 1 pt. by weight is sol in:

1.2 pts. methyl alcohol D^{15} 0.7990.
1.7 " ethyl " D^{15} 0.8100.
3.8 " propyl " D^{15} 0.8160.

(Rohland, Z. anorg. 1898, **18.** 325.)

100 g. methyl alcohol dissolve 90.35 g. NaI at 25°.
100 g. ethyl alcohol dissolve 46.02 g. NaI at 25°.
100 g. propyl alcohol dissolve 28.22 g. NaI at 25°.
100 g. isoamyl alcohol dissolve 16.30 g. NaI at 25°.

(Turner and Bissett, Chem. Soc. 1913, **103.** 1909.)

Solubility in methyl alcohol+ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.
G = g. NaI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution at 25°.

P	G	S 25°/4°
0.00	3.515	1.0806
4.37	3.768	1.1029
10.40	3.971	1.1123
41.02	4.598	1.1742
80.69	5.744	1.2741
84.77	5.892	1.2886
91.25	6.110	1.3056
100.00	6.322	1.3250

(Herz and Kuhn, Z. anorg. 1908, **60.** 154.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NaI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	6.322	1.3250
11.11	5.845	1.2853
23.8	5.464	1.2528
65.2	4.071	1.138
91.8	2.914	1.0420
93.75	2.649	1.0178
100.00	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, **60.** 156.)

Solubility in mixtures of propyl and ethy alcohol at 25°.

P = % propyl alcohol in the solvent.
G = g. NaI in 10 ccm. of the solution.
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	3.515	1.0806
8.1	3.460	1.0732
17.85	3.405	1.0720
56.6	2.841	1.0276
88.6	2.613	1.0130
91.2	2.588	1.0104
95.2	2.474	1.0020
100	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, **60.** 159.)

Sol. in normal propyl alcohol. (Loeb, J. Am. Chem. Soc. 1905, **27.** 1020.)
28.74 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, **14.** 276.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)
Sol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)
Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Solubility in organic solvents at t°.

C = pts. by wt. of NaI in 100 ccm. of the sat. solution.
L = no. of liters which at the saturation temp. hold in solution 1 mol. NaI.

Solvent	t°	C	L
Furfurol	25	25.10	0.597
Acetonitrile	25	18.43	0.813
"	0	22.09	0.679
Propionitrile	25	6.230	2.406
"	0	9.091	1.649
Nitromethane	25	0.478	31.36
"	0	0.339	44.27

(Walden, Z. phys. Ch. 1906, **55.** 718.)

Very sol. in acetone. (Walden.)
$+5H_2O$. Transition point of $NaI+5H_2O$ to $NaI+2H_2O$ is $-13.5°$, and sat. solution contains 60.2% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, **25.** 162.)

Sodium tin (stannous) iodide, NaI, SnI_2.
Very sol. in H_2O. When treated with little H_2O, NaI is dissolved out, but a larger amt. of H_2O dissolves it completely. (Boullay, A. ch. (2) **34.** 375.)

Sodium zinc iodide, $2NaI, ZnI_2+3H_2O$.
Deliquescent.
$NaZnI_3+2H_2O$. Very hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 383.)

Sodium nitride,
Decomp. by heat. (Franz Fisher, B. 1910, **43.** 1468.)

Sodium *sub*oxide, Na_3O.
Decomp. by H_2O. (de Forcrand, C. R. 1898, **127.** 365.)

Sodium oxide, Na_2O.
Very deliquescent, and sol. in H_2O with evolution of heat.
See **Sodium hydroxide.**

Sodium *per*oxide, Na_2O_2.
Deliquescent, and very sol. in H_2O with partial decomp.
Solution decomp. on boiling.
Cryst. with $2H_2O$, and $8H_2O$. (Fairley, Chem. Soc. **1877.** 125.)
Forms hydrate $Na_2O_2(OH)_4+4H_2O$.
Easily sol. in H_2O or dil. acids without decomp. (Schöne, A. **193.** 241.)

Sodium *per*oxide carbonate, Na_2CO_4.
Easily decomp. (Woffenstein, B. 1908. **41.** 285.)

Sodium *per*oxide *di*carbonate, $Na_2C_2O_6$.
Easily decomp. (Woffenstein, B. 1908, **41.** 287.)

Sodium *tri*oxide, NaO_3.
Sol. in H_2O forming a solution of Na_2O_2. (Joannis, C. R. 1893, **116.** 1371.)

Sodium *tri*oxide carbonate, Na_2CO_5.
(Woffenstein, B. 1908, **41.** 296.)

Sodium *tri*oxide *di*carbonate, $NaHCO_4$.
Two isomeric modifications. (Woffenstein, B. 1908, **41.** 390.)

Sodium *tri*oxide hydrate, NaO.OH.
See **Sodium *per*hydroxide.**
Isomeric with Tafel's sodyl hydroxide, O:Na.OH. (B. 27, 2297.)
Insol. in alcohol.
Very unstable. (Woffenstein, B. 1908, **41.** 290.)

Sodium phosphide, NaP_5.
Easily decomp. by H_2O. (Hugot, C. R. 1895, **121.** 208.)

Sodium hydrogen phosphide, NaH_2P.
Decomp. by H_2O. (Joannis, C. R. 1894, **119.** 558.)
$Na_3H_3P_2$. Decomp. by acids and H_2O. (Hugot, C. R.,1898, **126.** 1721.)

Sodium selenide, Na_2Se.
Very deliquescent. Decomp. by H_2O. (Uelsmann, A. **116.** 127.)
Insol. in liquid NH_3; sol. in air free H_2O to a colorless liquid. (Hugot, C. R. 1899, **129.** 299.)
Cryst. with $16H_2O$, $9H_2O$, and $^9/_2H_2O$. (Fabre, C. R. **102.** 613.)
$+10H_2O$. Very sol. in H_2O; very unstable in the air. (Clever, Z. anorg. 1895, **10.** 145.)

Sodium *di*selenide, Na_2Se_2.
(Jackson, B. **7.** 1277.)

Sodium *tri*selenide, Na_2Se_3.
Sol. in H_2O. (Mathewson, J. Am. Chem. Soc. 1907, **29.** 873.)

Sodium *hexa*selenide, Na_2S_6.
Sol. in H_2O. (Mathewson, J. Am. Chem. Soc. 1907, **29.** 873.)

Sodium *mono*sulphide, Na_2S.
Sol. in H_2O. Much less sol. in alcohol than in H_2O. Insol. in ether. (Roussin.)

$+5H_2O$. Tr. pt. from $Na_2S+5\frac{1}{2}H_2O$, 94°.

$+5\frac{1}{2}H_2O$.

The sat. solution contains:—

28.48% anhydrous salt	at	50°
29.27	"	"	55°
29.92	"	"	60°
31.38	"	"	70°
33.95	"	"	80°
37.20	"	"	90°

Labile from 48.9–91.5°; stabile from 91.5–96°.

(Parravano and Fornaini, C. C. **1908**, I. 5.)

$+6H_2O$. Less efflorescent than with $9H_2O$. Sol. in H_2O and alcohol.

The sat. solution contains:—

26.7 % anhydrous salt	at	50°
28.1	"	"	60°
30.22	"	"	70°
32.95	"	"	80°
36.42	"	"	90°

Tr. pt. to $Na_2S+5\frac{1}{2}H_2O$, 91.5°.

(Parravano and Fornaini.)

$+9H_2O$. Efflorescent. Much less sol. in alcohol than H_2O. When dissolved in H_2O, temp. sinks from +22 to −6.1°. (Finger, Pogg. **128**. 635.)

The sat. solution contains:—

9.34% anhydrous Na_2S	at	−10°
13.36	"	"	+10°
14.36	"	"	15°
15.30	"	"	18°
16.2	"	"	22°
17.73	"	"	28°
19.09	"	"	32°
20.98	"	"	37°
24.19	"	"	45°

Tr. pt. to $Na_2S+5\frac{1}{2}H_2O$, 48.9°.

(Parravano and Fornaini.)

Sodium *di*sulphide, Na_2S_2.

Sol. in H_2O and alcohol.

$+5H_2O$. Not efflorescent.

Sodium *tri*sulphide, Na_2S_3.

Sol. in H_2O with decomp.

Cryst. with $3H_2O$ from an alcoholic solution. (Böttger, A. **223**. 355.)

Sodium *tetra*sulphide, $Na_2S_4+6H_2O$.

Very deliquescent, and sol. in H_2O. Difficultly sol. in absolute alcohol. Insol. in ether. (Schöne.)

$+8H_2O$. Efflorescent. (Böttger.)

Sodium *penta*sulphide, $Na_2S_5+6H_2O$.

Sol. in H_2O. (Schöne.)

Sol. in alcohol.

$+8H_2O$. (Böttger.)

Solution is easily decomp. by warming. (Jones, Chem. Soc. **37**. 461.)

Sodium tellurium sulphide.

See **Sulphotellurate, sodium.**

Sodium stannic sulphide.

See **Sulphostannate, sodium.**

Sodium yttrium sulphide, Na_2S, Y_2S_3.

Decomp. by dil. acids, even by $HC_2H_3O_2$+Aq. (Duboin, C. R. **107**. 243.)

Sodium zinc sulphide, Na_2S, $3ZnS$.

Not so stable as the corresponding K salt. (Schneider, J. pr. (2) **8**. 29.)

Sodium sulphoselenide, $Na_2SSe_2+5H_2O$.

Hydroscopic, and decomp. in the air. (Messinger, B. 1897, **30**. 806.)

Sodium telluride, Na_2Te.

Sol. in H_2O. (Demarçay, Bull. Soc. (2) **40**. 99.)

Sodium *tri*telluride, Na_2Te_3.

Sol. in H_2O.

Sol. in liquid NH_3. (Hugot, C. C. **1899**, II. 580.)

Stannic acid, H_2SnO_3.

Insol. in H_2O. Sol. in HCl, and H_2SO_4+Aq, even when dil. (Fremy.) Easily sol. in acids, from which solution it may be pptd. by dilution or boiling. While moist it is sol. in HNO_3+Aq, but gradually separates on standing, and coagulates at once when heated to 50°. If NH_4NO_3 be added to the solution, it remains clear at ord. temp. (Berzelius.)

Easily sol. in HNO_3+Aq, when previously treated with NH_4OH+Aq. (Thénard.)

Easily sol. in KOH+Aq, but addition of large excess ppts. K_2SnO_3, insol. in KOH+Aq.

Easily sol. in NaOH+Aq, and not pptd. by an excess of that reagent. (Barfoed, J. B. **1867**. 267.)

Sl. sol. in NH_4OH+Aq or $(NH_4)_2CO_3$+Aq.

Completely sol. in K_2CO_3+Aq, but not in Na_2CO_3+Aq.

Insol. in alkali hydrogen carbonates or NH_4Cl+Aq.

Sol. in alkali sulphides+Aq. (Berzelius.)

Sol. in triethyltoluenyl ammonium hydrate+Aq.

Not pptd. by NH_4OH+Aq in presence of Na citrate+Aq.

SnO_2, $2H_2O$. (Weber, Pogg. **122**. 358.)

"*a-Orthostannic acid.*" Easily sol. in HCl+Aq. (Neumann, M. **12**. 515.)

$H_{10}Sn_5O_{15}$ (?)

Metastannic acid. Insol. in H_2O, HNO_3, or H_2SO_4+Aq. Insol. in HCl+Aq, but converted thereby into metastannic chloride, which dissolves after excess of HCl has been removed. (Fresenius.) Insol. in HCl+Aq of sp. gr. 1.1. (Barfoed.) Sol. in large amount

of conc. $HCl+Aq$. (Allen, Chem. Soc. (2) **10.** 274.)

In contact with $HCl+Aq$, metastannic acid is converted into stannic acid. (Barfoed.)

Insol. in HNO_3+Aq even after treatment with NH_4OH+Aq.

Insol. in NH_4OH+Aq.

Sol. in KOH or $NaOH+Aq$ with formation of metastannates, which are insol. in dil. $NaOH+Aq$, but sol. in H_2O or $KOH+Aq$, therefore $KOH+Aq$ dissolves metastannic acid, while $NaOH+Aq$ does not, but if the clear solution in $KOH+Aq$ is treated with a large excess of that reagent, a further pptn. occurs. (Barfoed, J. pr. **101.** 368.)

Insol. in K_2CO_3+Aq (Rose); alkali carbonates+Aq. (Fremy.)

Insol. in NH_4Cl+Aq even after long boiling.

Sol. in $Fe(NO_3)_3+Aq$ containing HNO_3. (Lepèz and Storch, W. A. B. **98, 2b.** 270.)

Also in $Cr(NO_3)_3+Aq$, but not in $Ce(NO_3)_3$, $Al(NO_3)_3$, $Co(NO_3)_2+Aq$, etc. (L. and S.)

A colloidal metastannic acid sol. in H_2O can be obtained. (Lepèz and Storch.)

According to Weber (Pogg. **122.** 358), stannic and metastannic acids are only different hydrates of same oxide, and it is not a case of allotropic modification.

Colloidal. H_2SnO_3 in colloidal state can be obtained in aqueous solution containing 5.164 g. SnO_2 in a litre. This solution is coagulated by HNO_3+Aq only when in great excess; easily by dil. H_2SO_4+Aq, but not by conc. $HCl+Aq$. NH_4OH+Aq in large excess causes coagulation; also NH_4Cl, NaOH, NaCl, Na_2SO_4, etc. (Schneider, Z. anorg. **5.** 83.)

***Para*stannic acid,** $H_2Sn_5O_{11}+3H_2O$.

(Engel, C. R. 1897, **125.** 711.)

Stannates.

Stannates of alkali metals are sol. in H_2O; others are insol. All metastannates, excepting Na, K, and NH_4 salts, are insol. in H_2O. (Fremy, A. ch. (3) **12.** 474.)

Ammonium stannate, $(NH_4)_2O$, $2SnO_2$.

Sol. in H_2O. Insol. in dil. NH_4OH+Aq. (Berzelius.)

$+xH_2O$. (Moberg, **1838.**)

Ammonium cupric stannate, $(NH_4)_2O$, $CuSnO_3+2H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96.** 701.)

Barium stannate, $BaSnO_3+6H_2O$.

Ppt. Sol. in $HCl+Aq$. (Moberg.)

$Ba_2SnO_4+10H_2O$. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **95.** 641.)

Calcium stannate, $CaSnO_3+4H_2O$.

Ppt. (Moberg.)

$+5H_2O$. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96.** 701.)

2CaO, SnO_2. (Zulkowski, Chem. Ind. 1901, **24.** 422.)

Cobaltous stannate, $CoSnO_3+6H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte.)

Cupric stannate, $CuSnO_3+3H_2O$.

(Moberg.)

$+4H_2O$. Insol. in H_2O. (Ditte.)

Cuprous stannous stannate, Cu_2O, 3SnO, SnO_2+5H_2O.

Slowly decomp. by dil. acids, and NH_4OH+Aq; completely decomp. by conc. acids. (Lenssen, J. pr. **79.** 90.)

Gold (aurous) stannate.

See **Gold purple.**

Lead stannate, $RbSn(OH)_6$.

Ppt. (Bellucci, Chem. Soc. 1905, **88.** (2) 40.)

Lithium stannate *hexa*tungstate, $2Li_2O$, SnO_2, $6WO_3=Li_2SnO_3$, $Li_2W_6O_{19}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27.** 49.)

Magnesium stannate.

Ppt. (Moberg.)

Manganous stannate.

Ppt. (Moberg.)

Mercurous stannate, $Hg_2SnO_3+5H_2O$.

Ppt.

Mercuric stannate, $HgSnO_3+6H_2O$.

Ppt. (Moberg, J. pr. **28.** 231.)

Nickel stannate, $NiSnO_3+5H_2O$.

Insol. in H_2O. Sol. in acids. (Ditte, C. R. **96.** 701.)

Platinous sodium stannous stannate, 2PtO, Na_2O, SnO, SnO_2(?).

(Schneider, Pogg. **136.** 105.)

Platinous stannous stannate, PtO, 2SnO, SnO_2.

Decomp. by conc. alkalies. (Schneider,) Pogg. **136.** 105.)

Potassium stannate, $K_2SnO_3+3H_2O$.

100 pts. H_2O dissolve 106.6 pts. at 10°, solution has sp. gr. = 1.618; 100 pts. dissolve 110.5 pts. at 20°, solution has sp. gr. = 1.627. (Ordway, Sill. Am. J. (2) **40.** 173.)

Very sl. sol. in conc. KOH+Aq.
Insol. in KCl+Aq. (Fremy.)
Insol. in alcohol.
Pptd. from aqueous solution by the addition of any soluble salt, especially those of K, Na, and NH_4 (Fremy); by NH_4Cl, but not by KCl or NaCl (Ordway).
Insol. in acetone. (Naumann, B. 1904, **37.** 329.)

Potassium *meta*stannate, K_2O, $10SnO_2$.
K_2O, $7SnO_2+3H_2O$. Sol. in H_2O. Solution gelatinises on heating. (Rose.)
K_2O, $6SnO_2+5H_2O$. Sol. in H_2O, but loses its solubility by drying. (Fremy, A. ch. (3) **12.** 475.)
K_2O, $5SnO_2+4H_2O$. Completely sol. in H_2O. Insol. in alcohol. (Fremy, A. ch. (3) **23.** 396.)
K_2O, $3SnO_2+3H_2O$. Deliquescent (Fremy.)

Silver stannate, Ag_2SnO_3.
Insol. in H_2O. Unacted upon by NH_4OH or HCl+Aq. (Ditte.)

Silver (argentous) stannous stannate (?), Ag_4O, SnO, $3SnO_2+3H_2O$ (?).
Cold dil. HNO_3+Aq slowly dissolves all Ag, hot HNO_3+Aq rapidly.
Easily sol. in boiling conc. H_2SO_4. (Schulze, J. B. **1857.** 257.)

Sodium stannate, $Na_2SnO_3+3H_2O$.
More easily sol. in cold than in hot H_2O. (Fremy.)
Sol. in 2 pts. H_2O at 20° and 100.° (Marignac.)
100 pts. H_2O dissolve 67.4 pts. at 0°, 61.3 pts. at 20°, and solutions have sp. gr. = 1.472 and 1.438 at 15.5°. (Ordway, Sill. Am. J. (2) **40.** 173.)
Pptd. from Na_2SnO_3+Aq by salts of K, Na, and NH_4.
Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)
$+4H_2O$. (Prandtl, B. 1907, **40.** 2129.)
$+8H_2O$. (Haeffely, J. B. **1857.** 650.)
$+9H_2O$. (Jones, C. C. **1865.** 607.)
$+10H_2O$. Very efflorescent. (Scheurer-Kestner, Bull. Soc. (2) **8.** 389.)

Sodium *meta*stannate, Na_2O, $9SnO_2+8H_2O$.
Sol. in H_2O. Insol. in NaOH+Aq or alcohol. (Barfoed, J. B. **1867.** 267.)
Na_2O, $5SnO_2$. Very difficultly sol. in H_2O. (Fremy, A. ch. (3) **23.** 399.)
Insol. in KOH+Aq.
$+8H_2O$. (Haeffely, Chem. Gaz. **1855.** 59.)

Sodium stannate vanadate,
Na_2SnO_3, $3Na_3VO_4+32H_2O$.
Na_2SnO_3, $4Na_3VO_4+48H_2O$.
Na_2SnO_3, $5Na_3VO_4+64H_2O$.
Na_2SnO_3, $6Na_3VO_4+80H_2O$. (Prandtl, B. 1907, **40.** 2128.)

Strontium stannate, 3SrO, $2SnO_2+10H_2O$.
Ppt. Insol. in H_2O. Sol. in acids. (Ditte, C. R. **95.** 641.)
$SrSn(OH)_6$. (Belluci, Chem. Soc. 1905, **88** (2) 40.)

Tin (stannous) stannate, SnO, $6SnO_2+5H_2O$.
Insol. in H_2O. Decomp. by HNO_3+Aq into metastannic acid. (Schiff, A. **120.** 53.)
Sol. in HCl+Aq, and in KOH+Aq.

Tin (stannous) *meta*stannate, SnO, $7SnO_2$.
SnO, $3SnO_2+9H_2O$. Sol. in KOH+Aq or in HCl+Aq. (Fremy.)
$+4H_2O$. (Schiff.)

Zinc stannate, $ZnSnO_3+2H_2O$.
Ppt. (Moberg, **1838.**)
3ZnO, $2SnO_2+10H_2O$. Insol. in H_2O. Sol. in acids. (Ditte.)

***Per*stannic acid,** $H_2Sn_2O_7$.
See **Perstannic acid.**

Stannophosphomolybdic acid.

Ammonium stannophosphomolybdate, $3(NH_4)_2O$, $4SnO_2$, $3P_2O_5$, $16MoO_3+28H_2O$.
Quite insol. even in boiling H_2O. (Gibbs, Am. Ch. J. **7.** 392.)

Stannophosphotungstic acid.

Ammonium stannophosphotungstate, $2(NH_4)_2O, 2SnO_2, P_2O_5, 22WO_3+15H_2O$.
Precipitate. Sl. sol. in boiling H_2O. (Gibbs, Am. Ch. J. **7.** 319.)

Stannosulphuric acid.
See **Sulphate, stannic.**

Stibine.
See **Hydrogen antimonide.**

Strontium, Sr.
Decomp. by H_2O with violence. Dil. H_2SO_4, and HCl+Aq decomp. and dissolve; cold H_2SO_4 attacks slowly. Fuming HNO_3 has scarcely any action even when boiling. (Franz, J. pr. **107.** 253.)
Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)
Sol. in excess of liquid NH_3 at —60° forming $Sr(NH_3)_6$. (Roederer, C. R. 1905, **140.** 1252.)

Strontium amalgam, $SrHg_{12}$.
Stable below 30°. Above 30° the composition of the amalgam varies. Can be cryst. from Hg at any temp. below 30°. (Kerp, Z. anorg. 1900, **25.** 68.)

Strontium amide, $Sr(NH_2)_2$.
(Roederer, Bull. Soc. 1906, (3) **35.** 715.)

Strontium arsenide, Sr_3As_2.

Decomp. by H_2O. (Lebeau, C. R. 1899, **129.** 47.)

Strontium azoimide, SrN_6.

Hydroscopic.

45.83 pts. are sol. in 100 pts. H_2O at 16°.

0.095 " " " " 100 " abs. alcohol at 16°.

Insol. in pure ether. (Curtius, J. pr. 1898, (2) **58.** 287.)

Strontium boride, SrB_6.

Sol. in fused oxidizing agents; not decomp. by H_2O; insol. in aq. acids; sl. sol. in conc. H_2SO; sol. in dil. and conc. HNO_3. (Moissan, C. R. 1897, **125.** 633.)

Strontium bromide, $SrBr_2$, and $+6H_2O$.

100 pts. H_2O dissolve at:

0°	20°	38°	59°	83°	110°	
87.7	99	112	133	182	250	pts. $SrBr_2$.

(Kremers, Pogg. **103.** 65.)

Sat. $SrBr_2$+Aq contains at:

—11°	—1°	+7°	18°	
43.1	46.85	48.2	51.7	% $SrBr_2$,
20°	93°	97°	107°	
51.8	68.5	68.7	69.8	% $SrBr_2$.

(Étard, A. ch. 1894, (7) **2.** 540.)

Sp. gr. of $SrBr_2$+19.5° containing:

5	10	15	20	25	% $SrBr_2$,
1.046	1.094	1.146	1.204	1.266	
30	35	40	45	50	% $SrBr_2$.
1.332	1.41	1.492	1.59	1.694	

(Kremers, Pogg. **99.** 444; calculated by Gerlach, Z. anal. **8.** 285.)

Somewhat sol. in absolute alcohol. (Löwig.)

Solubility of anhydrous $SrBr_2$ in alcohol is practically constant between 0° and 40°, 100 ccm. of abs. alcohol dissolving about 64.5 g. of the anhydrous salt and forming a solution having a sp. gr.=1.210 at 0°. (Fonzes-Diacon, Chem. Soc. 1895, **68** (2) 223.)

Much more sol. than $BaBr_2$ in boiling amyl alcohol.

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Strontium stannic bromide.

See **Bromostannate, strontium.**

Strontium bromide ammonia, $2SrBr_2, NH_3$.

Sol. in H_2O. (Rammelsberg, Pogg. **55.** 238.

Strontium bromide hydrazine, $SrBr_2, 3N_2H_4$.

Very sol. in H_2O. (Franzen, Z. anorg. 1908, **60.** 290.)

Strontium bromofluoride, $SrF_2, SrBr_2$.

Decomp. by H_2O. (Defacqz, A. ch. 1904, (8) **1.** 356.)

Strontium carbide, SrC_2.

Easily decomp. by H_2O and dil. acids. (Moissan, Bull. Soc. 1894, (3) **11.** 1008.)

Strontium carbonyl, $Sr(CO)_2$.

(Roederer, Bull. Soc. 1906, (3) **35.** 725.)

Strontium chloride, $SrCl_2$, and $+6H_2O$.

Deliquescent in moist air.

Sol. in 1.5 pts. H_2O at 15°, and 0.8 pt. at boiling (Dumas); in 1.996 pts. H_2O at 15° (Gerlach).

1 pt. anhydrous $SrCl_2$ is sol. in 2.27 pts. H_2O at 0°; in 1.88 pts. at 20°; in 1.54 pts. at 40°; in 1.18 pts. at 60°; in 1.08 pts. at 80°; in 0.98 pt. at 100°. (Kremers, Pogg. **103.** 66.)

100 pts. H_2O dissolve 106.2 pts. $SrCl_2$+$6H_2O$ at 0°, and 205.8 pts. at 40°. (Tilden, Chem. Soc. **45.** 409.)

Solubility in 100 pts. H_2O at t°

t°	Pts. $SrCl_2$	t°	Pts. $SrCl_2$	t°	Pts. $SrCl_2$
0	44.2	41	67.4	81	92.7
1	44.5	42	68.2	82	93.1
2	44.8	43	68.9	83	93.4
3	45.2	44	69.7	84	93.7
4	45.6	45	70.4	85	94.1
5	46.0	46	71.2	86	94.5
6	46.5	47	72.0	87	94.9
7	46.9	48	72.8	88	95.4
8	47.4	49	73.6	89	95.8
9	47.8	50	74.4	90	96.2
10	48.3	51	75.3	91	96.7
11	48.8	52	76.1	92	97.2
12	49.4	53	77.0	93	97.9
13	49.9	54	77.9	94	98.2
14	50.4	55	78.7	95	98.8
15	51.0	56	79.6	96	99.4
16	51.5	57	80.4	97	100.0
17	52.1	58	81.3	98	100.6
18	52.7	59	82.2	99	101.3
19	53.3	60	83.1	100	101.9
20	53.9	61	84.0	101	102.6
21	54.5	62	84.9	102	103.3
22	55.1	63	85.8	103	104.0
23	55.7	64	86.6	104	104.7
24	56.3	65	87.5	105	105.4
25	56.9	66	88.4	106	106.1
26	57.5	66.5	88.8	107	106.9
27	58.1	67	88.9	108	107.6
28	58.7	68	89.1	109	108.4
29	59.3	69	89.3	110	109.1
30	60.0	70	89.6	111	109.9
31	60.6	71	89.8	112	110.7
32	61.3	72	90.1	113	111.4
33	61.9	73	90.3	114	112.2
34	62.5	74	90.6	115	113.0
35	63.2	75	90.9	116	113.8
36	63.9	76	91.2	117	114.6
37	64.6	77	91.5	118	115.5
38	65.3	78	91.8	118.8	116.4
39	66.0	79	92.1	...	...
40	66.7	80	92.4	...	...

(Mulder, Scheik. Verhandel. **1864.** 118.)

100 pts. H_2O dissolve 52.4 pts. $SrCl_2$ at 18°. (Gerardin.)

Sat. $SrCl_2$+Aq contains % $SrCl_2$ at t°.

t°	% $SrCl_2$	t°	% $SrCl_2$
-17	26.5	75	46.5
-11	28.6	80	47.1
- 5	29.3	92	47.5
- 1	30.8	98	49.6
+ 2	31.3	104	50.7
7	31.7	105	50.7
18	33.7	118	52.0
21.5	34.7	132	52.5
35	37.8	144	54.7
44.5	39.8	153	55.7
54	42.8	175	60.5
55	43.8	215	64.1
59	47.7	222	65.4
64	46.4	250	67.3
70	46.1	..	...

(Étard, A. ch. 1894, (7) **2.** 535.)

$SrCl_2$+Aq sat. at 8° has sp. gr. = 1.379. (Anthon, A. **24.** 211.)

Sp. gr. of $SrCl_2$+Aq.

Pts. $SrCl_2$ to 100 pts. H_2O	Sp. gr.	Pts. $SrCl_2$ to 100 pts. H_2O	Sp. gr.
9.81	1.0823	41.04	1.3114
20.12	1.1632	51.69	1.3816
30.57	1.2401	.	

(Kremers, Pogg. **99.** 444.)

Sp. gr. of $SrCl_2$+Aq at 15°.

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1.0453	25	1.2580
10	1.0929	30	1.3220
15	1.1439	33	1.3633
20	1.1989	..	...

(Gerlach, Z. anal. **8.** 283.)

Sp. gr. of $SrCl_2$+Aq at 24.7°. a = no. of $\frac{\text{molecules}}{2}$ in grms. dissolved in 1,000 g. H_2O; b = sp. gr. when a = $SrCl_2+6H_2O$, ½ mol. $SrCl_2+6H_2O$ = 133.5 g.; c = sp. gr. when a = $SrCl_2$, ½ mol. = 79.5 g.

a	b	c	a	b	c
1	1.063	1.067	7	1.304	1.401
2	1.118	1.130	8	1.330	...
3	1.166	1.190	9	1.354	...
4	1.207	1.247	10	1.376	...
5	1.243	1.301	11	1.396	...
6	1.275	1.352	..	...	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $SrCl_2$+Aq at 18°.

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1.0443	20	1.2023
10	1.0932	22	1.2259
15	1.1456	..	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $SrCl_2$+Aq at 0°. S = pts. $SrCl_2$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
31.8193	1.3609	18.[illegible]629	1.1915
27.7170	1.3086	12.9997	1.1284
23.2300	1.2515	6.7243	1.0637

(Charpy, A. ch. (6) **29.** 24.)

Sat. $SrCl_2$+Aq boils at 114° (Kremers); 118.8° (Mulder); 117.45°, and contains 117.5 pts $SrCl_2$ to 100 pts. H_2O (Legrand); forms a crust at 115.5°, and contains 120.7 pts. $SrCl_2$ to 100 pts. H_2O; highest temp. observed, 119°. (Gerlach, Z. anal. **26.** 436.)

B.-pt. of $SrCl_2$+Aq containing pts. $SrCl_2$ to 100 pts. H_2O. G = according to Gerlach (Z. anal. **26.** 442); L = according to Legrand (A. ch. (2) **59.** 436.)

B.-pt.	G	L	B.-pt.	G	L
101°	11	16.7	110°	71.4	68.9
102	20.5	25.2	111	76.5	74.1
103	28.9	32.1	112	81.6	79.6
104	36.2	37.9	113	87	85.3
105	43.2	43.4	114	93.1	91.2
106	49.6	48.8	115	99.5	97.5
107	55.4	54.0	116	105.9	104.0
108	60.8	59.0	117	112.3	110.9
109	66.2	63.9	117.5	...	...

Melts in its crystal H_2O at 112°. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of $SrCl_2$+Aq at 25°.

Concentration of $SrCl_2$+Aq.	Sp. gr.
1-normal	1.0676
1/2- "	1.0336
1/4- "	1.0171
1/8- "	1.0084

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

$SrCl_2$+Aq containing 3.24% $SrCl_2$ has sp. gr. 20°/20° = 1.0284.

$SrCl_2$+Aq containing 7.08% $SrCl_2$ has sp. gr. 20°/20° = 1.0638.

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 279.)

Sp. gr. of $SrCl_2$+Aq at 20°.

g. mols. $SrCl_2$ per l.	Sp. gr.
0.01	1.0012284
0.02937	1.0038396
0.03987	1.0053832
0.05017	1.007028
0.07077	1.009560
0.10	1.013205
0.25	1.034433
0.50	1.068379
0.75	1.101760
1.00	1.135423

(Jones and Pearce, Am. Ch. J. 1907, **38.** 697.)

Conc. HCl+Aq ppts. part of the $SrCl_2$ from $SrCl_2$+Aq. (Hope.)

Solubility of $SrCl_2$ in HCl+Aq at 0°. $SrCl_2$ = ½ mols. $SrCl_2$ (in milligrammes) dissolved in 10 ccm. of liquid; HCl = mols. HCl (in milligrammes) dissolved in 10 ccm. of liquid.

$SrCl_2$	HCl	Sum of mols.	Sp. gr.
55	0	55.0	1.334
48.2	6.1	54.3	1.3045
41.25	12.75	54.00	1.2695
30.6	23.3	53.9	1.220

(Engel, Bull. Soc. (2) **45.** 655.)

Solubility of $SrCl_2$ in HCl+Aq at 0°.

Mg. mols. per 10 cc. solution		Sp. gr. of solution	G. per 100 cc. solution	
$\frac{SrCl_2}{2}$	HCl		$SrCl_2$	HCl
51.6	0	1.334	40.9	0.0
44.8	6.1	1.304	35.5	2.22
37.85	12.75	1.269	30.0	4.65
27.2	23.3	1.220	21.56	8.49
22.0	28.38	1.201	17.44	10.35
14.0	37.25	1.167	11.09	13.58
4.25	52.75	1.133	3.37	19.23

(Engel, A. ch. 1888, (6) **13.** 376.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sol. in 6 pts. alcohol of 0.833 sp. gr. at 15°. (Vauquelin.)

Sol. in 24 pts. absolute alcohol at 15°, and in 19 pts. at boiling. (Bucholz.) Sol. in 2.5 pts. of boiling alcohol.

Anhydrous $SrCl_2$ is sol. in 111.6–116.4 pts. alcohol of 99.3% at 14.5°, and in 26.2 pts. of the same alcohol at boiling. (Fresenius, A. **59.** 127.)

100 pts. alcohol of given sp. gr. at 0° dissolve pts. $SrCl_2$ at 18°.

0.990	0.985	0.973	0.966	0.953	sp. gr.
49.81	47.0	39.6	35.9	30.4	pts. $SrCl_2$,
0.939	0.909	0.846	0.832		sp. gr.
26.8	19.2	4.9	3.2		pts. $SrCl_2$.

Insol. in absolute alcohol. (Gerardin, A. ch. (4) **5.** 156.)

100 pts. absolute methyl alcohol dissolve 63.3 pts. $SrCl_2+6H_2O$ at 6°; ethyl alcohol, 3.8 pts. (de Bruyn, Z. phys. Ch. **10.** 787.)

Sl. sol. in boiling amyl alcohol. (Browning, Sill. Am. J. **144.** 459.)

100 g. 95% formic acid dissolve 23.8 g. $SrCl_2$ at room temp. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Absolutely insol. in acetic ether. (Cann, C. R. **102.** 363.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Sl. sol. in anhydrous pyridine. Sol. in 97%, 95% and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, **30.** 1107.)

$+2H_2O$. Tr. pt. from $+6H_2O$ is 61.5°. (Richards and Churchill, Z. phys. Ch. 1899, **28.** 313.)

$+6H_2O$. *See* above.

Strontium thallic chloride, $SrCl_2$, $2TlCl_3+6H_2O$.

(Gewecke, A. 1909, **366.** 223.)

Strontium tin (stannous) chloride, $SrCl_2$, $SnCl_2+4H_2O$.

Sol. in H_2O. (Poggiale, C. R. **20.** 1183.)

Strontium tin (stannic) chloride.

See **Chlorostannate, strontium.**

Strontium uranium chloride, $SrCl_2$, UCl_4.

Decomp. by H_2O. (Aloy, Bull. Soc. 1899, (3) **21.** 265.)

Strontium zinc chloride, $SrZnCl_4+4H_2O$.

Very sol. in H_2O. (Ephraim, Z. anorg. 1910, **67.** 380.)

Strontium chloride ammonia, $SrCl_2$, $8NH_3$.

Decomp. by H_2O. (Rose, Pogg. **20.** 155.)

Strontium chloride hydrazine, $SrCl_2$, $2N_2H_4+H_2O$.

Hydroscopic. (Franzen, Z. anorg. 1908, **60.** 289.)

Strontium chloride hydroxylamine, $2SrCl_2$, $5NH_2OH+2H_2O$.

As Ca comp. (Antonow, J. Russ. Phys. Chem. Soc. 1905, **37.** 482.)

Strontium hydrogen chloride hydroxylamine, $2SrCl_2$, $3HCl$, $9NH_2OH+H_2O$.

(Antonow, J. Russ. Phys. Chem. Soc. 1905, **37.** 482.)

Strontium chlorofluoride, SrF_2, $SrCl_2$.

Decomp. by H_2O, by very dil. HCl, HNO_3 or acetic acid, by hot dil. or conc. H_2SO_4.

Sol. in conc. HCl or HNO_3. Insol. in, and not decomp. by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) **1.** 355.)

Strontium fluoride, SrF_2.

Somewhat sol. in H_2O. (Fr. Röder.)

1 l. H_2O dissolves 113.5 mg. SrF_2 at 0.26°; 117.3 mg. at 17.4°; 119.3 mg. at 27.4°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Insol in HF+Aq. (Berzelius.)

Boiling HCl+Aq dissolves; sl. attacked by boiling HNO_3+Aq; decomp. by hot H_2SO_4. (Poulenc, C. R. **116.** 987.)

Strontium stannic fluoride.

See **Fluostannate, strontium.**

Strontium titanium fluoride.

See **Fluotitanate, strontium.**

Strontium fluoiodide, SrF_2, SrI_2.

Decomp. by cold H_2O, more rapidly by hot H_2O. Decomp. by dil. HCl, dil. HNO_3, dil. H_2SO_4 or conc. H_2SO_4, also by alcohol and by ether, if not absolute. (Defacqz, A. ch. 1904, (8) **1.** 358.)

Strontium hydride, SrH.

Decomp. by H_2O or HCl+Aq. (Winkler, B. **24.** 1976.)

SrH_2. Decomp. by H_2O. (Gautier, C. R. 1902, **134.** 100.)

Strontium hydroselenide.

Sol. in H_2O.

Strontium hydrosulphide, SrS_2H_2.

Sol. in H_2O; decomp. by boiling.

Strontium hydroxide, SrO_2H_2, and $+8H_2O$.

Deliquescent.

Sol. in 50 pts. cold, and 2.4 pts. boiling H_2O (Bucholz); in 50 pts. H_2O at 15.56° (Dalton); in 51.4 pts. H_2O at 15.56°, and 2 pts. at 100° (Hope); in 52 pts. H_2O at 15°, and 2.4 pts. at 100° (Berzelius); in 48 pts. H_2O at 18.75° (Abl).

100 pts. H_2O at 20° dissolve 1.49 pts. SrO. (Bineau, C. R. 41. 509.)

100 pts. aqueous solution of SrO_2H_2 contain pts. SrO and pts. $SrO_2H_2+8H_2O$ at t°.

t°	Pts. SrO	Pts. SrO_2H_2 $+8H_2O$	t°	Pts. SrO	Pts. SrO_2H_2 $+8H_2O$
0	0.35	0.90	55	2.54	6.52
5	0.41	1.05	60	3.03	7.77
10	0.48	1.23	65	3.62	9.29
15	0.57	1.46	70	4.35	11.16
20	0.68	1.74	75	5.30	13.60
25	0.82	2.10	80	6.56	16.83
30	1.00	2.57	85	9.00	23.09
35	1.22	3.13	90	12.00	30.78
40	1.48	3.80	95	15.15	38.86
45	1.78	4.57	100	18.60	47.71
50	2.13	5.46	...	...	...

(Scheibler, J. pharm. Chim. 1883, (5) **8.** 540.)

Sol. in cold NH_4Cl+Aq. (Rose.)

Solubility in $Sr(NO_3)_2$+Aq at 25°.

Sp. gr. 25°/25°	G. SrO as $Sr(OH)_2$ in 100 g. H_2O	G. $Sr(NO_3)_2$ in 100 g. H_2O
1.481	0.0	79.27
*1.506	1.76	81.06
1.490	1.71	74.27
1.450	1.55	66.88
1.419	1.51	63.71
1.403	1.47	60.37
1.381	1.41	56.30
1.359	1.34	52.90
1.337	1.27	46.97
1.317	1.20	44.03
1.291	1.14	40.83
1.267	1.11	37.81
1.239	1.03	32.41
1.217	1.01	28.80
1.206	0.96	26.58
1.178	0.93	23.83
1.148	0.91	17.96
1.126	0.87	16.21
1.108	0.84	12.78
1.079	0.81	8.96
1.059	0.79	6.29
1.033	0.78	4.45

*Solution is sat. with respect to both substances.

(Parsons and Perkins, J. Am. Chem. Soc. 1910, **32.** 1388.)

Sol. in methyl alcohol. At room temp. 1 l. contains 31.5 g. SrO. (Neuberg and Rewald, Biochem. Z. 1908, **9.** 540.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in an aqueous solution of cane sugar. (Hunton, Phil. Mag. (3) **11.** 156.)

Solubility in H_2O containing 10 g. sugar at t°.

t°	g. $SrO_2H_2+8H_2O$	t°	g. $SrO_2H_2+8H_2O$
3	3.10	24	4.79
15	3.79	40	9.70

(Sidersky, C. C. **1886.** 57.)

$+8H_2O$. 0.0835 mol. is sol. in 1 l. H_2O at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Solubility in organic compds.+Aq at 25°.

Solvent	Mol. $SrO_2H_2+8H_2O$ sol. in 1 litre
water	0.0835
0.5-N methyl alcohol	0.0820
" ethyl alcohol	0.0744
" propyl alcohol	0.0708
" tert. amyl alcohol	0.0630
" acetone	0.0692
" ether	0.0645

Solubility in organic compds.+Aq at 25°.—*Continued.*

Solvent	Mol. $SrO_2H_2+8H_2O$ sol. id 1 litre
0.5–N glycol	0.0922
" glycerine	0.1094
" mannitol	0.1996
" urea	0.0820
" ammonia	0.0785
" diethyl amine	0.0586
" pyridine	0.0694

(Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

See also **Strontium oxide.**

Strontium iodide, SrI_2, and +6, or $7H_2O$.

100 pts. H_2O dissolve at:

0°	20°	40°	70°	100°
164	179	196	250	370 pts. SrI_2.

(Kremers, Pogg. **103.** 65.)

Sat. aq. solution contains at:

—20°	—10°	—3°	+7°	11°	18°	38°
60.0	60.3	62.2	63.0	63.4	63.5	64.8% SrI_2,

52°	63°	77°	81°	97°	105°	120	175°
66.0	68.5	70.5	74.0	79.2	79.4	80.8	85.6% SrI_2.

(Étard, A. ch. 1894, (7) **2.** 543.)

Sp. gr. of SrI_2+Aq at 19.5° containing:

5	10	20	30 % SrI_2,
1.045	1.091	1.200	1.330

40	50	60	65 % SrI_2.
1.491	1.695	1.955	2.150

(Kremers, Pogg. **103.** 67; calculated by Gerlach, Z. anal. **8.** 285.)

Sat. solution in abs. ethyl alcohol contains at:

—20°	+4°	39°	82°
2.6	3.1	4.3	4.7% SrI_2.

(Étard, A. ch. 1894, (7) **2.** 565.)

Strontium *per*iodide, SrI_3+15H_2O.

(Mosnier, A. ch. 1897, (7) **12.** 399.)

SrI_4. (Herz and Bulla, Z. anorg. 1911, **71.** 255.)

Strontium stannous iodide.

Very sol. in H_2O. (Boullay.)

Strontium zinc iodide, $SrZnI_4+9H_2O$.

Hydroscopic. (Ephraim, Z. anorg. 1910, **67.** 385.)

Strontium nitride, Sr_3N_2.

Decomp. H_2O violently, but not alcohol. (Maquenne, A. ch. (6) **29.** 225.)

Strontium oxide, SrO.

Decomp. by H_2O to SrO_2H_2, which see.

Sol. in 160 pts. H_2O at 15.56° (Dalton); in 50 pts. at 100° (Dalton); in 130 pts. at 20° (Bineau); in 40 pts. cold, and 20 pts. hot H_2O (Dumas).

Very sl. sol. in alcohol. Insol. in ether.

1 l. methyl alcohol dissolves 11.2 g. SrO. (Neuberg and Rewald, Biochem. Z. 1908, **9.** 540.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Sol. in cane sugar+Aq.

Solubility in H_2O containing 10 g. sugar at t°.

t°	g. SrO	t°	g. SrO
8	1.21	24	1.87
15	1.48	40	3.55

(Sidersky, C. C. **1886.** 57.)

See also **Strontium hydroxide.**

Strontium *per*oxide, SrO_2.

Sl. sol. in H_2O. Easily sol. in acids and NH_4Cl+Aq. Insol. in NH_4OH+Aq. (Conroy, Chem. Soc. (2) **11.** 812.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Strontium oxybromide, $SrBr_2$, $SrO+9H_2O$.

Not hydroscopic; sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1339.)

Strontium oxychloride, $SrCl_2$, $SrO+9H_2O$.

Very easily decomp. by H_2O and alcohol. (André, A. ch. (6) **3.** 76.)

Strontium oxyiodide, $2SrI_2$, $5SrO+30H_2O$.

Not hydroscopic; sol. in H_2O. (Tassilly, C. R. 1895, **120.** 1339.)

Strontium oxysulphide, $Sr_2OS_4+12H_2O$.

Decomp. by H_2O.

Insol. in alcohol, ether, and CS_2. (Schöne.)

Mixture of SrS_2O_3 and SrS_2. (Geuther, A. **224.** 178.)

Strontium phosphide, Sr_3P_2.

Crystallized. Sol. in dil. acids; insol. in conc. acids; decomp. by H_2O. Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, **129.** 764.)

Strontium selenide, SrSe.

Sl. sol. in H_2O. (Fabre, C. R. **102.** 1469.)

Strontium silicide, $SrSi_2$.

Decomp. by H_2O. (Bradley, C. N. 1900, **82.** 150.)

Strontium sulphide, SrS.

Sol. in H_2O with decomp. into SrO_2H_2 and SrS_2H_2.

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37.** 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Strontium *tetra*sulphide, SrS_4.

Very deliquescent, and sol. in H_2O and alcohol. Aqueous solution decomp. on air. Cryst. with 2, or $6H_2O$. (Schöne, Pogg **117.** 58.)

Strontium *penta*sulphide, SrS_5.

Known only in solution.

Strontium stannic sulphide.

See **Sulphostannate, strontium.**

Sulphaluminic acid.

Silver sulphaluminate, $4Ag_2S, 5Al_2S_3$.

(Cambi, Real. Ac. Linc. 1912, (5) **21,** II. 837.)

Sulphamic acid, $HOSO_2NH_2$.

See **Amidosulphonic acid.**

Ammonium sulphamate, $2NH_3, SO_3$.

(Woronin.)

Is ammonium imidosulphonate, which see. (Berglund.)

Ammonium sulphamate, acid, $3NH_3, 2SO_3$.

(Woronin.)

Is basic ammonium imidosulphonate, which see. (Berglund.)

Barium sulphamate, basic, $2BaO, 3SO_3, 2NH_3$

Somewhat sol. in H_2O, easily in HCl+Aq. (Jacquelain, A. ch. (3) **8.** 304.)

$BaS_2O_6(NH_2)_2$. Sl. sol. in H_2O. Decomp. by heating with H_2O. (Woronin, J. B. **1860.** 80.)

Is barium imidosulphonate. (Berglund.)

Sulphamide, $SO_2(NH_2)_2$.

Very sol. in H_2O. (Regnault, A. ch. **69.** 170; Mente, A. **248.** 267.)

Insol. in alcohol, ether, etc. (Traube, B. **26.** 607.)

Very sol. in H_2O.

Sl. sol. in abs. alcohol.

Sl. sol. in dry ether. (Divers and Ogawa, Chem. Soc. 1902, **81.** 504.)

Very sol. in liquid NH_3. (Franklin and Stafford, Am. Ch. J. 1902, **28.** 95.)

Sol. in alcohol; very sol. in H_2O. (Hantzsch, B. 1901, **34.** 3436.)

Silver sulphamide, $SO_2(NHAg)_2$.

Sl. sol. in cold H_2O. Sol. in HNO_3, and $(NH_4)_2CO_3$+Aq. (Traube, B. **26.** **607.**)

$3NH_3, 2SO_3$. (Jacquelain.)

Is basic ammonium imidosulphonate, which see. (Berglund.)

Sulphamidic acid.

(Fremy.)

See **Imidosulphonic acid.**

Sulphaminoplatinous acid.

Ammonium *tetra*sulphaminoplatinite, $[Pt(SO_3NH_2)_4](NH_4)_2+6H_2O$.

Sl. sol. in cold H_2O. (Ramberg, B. 1912, **45.** 1512.)

Potassium ——, $[Pt(SO_3NH_2)_4]K_2+2H_2O$.

Very sl. sol. in cold H_2O. (Ramberg.)

Sodium ——.

Easily sol. in cold H_2O. (Ramberg.)

Sulphammonic, *and Meta*sulphammonic acids.

(Fremy.)

See **Nitrilosulphonic acid.**

*Mono*sulphammonic acid.

(Claus.)

See **Amidosulphonic acid.**

*Di*sulphammonic acid.

(Claus.)

See **Imidosulphonic acid.**

*Tri*sulphammonic acid.

(Claus.)

See **Nitrilosulphonic acid.**

*Tetra*sulphammonic acid.

(Claus.)

Does not exist. *See* **Nitrilosulphonic acid.**

Sulphammonium, $S(NH_3)_2, 2NH_3$.

Sol. in liquid NH_3.

Sol. in abs. alcohol and anhydrous ether. (Moissan, C. R. 1901, **132.** 517.)

Sulphantimonic acid.

Sulphantimonates.

The alkali sulphantimonates are sol. in H_2O, but the solutions decomp. on the air; most of the other sulphantimonates are insol. in H_2O; all sulphantimonates are insol. in alcohol. (Rammelsberg.)

Ammonium sulphantimonate, $(NH_4)_3SbS_4$.

Sol. in H_2O.

Sol. in dil. acids with decomp. (Stanek, Z. anorg. 1898, **17.** 122.)

$+4H_2O$. (Stanek.)

Solubility of $(NH_4)_3SbS_4+4H_2O$ in H_2O at t°.

t°	% $(NH_4)_3SbS_4$	Solid phase
− 1.9	9.9	Ice
− 5	20.0	"
− 8	30.2	"
−13.5	41.6	Ice+$(NH_4)_3SbS_4$, $4H_2O$
0	41.6	$(NH_4)_3SbS_4$, $4H_2O$
+20	47.7	"
30	54.5	"

(Donk, Chem. Weekbl, 1908, **5.** 529.)

Solubility of $(NH_4)_3SbS_4$ in alcohol at 10°.
Solid phase, $(NH_4)_3SbS_4+4H_2O$.

% C_2H_5OH	% $(NH_4)_3SbS_4$	% C_2H_5OH	% $(NH_4)_3SbS_4$
0	43.2	43.1	8.7
5.1	35.9	53.1	4.1
19.1	23.1	93.3	0

(Donk, *l. c.*)

Antimonyl sulphantimonate, $(SbO)_3SbS_4$.

Sol. in HCl. (Rammelsberg, Pogg. 1841, **52.** 236.)

Barium sulphantimonate, $Ba_3(SbS_4)+3H_2O$.

Sol. in H_2O. Insol. in alcohol.

Barium potassium sulphantimonate, $KBaSbS_4+6H_2O$.

Easily sol. in H_2O.

Decomp. by acids. (Glatzel, Z. anorg. 1911, **72.** 100.)

Bismuth sulphantimonate.

Ppt.

Cadmium sulphantimonate.

Ppt. (Rammelsberg, Pogg. **52.** 236.)

Calcium sulphantimonate, $Ca_3(SbS_4)_2$.

Partially sol. in H_2O. Insol. in alcohol.

Cobaltous sulphantimonate, $Co_3(SbS_4)_2$.

Ppt. Decomp. by HCl+Aq. (Rammelsberg, Pogg. **52.** 236.)

Cupric sulphantimonate, $Cu_3(SbS_4)_2$.

Ppt. (Rammelsberg, Pogg. **52.** 226.)

Iron (ferrous) sulphantimonate.

Ppt.

Iron (ferric) sulphantimonate, $Fe_2(SbS_4)_2$. (Rammelsberg, Pogg. **52.** 234.)

Lead sulphantimonate, $Pb_3(SbS_4)_2$.

Ppt. Decomp. by KOH+Aq. (Rammelsberg, Pogg. **52.** 223.)

Lithium sulphantimonate, $Li_3SbS_4+8\frac{1}{2}H_2O$.

100 g. sat. solution in H_2O contain 50.8 g. anhyd. Li_3SbS_4.

Solubility in alcohol at 30°.

% alcohol	% Li_3SbS_4	Solid phase
0	50.8	Li_3SbS_4, $8\frac{1}{2}H_2O$
13.3	46.3	"
51.9	30.7	"
54.8	29.9	"
58.4	30.8	Li_3SbS_4, $8\frac{1}{2}H_2O$+Li_3SbS_4
58.6	32.3	"
65.26	29.31	Li_3SbS_4
74.3	24.1	"
79.5	20.5	"

(Schreinemakers and Jacobs, Ch. Weekbl. 1910, **72.** 213.)

$+9H_2O$. Very sol. in H_2O. (Brinkmann, Dissert. **1891.**)

$+10H_2O$. Solubility of $Li_3SbS_4+10H_2O$ in H_2O at t°.

t°	% Li_3SbS_4	Solid phase
− 1.7	7.1	Ice
− 3.2	12.8	"
− 5.1	17.5	"
−10.8	23.2	"
−15.9	28.5	"
−26.2	35.3	"
−42	40.4	Ice+Li_3SbS_4, $10H_2O$
0	45.5	Li_3SbS_4, $10H_2O$
+10	46.9	"
30	50.1	"
50	51.3	"

(Donk, Chem. Weekbl. 1908, **5.** 629.)

At 10°, 100 g. sat. $Li_3SbS_4+10H_2O$ in 10.7 % alcohol contain 41.8 g. Li_3SbS_4; 26.2% alcohol, 36.5 g. Li_3SbS_4. (Donk, *l. c.*)

Magnesium sulphantimonate, $Mg_3(SbO_4)_2$.

Deliquescent. Sol. in H_2O. Decomp. by alcohol.

Mercurous sulphantimonate, $(Hg_2)_3(SbS_4)_2$.

Ppt.

Mercuric sulphantimonate, $Hg_3(SbS_4)_2$.

Ppt. (Rammelsberg, Pogg. **52.** 229.)

Mercuric sulphantimonate chloride, $Hg_3(SbS_4)_2$, $3HgCl_2$, $3HgO$.

Insol. in acids, except aqua regia. (Rammelsberg.)

Nickel sulphantimonate, $Ni_3(SbS_4)_2$.

Ppt. Decomp. by hot HCl+Aq. (Rammelsberg, Pogg. **52.** 226.)

Potassium sulphantimonate, K_3SbS_4.

Sol. in H_2O.

Solubility of K_3SbS_4 in H_2O at t°.

t°	% K_3SbS_4	Solid phase
− 1.3	9.5	Ice
− 2.6	17.1	"
− 4	24.2	"
− 7.2	35.4	"
−10.6	42.9	"
−13.5	48.8	"
−18.5	52.6	"
−28.8	59.6	"
−34	62	Ice+K_3SbS_4, $6H_2O$
−10	65.5	K_3SbS_4, $6H_2O$
− 4.5	69.1	"
0	75.4	K_3SbS_4, $5H_2O$
+10	76.2	"
30	77.1	"
50	77.7	K_3SbS_4, $3H_2O$
80	79.2	"

(Donk, Chem. Weekbl. 1908, **5.** 529, 629, 767.)

Solubility of K_3SbS_4 in KOH+Aq at 25°.

% K_3SbS_4	% KOH	Solid phase
75	0	K_3SbS_4, $5H_2O$
68.4	3.4	K_3SbS_4, $3H_2O$
56.8	11.0	"
50.9	16.1	K_3SbS_4
37.7	25.5	"
19.8	40.5	"
11.5	46.9	K_3SbS_4+KOH, $2H_2O$
9.4	49.9	KOH, $2H_2O$
00.0	56.3	"

(Donk.)

Solubility of K_3SbS_4 in alcohol+Aq at 10°.

% C_2H_5OH	% K_3SbS_4	Solid phase
94	0	K_3SbS_4, $5H_2O$
90.5	0	"
....*	....	...
0.8	69.2	"
0	76.1	"

* Two liquid layers are formed.

Composition of the liquid layers.

Alcohol layer		H_2O layer	
% C_2H_5OH	% K_3SbS_4	% alcohol	% K_3SbS_4
85	0	1.1	67.4
54.7	2.2	3.4	49.0
46.9	4.2	3.8	45.6
16	27.4	....	....
....	....	31.1	12.7

(Donk, *l. c.*)

$+4^1/_2H_2O$. Deliquescent. Sol. in H_2O; more sol. than the Na salt.

+3, 5, and $6H_2O$. *See* Donk above.

$2K_2S$, Sb_2S_3. Decomp. by cold H_2O. (Ditte, C. R. **102.** 168.)

K_2S, $2Sb_2S_3+3H_2O$. Sl. sol. in H_2O. (Ditte.)

K_2S, Sb_2S_3. Decomp. by H_2O. (Ditte.)

K_2S, $2Sb_2S_3$. (Ditte.)

Silver sulphantimonate, Ag_3SbS_4.

Insol. in H_2O or acids. Decomp. by KOH +Aq. (Rammelsberg, Pogg. **52.** 218.)

Sodium sulphantimonate, $Na_3SbS_4+9H_2O$.

(*Schlippe's salt.*) Sol. in 2.9 pts. H_2O at 15°. Aqueous solution is precipitated by alcohol. (Rammelsberg.)

Sol. in 3 pts. cold H_2O. (van den Corput.)

Sol. in 4 pts. cold H_2O. (Duflos.)

Sol. in 1 pt. boiling H_2O. (Duflos.)

Solubility of $Na_3SbS_4+9H_2O$ in H_2O at t°.

t°	% Na_3SbS_4	Solid phase
− 0.1	0.5	Ice
− 0.65	4	"
− 0.9	5.7	"
− 1.26	7.8	"
− 1.45	9.2	"
− 1.75	11.2	"
0	11.3	Na_3SbS_4, $9H_2O$
15	19.3	"
30	27.1	"
38	32	"
49.6	38.9	"
59.6	45	"
69.6	50.7	"
79.5	57.1	"

(Donk, Chem. Weekbl. 1908, **5.** 529, 629, 767.)

Solubility of $Na_3SbS_4+Na_2S_2O_3$ in H_2O.

% Na_3SbS_4	% $Na_2S_2O_3$	Solid phase
t° = 10°.		
11.8	0	Na_3SbS_4, $9H_2O$
4.4	4.9	"
0.8	14.6	"
0.1	27.3	"
0.0	33.6	$Na_2S_2O_3$, $5H_2O$
t° = 30°.		
19.9	7.7	Na_3SbS_4, $9H_2O$
12.5	16.4	"
4.2	37.7	"
1	43.8	"
1	47	"
1	47.8	$Na_3SbS_4+Na_2S_2O_3$, $5H_2O$
0	45.8	$Na_2S_2O_3$, $5H_2O$

(Donk, *l. c.*)

Solubility of Na_3SbS_4 in alcohol+Aq at t°.

Solid phase, $Na_3SbS_4+9H_2O$.

t = 0°		t = 30°		t° = 65°	
% C_2H_5OH	% Na_3SbS_4	% C_2H_5OH	% Na_3SbS_4	% C_2H_5OH	% Na_3SbS_4
0	11.8	5.	19.3	0	47.9
3.7	8.2	10.3	14.6	4.7	39.3
12.7	3.2	24.8	6.4	8	36.5
29.	0.9	46	1.2	* 54.1	4.1
60.8	0	76.2	0	81.	0

* Two layers are formed.

Composition of above layers.

Alcohol layer		H_2O layer	
% alcohol	% Na_3SbS_4	% alcohol	% Na_3SbS_4
54.1	4.1	8.0	36.5
40.4	10.2	14.3	27.8
33.5	14.1	18.8	24.1
....	....	27.2	18.0

(Donk, *l. c.*)

Solubility of Na_3SbS_4 in methyl alcohol at t°. Solid phase, $Na_3SbS_4+9H_2O$.

t = 0°		t = 30°	
% CH_3OH	% Na_3SbS_4	% CH_3OH	% Na_3SbS_4
3.4	8.6	0	27.1
15.5	2.8	18.1	12.8
23.1	2.1	33.1	5.8
50.3	0.3	65.7	0.1
57	0.1	84.2	0.1
81.7	0.05	91 2	1.2
92	0.2	94.	3.9
95.9	2.0	....	....

(Donk, *l. c.*)

Sodium sulphantimonate thiosulphate, Na_3SbS_4, $2Na_2S_2O_3+20H_2O$.

Efflorescent, and decomp. by H_2O. (Unger, Arch. Pharm. (2) **147.** 193.)

No double salt exists. *See* Donk, $Na_3SbS_4+Na_2S_2O_3$ under Na_3SbS_4.

Strontium sulphantimonate.

Sol. in H_2O; pptd. by alcohol.

Uranium sulphantimonate.

Ppt.

Zinc sulphantimonate, $Zn_3(SbS_4)_2$.

Ppt. Sol. in hot Na_3SbS_4+Aq; insol. in $ZnSO_4$+Aq. Partially sol. in KOH+Aq; sol. in hot HCl+Aq. (Rammelsberg, Pogg. **52.** 233.)

Sulphantimonous acid.

Ammonium ***meta*****sulphantimonite,** NH_4SbS_2.

Insol. in H_2O. (Rouget, C. R. 1898, **126.** 1145.)

$+2H_2O$. Insol. in H_2O and alcohol. Decomp. in the air. (Stanek, Z. anorg. 1898, **17.** 119.)

Ammonium ***ortho*****sulphantimonite,** $(NH_4)_3SbS_3$.

Easily decomp. Stable only in presence of $(NH_4)_2S$. Sol. in H_2O. Insol. in alcohol, by which it is pptd. from aqueous solution. (Pouget, A. ch. 1899, (7) **18.** 536.)

Ammonium ***para*****sulphantimonite,** $(NH_4)_2Sb_4S_7$.

Stable in the air.

Insol. in H_2O.

Decomp. by acids. (Stanek, Z. anorg. 1898, **17.** 120.)

Stable; cryst. from hot solutions. (Pouget C. R. 1898, **126.** 1145.)

Ammonium silver *ortho*sulphantimonite, $NH_4Ag_2SbS_3$.

Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 551.)

Barium *meta*sulphantimonite, $BaSb_2S_4 + 4^1/_2H_2O$.

Insol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 541.)

Barium *ortho*sulphantimonite, $Ba_3Sb_2S_6 + 8H_2O$.

Decomp. in the air and by H_2O. Somewhat sol. in BaS+Aq. (Pouget, C. R. 1898, **126.** 1792.)

Barium *pyro*sulphantimonite, $Ba_2Sb_2S_5 + 8H_2O$.

Decomp. by H_2O.
Nearly insol. in BaS+Aq. (Rouget.)

Barium sulphantimonite, $Ba_3Sb_4S_9 + 10H_2O$.

Pptd. from aq. solution of ortho and pyrobarium salts. (Pouget.)
$Ba_5Sb_4S_{11} + 16H_2O$. (Pouget, A. ch. 1899, (7) **18.** 538.)

Calcium sulphantimonite basic, $Ca(OH)SbS_2$.

Insol. in H_2O.
Sol. in conc. HCl. (Pouget, A. ch. 1899, (7) **18.** 544.)

Calcium *pyro*sulphoantimonite, $Ca_2Sb_2S_5 + 15H_2O$.

Sol. in H_2O without decomp. (Pouget, C. R. 1898, **126.** 1793.)

Cobaltous *ortho*sulphantimonite, $Co_3Sb_2S_6$.

Ppt. (Pouget, A. ch. 1899, (7) **18.** 554.)

Cuprous *meta*sulphantimonite, $CuSbS_2$.

Sol. in mixture of HNO_3 and tartaric acid with separation of S.
Insol. in NH_4OH+Aq. Decomp. by hot KOH and alkali sulphides+Aq. (Sommerlad, Z. anorg. 1898, **18.** 430.)
Min. *Wolfsberite.* Sol. in HNO_3+Aq with separation of S and Sb_2O_3.

Cuprous *ortho*sulphantimonite, Cu_3SbS_3.

(Sommerlad, Z. anorg. 1898, **18.** 432.)
Ppt. Insol. in H_2O. Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 556.)

Cuprous sulphantimonite, $Cu_2Sb_4S_7$.

Min. *Guejarite.*

Cupric *ortho*sulphantimonite, $Cu_3Sb_2S_6$.

Ppt. (Pouget, A. ch. 1899, (7) **18.** 557.)

Cuprous lead sulphantimonite, Cu_3SbS_3, $2Pb_3SbS_3$.

Min. *Bournonite.* Decomp. by HNO_3+Aq, and aqua regia.

Cuprous potassium *ortho*sulphantimonite, Cu_2KSbS_3.

Ppt., easily decomp. by H_2O. (Pouget, C. R. 1899, **129.** 104.)
$+3H_2O$. Ppt., decomp. by H_2O. (Pouget. A. ch. 1899, (7) **18.** 556.)

Iron (ferrous) *ortho*sulphantimonite, $Fe_3(Sb_3S)_2$.

Ppt. (Pouget, A. ch. 1899, (7) **18.** 554.)
Min. *Berthierite* Sl. sol in HCl+Aq; easily sol. in aqua regia.

Lead *ortho*sulphantimonite, $Pb_3(SbS_3)_2$.

Ppt. Very sl. sol. in H_2O. Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 553.)
Min. *Boulangerite.* Completely sol. in hot HCl+Aq; decomp. by HNO_3+Aq.

Lead sulphantimonite.

Sol. in boiling conc. HNO_3+Aq. (Fournet.)
$Pb(SbS_2)_2$. Min. *Zinckenite.* Decomp. by hot HCl+Aq.
$4PbS$, Sb_2S_3. Min. *Plagionite.*
$2PbS$, Sb_2S_3. Min. *Jamesonite.* Decomp. by hot HCl+Aq.
$4PbS$, Sb_2S_3. Min. *Meneghinite.*
$5PbS$, Sb_2S_3. Min. *Geokronite.*
$6PbS$, Sb_2S_3. Min. *Kibrickenite* (?).

Lead potassium *ortho*sulphantimonite, $PbKSbS_3$.

Very sl. sol. in H_2O.
Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 554.)

Lead silver sulphantimonite, $(Ag_2, Pb)_5Sb_4S_{11}$.

Min. *Freieslebenite.*

Lithium *ortho*sulphantimonite, $Li_3SbS_3 + 3H_2O$.

Very deliquescent.
Very sol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 530.)

Lithium *para*sulphantimonite, $Li_2Sb_4S_7 + 3H_2O$.

Ppt. (Pouget, A. ch. 1899, (7) **18.** 531.)

Lithium silver *ortho*sulphantimonite, $LiAg_2SbS_3$.

Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 551.)

Manganous *ortho*sulphantimonite, $Mn_3Sb_2S_6$.

Ppt. Sl. sol. in H_2O. (Pouget, A. ch 1899, (7) **18.** 553.)

Manganous potassium *ortho*sulphantimonite, $MnKSbS_3$.

Sl. sol. in H_2O. Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 553.)

Nickel *ortho*sulphantimonite, $Ni_3Sb_2S_6$.
Ppt. (Pouget, A. ch. 1899, (7) **18.** 554.)

Potassium *meta*sulphantimonite, $KSbS_2$.
Insol. in cold H_2O. Decomp. by hot H_2O. (Pouget, A. ch. 1899, (7) **18.** 513.)
$+1\frac{1}{2}H_2O$. Sol. in H_2O, but decomp. quickly.
Sol. in H_2O. (Stanek, Z. anorg. 1898, **17.** 119.)

Potassium *ortho*sulphantimonite, K_3SbS_3.
Very deliquescent.
Very sol. in H_2O.
Decomp. by acids. (Pouget, A. ch. 1899, (7) **18.** 518.)

Potassium sulphantimonite, $K_2Sb_4S_7+3H_2O$.
Sl. sol. in H_2O and not decomp. thereby. (Pouget, A. ch. 1899, (7) **18.** 522.)
Decomp. in the air.
Sol. in K_2S+Aq. (Stanek, Z. anorg. 1898, **17.** 120.)
$2K_2S$, Sb_2S_3. Sol. in H_2O. (Ditte, C. R. **102.** 68.)
xK_2S, ySb_2S_3. Deliquescent. When K_2S is in excess, sol. in H_2O; when Sb_2S_3 is in excess, partially sol. Aqueous solution is decomp. by all acids, even CO_2, and by K_2CO_3, Na_2CO_3, $NaHCO_3$, $KHCO_3$, NH_4HCO_3+Aq. Insol. in absolute alcohol. (Kohl.)

Potassium hydrogen sulphantimonite, $KHSb_4S_7$.
(Pouget, A. ch. 1899, (7) **18.** 522.)

Potassium silver *ortho*sulphantimonite, Ag_2KSbS_3.
Decomp. by boiling H_2O. (Pouget, C. R. 1897, **124.** 1519.)

Potassium zinc *ortho*sulphantimonite, $KZnSbS_3$.
Decomp. by H_2O. (Pouget, A. ch. 1899, (7) **18.** 552.)

Silver *ortho*sulphantimonite, Ag_3SbS_3.
Ppt. Sl. sol. in H_2O. (Pouget, A. ch. 1899, (7) **18.** 547.)
Min. *Pyrargyrite.* Sol. in HNO_3+Aq with residue of S and Sb_2O_3. KOH+Aq dissolves out Sb_2S_3.

Silver sulphantimonite.
$AgSbS_2$. Min. *Miargyrite.*
$5Ag_2S$, Sb_2S_3. Min. *Stephanite.* Easily decomp. by warm HNO_3+Aq.
$12Ag_2S$, Sb_2S_3. Min. *Polyargyrite.*

Silver sodium *ortho*sulphantimonite, Ag_2NaSbS_3.
Decomp. by H_2O. Pouget, A. ch. 1899, (7) **18.** 551.)

Sodium *meta*sulphantimonite, $NaSbS_2$.
Deliquescent. Decomp. by hot H_2O. When Na_2S is in excess, sol. in H_2O, but partially sol. if Sb_2S_3 is in excess. (Unger, Arch. Pharm. (2) **148.** 1.)
Ppt. Insol. in H_2O. (Pouget, C. R. 1898, **126.** 1145.)

Sodium *ortho*sulphantimonite, $Na_3SbS_3+9H_2O$.
Decomp. in solution in H_2O. (Pouget, C. R. 1898, **126.** 1144.)

Sodium sulphantimonite, $Na_2Sb_4S_7+2H_2O$.
Sol. in H_2O. (Pouget, C. R. 1898, **126.** 1145.)
$Na_6Sb_4S_9$. (Pouget, C. R. 1898, **126.** 1144.)
$4Na_2S$, $3Sb_2S_3+3H_2O$. Permanent; sol. in H_2O. Insol. in alcohol and ether. (Kohl.)

Strontium *ortho*sulphantimonite, $Sr_3Sb_2S_6+10H_2O$.
Sol. in H_2O. (Pouget, C. R. 1898, **126.** 1793.)

Strontium *pyro*sulphantimonite, $Sr_2Sb_2S_5+15H_2O$.
Sol. in H_2O without essential decomp. (Pouget, C. R. 1898, **126.** 1793.)

Zinc *ortho*sulphantimonite, $Zn_3Sb_2S_6$.
Ppt. (Pouget, A. ch. 1899, (7) **18.** 552.)

***Ortho*sulpharsenic acid,** H_3AsS_4.
Ppt. Loses H_2S by prolonged boiling with H_2O. (Nilson, J. pr. (2) **14.** 145.)
See also **Sulphoxyarsenic acid.**

Ammonium sulpharsenate, $(NH_4)_4As_2S_7$.
Known only in solution in H_2O. Decomp. on boiling into—
NH_4AsS_3. Sol. in alcohol.
$(NH_4)_3AsS_4$. Sol. in H_2O. Precipitated by alcohol.
$(NH_4)_2S$, $12As_2S_5$. Ppt. Insol. in H_2O.

Ammonium magnesium sulpharsenate, $(NH_4)_2S$, MgS, As_2S_5.

Ammonium sodium sulpharsenate, $(NH_4)_3AsS_4$, Na_3AsS_4.
Much more sol. in H_2O than Na_3AsS_4; sl. sol. in cold, more sol. in hot alcohol. (Berzelius.)

Barium sulpharsenate, $Ba(AsS_3)_2$.
Sol. in H_2O and alcohol. Decomp. by evaporation.
$Ba_2As_2S_7$. Sol. in H_2O in all proportions with decomp. Decomp. by alcohol.
$Ba_3(AsS_4)_2$. Sol. in H_2O. Insol. in alcohol.
BaS, $3As_2S_5$. Ppt. Insol. in H_2O.

Barium potassium sulpharsenate, $KBaAsS_4+6H_2O$.

Easily sol. in H_2O.

Decomp. by acids with separation of As_2S_5. (Glatzel, Z. anorg. 1911, **71.** 209.)

Barium sulpharsenate sulpharsenite, $Ba_3(AsS_4)_2$, $Ba_2As_2S_5+4H_2O$.

Sl. sol. in cold, more easily in hot H_2O. (Nilson.)

Bismuth sulpharsenate, $2Bi_2S_3$, $3As_2S_5$.

Sol. in Na_3AsS_4+Aq.

Bi_2S_3, $3As_2S_5$. As above (Berzelius.)

Cadmium sulpharsenate.

Ppt. (Berzelius, Pogg. **7.** 88.)

Calcium sulpharsenate, $Ca_2As_2S_7$.

Sol. in H_2O and alcohol.

$Ca_3(AsS_4)_2$. Easily sol. in H_2O. Insol. in alcohol.

$+10H_2O$. Easily sol. in H_2O. (Nilson, J. pr. (2) **14.** 169.)

$5CaS$, $2AsS_2S_5+6H_2O$. Easily sol. in H_2O. (Nilson,, J. pr. (2) **14.** 163.)

Cerous sulpharsenate, $Ce_2As_2S_7$.

Ppt.

$Ce_3(AsS_4)_2$. Ppt.

$Ce_4(As_2S_7)_3$. Ppt.

Cobaltous sulpharsenate, $Co_2As_2S_7$.

Ppt. Sol. in excess of sodium sulpharsenate+Aq.

Cuprous sulpharsenate, Cu_3AsS_4.

Ppt. (Preis, A. **257.** 201.)

Min. *Enargite. Clarite.* Not wholly decomp. by HCl+Aq. Sol. in HCl+Aq with residue of As_2O_3. Not attacked by KOH+Aq.

Cupric sulpharsenate, $Cu_2As_2S_7$.

Ppt. Sol. in $(NH_4)_2S$+Aq. Decomp. by NH_4OH+Aq. (Berzelius.)

$Cu_3(AsS_4)_2$. Ppt. (Preis, A. **257.** 201.)

Glucinum sulpharsenate.

Sl. sol. in H_2O.

Gold sulpharsenate, $AuAsS_4$.

Sol. in pure H_2O. Insol. in Na_3AsS_4+Aq.

$2Au_2S_3$, $3As_2S_5$. Sol. in H_2O. (Berzelius.)

Iron (ferrous) sulpharsenate, $Fe_2As_2S_7$.

Ppt. Sol. in Na_3AsS_4+Aq. (Berzelius.)

Iron (ferric) sulpharsenate, $Fe_4(As_2S_7)_3$.

Ppt. Sol. in Na_3AsS_4+Aq. (Berzelius.)

Lead sulpharsenate, $Pb_2As_2S_7$.

Ppt. (Berzelius.)

$Pb_3(AsS_4)_2$. Ppt.

Lithium sulpharsenate, Li_3AsS_4.

Easily sol. in hot, less sol. in cold H_2O. Insol. in alcohol.

$Li_4As_2S_7$. Completely sol. in H_2O. Decomp. by alcohol.

$LiAsS_3$. Known only in acid solution.

Magnesium sulpharsenate, $Mg_2As_2S_7$.

Sol. in all proportions of H_2O, and in alcohol.

$Mg_3(AsS_4)_2$. Sol. in H_2O. Decomp. alcohol.

$3MgS$, As_2S_5. Nearly insol. in H_2O.

$5MgS$, $2As_2S_5+15H_2O$. Very sol. in H_2O. (Nilson.)

Manganous sulpharsenate, $Mn_2As_2S_7$.

Sl. sol. in H_2O.

$Mn_3(AsS_4)_2$. Permanent. Sl. sol. in H_2O.

$6MnS$, As_2S_5. Sl. sol. in H_2O.

Mercurous sulpharsenate, $(Hg_2)_2As_2S_7$.

Ppt.

Mercuric sulpharsenate, $Hg_2As_2S_7$.

Ppt. (Berzelius, Pogg. **7.** 29.)

$Hg_3(AsS_4)_2$. Ppt. (Preis, A. **257.** 200.)

Nickel sulpharsenate, $Ni_3(AsS_4)_2$.

Ppt. Not decomp. by HCl+Aq. Sol. in Na_3AsS_4+Aq. (Berzelius.)

$2NiS$, As_2S_5. As above.

Potassium sulpharsenate, $KAsS_3$.

Known only in alcoholic solution.

$K_4As_2S_7$. Deliquescent. Sol. in H_2O, from which alcohol ppts. K_3AsS_4.

K_3AsS_4. Deliquescent. Very sol. in H_2O, from which it is precipitated by alcohol.

$+H_2O$. Very deliquescent. (Nilson, J. pr. (2) **14.** 159.)

Potassium sodium sulpharsenate.

Sol. in H_2O.

Silver sulpharsenate, Ag_3AsS_4.

Ppt. (Berzelius, Pogg. **7.** 29.)

$Ag_2As_2S_7$. Ppt.

Sodium sulpharsenate, $NaAsS_3$.

Known only in alcoholic solution.

$Na_4As_2S_7$. Sol. in H_2O. Alcohol ppts. Na_3AsS_4 from H_2O solution.

$Na_3AsS_4+7\frac{1}{2}H_2O$. Easily sol. in H_2O, from which it is precipitated by alcohol.

$+8H_2O$. Insol. in alcohol; very sol. in H_2O. (McCay, Z. anal. 1895, **34.** 726.)

$+9H_2O$. (Nilson, J. pr. (2) **14.** 160.)

Na_2S, $12As_2S_5$ (?). Insol. in H_2O.

Sodium zinc sulpharsenate, $NaZnAsS_4+4H_2O$.

Sol. in hot H_2O with decomp. (Preis, A. **257.** 202.)

Strontium sulpharsenate, $Sr_3(AsS_4)_2$.
Easily sol. in H_2O; insol. in alcohol.
$Sr_2As_2S_7$. Easily sol. in H_2O, from which alcohol ppts. $Sr_3(AsS_4)_2$.

Strontium sulpharsenate sulpharsenite, $Sr_3(AsS_4)_2$, $Sr_2As_2S_5+4H_2O$.
Easily sol. in H_2O. (Nilson, J. pr. (2) **14.** 162.)

Thallous sulpharsenate, Tl_3AsS_4.
Not decomp. by H_2O. Decomp. by dil. acids. Insol. in dil. alkali sulphides. Partially decomp. by boiling with a conc. solution of sodium sulphide. (Hawley, J. Am. Chem. Soc. 1907, **29.** 1013.)

Tin (stannous) sulpharsenate.
Ppt.

Tin (stannic) sulpharsenate.
Ppt.

Uranic sulpharsenate, $2U_2S_3$, As_2S_5.
Ppt. Sol. in Na_3AsS_4+Aq.

Zinc sulpharsenate, $Zn_3(AsS_4)_2$.
Ppt. (Berzelius.)
$2ZnS$, As_2S_5. Ppt. (Berzelius.)
ZnS, As_2S_5. (Wöhler.)

*Di*sulpharsenic acid.
*See Di*sulphoxyarsenic acid.

Sulpharseniosulphomolybdic acid.

Ammonium sulpharseniosulphomolybdate, $(NH_4)_4As_2S_7(MoS_3)_2+5H_2O$.
Very unstable.
Sol. in H_2O with decomp. (Weinland, Z. anorg. 1897, **15.** 49.)

Barium ——, $Ba_2As_2S_7(MoS_3)_2+14H_2O$.
Sol. in H_2O with decomp. (Weinland.)

Potassium ——, $KAsS_3(MoS_3)+4H_2O$. (Weinland.)
$K_4As_2S_7(MoS_3)_2+8H_2O$. Sol. in H_2O. Decomp. by mineral acids. Insol. in alcohol. (Weinland.)

Sodium ——, $NaAsS_3(MoS_3)+6H_2O$.
Insol. in H_2O. Easily sol. in dil. NaOH and NH_3+Aq. (Weinland.)
$Na_4As_2S_7(MoS_3)_2+14H_2O$. Sol. in H_2O. Decomp. by mineral acids. (Weinland.)

Sulpharseniosulphoxymolybdic acid.

Barium sulpharseniosulphoxymolybdate, $Ba_2As_2S_7(Mo_2S_3O_3)+12H_2O$.
Sol. in H_2O. (Weinland, Z. anorg. 1897, **15.** 60.)

Magnesium sulpharseniosulphoxymolybdate, $Mg_2As_2S_7(Mo_2S_3O_3)+16H_2O$.
Very sol. in H_2O. (Weinland.)

Potassium ——, $KAsS_3(MoSO_2)+2\frac{1}{2}H_2O$.
Sol. in H_2O with decomp. (Weinland.)
$K_4As_2S_7(Mo_2S_3O_3)+6H_2O$. Very sol. in H_2O. Weinland.)
$+10H_2O$. (Weinland.)

Sodium ——, $NaAsS_3(MoSO_2)+5H_2O$.
Sl. sol. in cold, very sol. in hot H_2O. (Weinland.)
$Na_4As_2S_7(Mo_2S_3O_3)+15H_2O$. Very sol. in H_2O. (Weinland.)

Sulpharsenious acid.

Ammonium sulpharsenite, $NH_4As_3S_5+2H_2O$.
Insol. in H_2O. Ppt. Sol. in KOH or NH_4OH+Aq. Sl. attacked by boiling HCl+Aq. (Nilson, J. pr. (2) **14.** 42.)
$(NH_4)_4As_2S_5=2(NH_4)_2S$, As_2S_3. Sol. in H_2O, from which alcohol ppts. $(NH_4)_3AsS_3$.
$(NH_4)_3AsS_3=3(NH_4)_2S$, As_2S_3. Decomp. on air; sol. in H_2O. Insol. in alcohol.
$(NH_4)_5As_3S_{10}$. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 160.)

Barium sulpharsenite, $Ba_2As_2S_5$.
Sl. sol. in H_2O. Decomp. by alcohol.
$+5H_2O$. Sl. sol. in H_2O. (Nilson, J. pr. (2) **14.** 46.)
$+15H_2O$. Sl. sol. in cold H_2O. (Nilson.)
$Ba_3(AsS_3)_2$. Sl. sol. in H_2O. Precipitated by alcohol.
$+14H_2O$. Sl. sol. in cold, easily in hot H_2O. (Nilson.)
$Ba(AsS_2)_2+2H_2O$. Insol. in H_2O. (Nilson, J. pr. (2) **14.** 44.)
$BaAs_{12}S_{19}$. Insol. in HCl+Aq. (Nilson.)

Bismuth sulpharsenite, $2Bi_2S_3$, As_2S_3.
Ppt.

Cadmium sulpharsenite.
Ppt. (Berzelius, Pogg. **7.** 146.)

Calcium sulpharsenite, $Ca_2As_2S_5$.
Sol. in H_2O, from which alcohol ppts. $Ca_3(AsS_3)_2$.
$Ca_3(AsS_3)_2$. Sol. in H_2O.
$+15H_2O$. Precipitated by alcohol.
$Ca(AsS_2)_2+10H_2O$. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 54.)
$CaAs_8S_{13}+10H_2O$ (?). Insol. in cold H_2O. Decomp. by hot H_2O. (Nilson.)
$CaAs_{18}S_{28}+10H_2O$ (?). Sl. sol. in hot H_2O. (Nilson.)
$Ca_7As_2S_{10}+25H_2O$. Sl. sol. in cold or hot H_2O. (Nilson.)

Cerous sulpharsenite, $Ce_2As_2S_5$.
Ppt.

Chromic sulpharsenite, $2Cr_2S_3$, $3As_2S_3$.

Ppt. Insol. in Na_2S+Aq.

Cobaltous sulpharsenite, 2CoS, As_2S_3.

Ppt. Sol. in excess of sodium sulpharsenite+Aq.

Cuprous sulpharsenite,
$3Cu_2S$, $2As_2S_3 = Cu_6As_4S_9$.

Min. *Binnite.* Decomp. by hot acids and KOH+Aq.

$2Cu_2S$, $As_2S_3 = Cu_4As_2S_5$. Decomp. by acids, KOH and K_2S+Aq. (Sommerlad, Z. anorg. 1898, **18.** 434.)

Cupric sulpharsenite, Cu_3AsS_3.

Insol. in H_2O or HCl+Aq. Sol. in Na_3AsS_3+Aq.

$Cu_2As_2S_5$. Ppt. (Berzelius.)

Glucinum sulpharsenite, 2GlS, As_2S_3.

Ppt. Sol. in acids; partly sol. in NH_4OH+Aq.

Gold sulpharsenite, $2Au_2S_3$, $3As_2S_3$.

Ppt. (Berzelius.)

Iron (ferrous) sulpharsenite.

Ppt. Sol. in Na_3AsS_3+Aq. (Berzelius.)

Iron (ferric) sulpharsenite.

Ppt. Sol. in excess of a ferric salt, or Na_3AsS_3+Aq. (Berzelius.)

Lead sulpharsenite, $Pb_2As_2S_5$.

Ppt. Min. *Dufreynosite.*

$Pb(AsS_2)_2 = PbS$, As_2S_3. Min. *Sartorite.*

$Pb_4As_2S_7$. Min. *Jordanite.*

Lithium sulpharsenites.

Resemble K salts.

Magnesium sulpharsenite, $Mg_2As_2S_5$.

Almost completely sol. in H_2O. Easily sol. in alcohol. (Berzelius.)

$+8H_2O$. Sl. sol. in H_2O. (Nilson.)

$Mg(AsS_2)_2+5H_2O$. Slowly sol. in both cold and hot H_2O. (Nilson, J. pr. (2) **14.** 59.)

$Mg_3(AsS_3)_2+9H_2O$. (Nilson.)

Manganous sulpharsenite, $Mn_2As_2S_5$.

Ppt. Decomp. by HCl+Aq.

Mercurous sulpharsenite, $(Hg_2)_2As_2S_5$.

Ppt. (Berzelius.)

Mercuric sulpharsenite, $Hg_2As_2S_5$.

Ppt.

$Hg(AsS_2)_2$. Ppt. (Berzelius, Pogg. **7.** 149.)

Nickel sulpharsenite, $Ni_3(AsS_3)_2$.

Ppt. (Berzelius.)

Platinum sulpharsenite, $Pt_2As_2S_5$.

Ppt.

Potassium sulpharsenite, $K_4As_2S_5$.

Decomp. by H_2O or alcohol. (Berzelius.)

K_3AsS_3. Sol. in H_2O. Insol. in alcohol. (Berzelius.)

$K_2As_4S_7$. Sol. in H_2O and alcohol. (Berzelius.)

K_2AsS_2. Decomp. by H_2O. (Berzelius.)

$+2\frac{1}{2}H_2O$. Not wholly sol. in H_2O. (Nilson, J. pr. (2) **14.** 30.)

$K_2As_4S_7+8H_2O$. (Nilson.)

$KAs_3S_5+H_2O$. Insol. in H_2O. Slowly attacked by hot HCl+Aq. Sol. in KOH+Aq. (Nilson.)

Silver sulpharsenite, $12Ag_2S$, As_2S_3.

Ppt. (Sommerlad, Z. anorg. 1898, **18.** 428.)

$5Ag_2S$, $As_2S_3 = Ag_5AsS_4$. (Sommerlad.)

Ag_3AsS_3. Min. *Proustite.* Sol. in HNO_3+Aq. KOH+Aq dissolves out Sb_2S_3. (Senarmont, A. ch. (3) **32.** 129; Wöhler, A. **27.** 159.)

$2Ag_2S$, As_2S_3. Partially sol. in HNO_3+Aq. (Berzelius.)

$AgAsS_2$. (Berzelius, Pogg. **7.** 150.)

Sodium sulpharsenite, $NaAsS_2+\frac{1}{2}H_2O$.

Attacked by HCl+Aq with difficulty. (Nilson, J. pr. (2) **14.** 37.)

$+1\frac{1}{2}H_2O$. Forms coagulum with cold, sol. in hot H_2O. (Nilson.)

$Na_2As_4S_7+6H_2O$. Sol. in much H_2O; not easily decomp. by HCl+Aq. (Nilson.)

$NaAs_3S_5+4H_2O$. Ppt. (Nilson, J. pr. (2) **14.** 3.)

Strontium sulpharsenite, 3SrS, As_2S_3+$15H_2O$.

Sol. in H_2O+Aq; insol. in alcohol. (Voigt and Göttling.)

2SrS, As_2S_3. Sol. in H_2O; decomp. by alcohol.

$+15H_2O$. (Nilson, J. pr. (2) **14.** 53.)

$Sr(AsS_2)_2+2\frac{1}{2}H_2O$. Sl. sol. in H_2O. (Nilson.)

Thallous sulpharsenite, $TlAsS_2$.

Ppt. Decomp. by KOH+Aq. (Gunning, J. B. **1868.** 247.)

Above compound is a mixture of As_2S_3 and Tl_2S. (Hawley, J. Am. Chem. Soc. 1907, **29.** 1012.)

Min. *Lorandite.* (Kuenner and Loezka, C. C. **1904,** II. 844.)

Tin (stannous) sulpharsenite, $Sn_2As_2S_5$.

Ppt.

Tin (stannic) sulpharsenite, $SnAs_2S_5$.

Ppt. (Berzelius, Pogg. **7.** 147.)

Uranic sulpharsenite, $2U_2S_3$, As_2S_3.

Ppt.

Zinc sulpharsenite.
Ppt. (Berzelius, Pogg. **7.** 145.)

Zirconium sulpharsenite, $2Zr_2S_3, As_2S_3$.
Ppt. Insol. in solutions of alkali sulpharsenites. Sl. sol. in Na_2S Aq. Not decomp. by acids. (Berzelius.)

"Sulphatammon," $2NH_3, SO_3$.
(Rose.)
Is ammonium imidosulphonate, which see. (Berglund.)

"*Para*sulphatammon," $3NH_3, 2SO_3$.
(Rose.)
Is basic ammonium imidosulphonate, which see. (Berglund.)

Sulphatoiodic acid.

Potassium sulphatoiodate, $K_2HO_3SIO_4$ or $KIO_3, KHSO_4$.
Decomp. by H_2O. (Blomstrand, J. pr. (2) **40.** 317.)
See **Iodate sulphate, potassium.**

Sulphatooctamine cobaltic carbonate $(SO_4)_2Co_2(NH_3)_8CO_3+4H_2O$.
Sol. in H_2C. (Vortmann and Blasberg, B. **22.** 2650.)
$(SO_4)Co_2(NH_3)_8(CO_3)_2+3H_2O$. Sol. in H_2O. (V. and B.)
See **Carbonatotetramine cobaltic sulphate.** (Jörgensen.)

Sulphatoplatinamine sulphate, $SO_4Pt(NH_3)_2SO_4+3H_2O$.
Easily sol. in H_2O. Sol. in H_2SO_4+Aq.

Sulphatoplatin*di*amine sulphate, $SO_4Pt(N_2H_6)_2SO_4+H_2O$.
Insol. in H_2O.

Sulphatopurpureocobaltic bromide, $Co(SO_4)(NH_3)_5Br$.
Sol. in H_2O, from which it is precipitated by conc. HBr+Aq. (Jörgensen, J. pr. (2) **25.** 94.)

—— **carbonate,** $[(SO_4)Co(NH_3)_5]_2CO_3+4H_2O$.
Sol. in H_2O. (Vortmann and Blasberg, B. **22.** 2648.)

—— **chloroplatinate,** $2Co(SO_4)(NH_3)_5Cl, PtCl_4+2H_2O$.
Sl. sol. in cold H_2O. (Jörgensen.)

—— **nitrate,** $Co(SO_4)(NH_3)_5(NO_3)$.
Somewhat sl. sol. in cold H_2O. (Jörgensen.)

Sulphatopurpureocobaltic sulphate, $[Co(SO_4)(NH_3)_5]_2SO_4+H_2O$.
Very easily sol. in H_2O. (Jörgensen, J. pr. (2) **25.** 94.)
$Co(SO_4)NH_3)_5(HSO_4)+2H_2O$. Sol. in about 25 pts. of cold H_2O. Sol. in dil., insol. in conc. NH_4OH+Aq. (Jörgensen.)

Sulphazic acid, $H_4S_2N_2O_9 = SO_3H—N(OH)—O—N—(OH)SO_3H$.
Known only in its salts. (Raschig, A. **241.** 161.)

Potassium sulphazate, $K_3HS_2N_2O_9 = (SO_3K)(OK)N—O—N(OH)—(SO_3K)$.
Sol. in H_2O, but decomp. on standing. (Raschig, A. **241.** 161.)

Sulphazidic acid.
(Fremy.)
See **Hydroxylamine *mono*sulphonic acid.**

Sulphazilinic acid.
See **Oxysulphazotic acid.**

***Meta*sulphazilinic acid.**
See ***Tri*sulphoxyazotic acid.**

Sulphazinous acid.
(Fremy.)
See ***Di*hydroxylamine sulphonic acid.**

Sulphazotic acid, $H_6N_2S_4O_{14} = (SO_3H)_3\equiv NH—NO = OH(SO_3H)$.
Known only in its salts. (Claus, A. **158.** 52 and 194). Has the formula

$$(SO_3H)_2NH{<}{}^{O}_{O}{>}NH(SO_3H)_2.$$

(Raschig, A. **241.** 161.)

Lead potassium sulphazotate.
Insol. in cold, decomp. by hot H_2O. Insol. in alcohol and ether. (Fremy, A. ch. (3) **15.** 439.)

Potassium sulphazotate, $K_5HN_2S_4O_{14}+H_2O$

$$=(SO_3K)_2NK{<}{}^{O}_{O}{>}NH(SO_3K)_2.$$

Very sol. in hot, less in cold H_2O. (Raschig, A. **241.** 161.) Decomp. gradually by boiling. (Claus.) Insol. in alcohol or ether. (Fremy, A. ch. (3) **15.** 428.)
True composition is $HON(SO_3K)_2, KON(SO_3K)_2+H_2O$. Potassium hydroxylamine *di*sulphonate. (Divers and Haga, Chem. Soc. 1900, **77.** 432.)
Forms basic salt

$(SO_3K)_2NK{<}{}^{O}_{O}{>}NK(SO_3K)_2$, which is easily sol. and decomp. by H_2O. (Raschig.)

Potassium sodium sulphazotate, $K_4NaHN_2S_4O_{14}+2H_2O$.
Quite easily sol. in H_2O. (Raschig, A. **241.** 161.)

***Di*sulphhydroxyazotic acid,** $ONH(SO_2H)_3$.
Known only in its salts. (Claus, A. **158.** 52 and 194.) Correct composition is hydroxylamine sulphonic acid $HON(SO_3H)_2$, which see. (Raschig, A. **241.** 161.)

Sulphhydroxylamic acid.
(Claus.)
See **Hydroxylamine *mono*sulphonic acid.**

***Di*sulphhydroxyazotic acid.**
(Claus.)
See **Hydroxylamine disulphonic acid.**

Sulphides.
The sulphides of the alkali metals are sol. in H_2O; those of the alkali-earth metals are much less sol., and are decomp. upon solution into hydrosulphide and hydroxide.
The other sulphides are insol. in H_2O.
For each sulphide, see under the respective element.

Sulphimide, SO_2NH.
See **Imidosulphamide.**

***Tri*sulphimide,** $OHSO\langle{}^{NSO.OH}_{NSO.OH}\rangle N$
$(SO_2NH)_3$.
Sol. in methyl alcohol; sl. sol. in ether; insol. in chloroform and benzene. (Hantzsch B. 1901, **34.** 3440.)

Ammonium sulphimide, $SO_2N(NH_4)$.
Sol. in H_2O; insol. in alcohol. (Traube.)

Barium ——, $(SO_2N)_2Ba+2H_2O$.
Sol. in H_2O. (Traube.)

Potassium ——, SO_2NK.
Not very sol. in H_2O.

Silver ——, SO_2NAg.
Sol. in 500–600 pts. cold, more easily in hot H_2O. Sol. in acids.

Sodium ——, SO_2NNa.
Very sol. in H_2O.

"Sulphitammon," NH_3, SO_2.
See **Thionamic acid.**

Sulphobismuthous acid.

Cuprous sulphobismuthite, $AuBiS_2$.
Min. *Emplectite*. Sol. in HNO_3+Aq.
$Cu_6Bi_4S_9$. Min. *Klaprothite*. Completely sol. in HCl+Aq.
Cu_3BiS_3. Min. *Wittichenite*. Sol. in HCl +Aq and in HNO_3+Aq.

Cuprous lead sulphobismuthite, Cu_2S, $2PbS$, Bi_2S_3.
Min. *Patrinite*.
Sol. in HNO_3+Aq with residue of S and $PbSO_4$.

Lead ——, $2PbS$, Bi_2S_3.
Min. *Cosalite*.
$2PbS$, $3Bi_2S_3$. Min. *Chiviatite*.

Potassium ——, $KBiS$.
Decomp. by H_2O.
Sol. in HCl+Aq. (Schneider, Pogg. 1869, **136.** 164.)

***Meta*sulphoboric acid,** $B_2S_3H_2S$.
Decomp. by H_2O and alcohol.
1 pt. is sol. in 5 pts. benzene
1 pt. is " " 5 " CS_2
Very sl sol. in CS_2 at $-20°$. (Stock, B. 1901, **34.** 401.)

Sulphocarbonic acid.

Ammonium cuprous sulphocarbonate, CS_3CuNH_4.
This salt was formerly described as cupric sulphocarbonate ammonia, CS_3Cu, NH_3. (Hofmann, B. 1903, **36.** 1146.)

Cuprous potassium sulphocarbonate, CS_3CuK.
Nearly insol. in cold H_2O.
Somewhat sol. in hot H_2O, NaOH and NH_4OH+Aq. (Hofmann.)

Cupric sulphocarbonate ammonia, CS_3Cu, NH_3.
Very sl. sol. in strong NH_4OH+Aq.; insol. in cold H_2O, sl. sol. in hot H_2O. (Hofmann, Z. anorg. 1897, **14.** 295.)
Is ammonium cuprous sulphocarbonate. (Hofmann, B. 1903, **36.** 1146.)

Cuprous sulphocarbonate potassium cyanide, CS_3Cu_2, $2KCN+2H_2O$.
Sol. in H_2O and dil. alkalies on warming. (Hofmann, B. 1903, **36.** 1148.)

Zinc sulphocarbonate ammonia, CS_3Zn, $2NH_3$.
Ppt. (Hofmann, Z. anorg. 1897, **14.** 277.)

Sulphochromic acid, H_2CrO_4, SO_3. (?).
Sol. in H_2O. (Bolley, A. **56.** 113.)
$(SO_3)_4Cr_2O_2(OH)_2$. Sol. in H_2O. All salts even alkali salts are insol. in H_2O. (Recoura, Bull. Soc. 1896, (3) **15.** 315.)
$[Cr_2O_2(OH)_4(SO_2)_4O_3$, $Cr_2O(OH)_2(SO_2)_3(OH)_2](OH)_2$. Sol. in H_2O. (Wyrouboff, Bull. Soc. 1902, (3) **27.** 721.)

Chromium sulphochromate, $Cr_2O_2(OH)_4(SO_2)_4O_2(OH)_2Cr_2(OH)_6$.

Ppt.; decomp. by boiling H_2O. (Wyrouboff, Bull. Soc. 1902, (3) **27.** 720.)

Sulphochromous acid.

Ferrous sulphochromite, $FeCr_2S_4$.

Insol. in H_2O, and nearly so in HCl+Aq. (Gröger, W. A. B. **81, 2.** 531.)

Manganous ——, $MnCr_2S_4$.

Insol. in H_2O and HCl+Aq. (Gröger.)

Potassium ——, $K_2Cr_2S_4$.

Insol. in H_2O and in hot HCl+Aq.

Easily sol. in aqua regia . Slowly sol. in cold, rapidly sol. in hot dil. HNO_3+Aq. (Milbauer, Z. anorg. 1904, **42.** 443.)

$K_2Cr_4S_7$. Stable in the air; sol. in HNO_3 and aqua regia with decomp. (Schneider, J. pr. 1897, (3) **56.** 407.)

Silver ——, $Ag_2Cr_2S_4$.

Not attacked by HCl+Aq even on heating. Decomp. by conc. HNO_3. (Schneider, J. pr. 1897, (2) **56.** 401.)

Sodium ——, $Na_2Cr_2S_4$.

Insol. in H_2O. Sl. attacked by dil. HCl or H_2SO_4+Aq. Sol. in cold conc. HNO_3 or aqua regia. Sol. in hot dil. HNO_3+Aq. (Gröger.)

Sol. in acids with decomp. (Schneider, J. pr. 1897, (3) **56.** 415.)

Zinc ——, $ZnCr_2S_4$.

Insol. in H_2O; sol. in traces in boiling conc. HCl or dil. H_2SO_4+Aq; sol. in HNO_3+Aq. (Gröger, W. A. B. **81, 2.** 531.)

Sulphocyanhydric acid, HSCN.

Sol. in H_2O.

Sat. HSCN+Aq has sp. gr. = 1.022. (Porrett, **1814.**) HSCN+Aq containing 12.7% HSCN has sp. gr. 1.040 at 12.7°. (Hermes, Z. Ch. **1866.** 417.)

Sulphocyanides.

Most sulphocyanides are sol. in H_2O, but Cu, Pb, Hg, and Ag sulphocyanides are insol.

Aluminum sulphocyanide, $Al(SCN)_3$.

Known only in solution.

$Al(SCN)_2(OH)_4$. Known only in solution. (Suida.)

Aluminum potassium sulphocyanide, $K_3Al(SCN)_6+4H_2O$.

Very hydroscopic.

Sol. in H_2O and alcohol. (Rosenheim, Z. anorg. 1901, **27.** 302.)

Ammonium sulphocyanide, NH_4SCN.

Deliquescent, and very sol. in H_2O.

100 pts. H_2O dissolve 128.1 pts. at 0° and 162.2 pts. at 20°.

NH_4SCN+Aq sat. at ord. temp. has density of 1.138 and 100 cc. contains 69.16 g. NH_4SCN. (Klason, J. pr. 1887, (2) **36.** 67.)

By dissolving 90 g. NH_4SCN in 90 g. H_2O at 17°, the temp. falls to —12°. (Clowes, Z. Ch. **1866.** 190.)

133 pts. NH_4SCN+100 pts. H_2O at 13.2° lower the temp. 31.2°. (Rüdorff, B. **2.** 68.)

Sol. in liquid SO_2. (Walden, B. 1899, **32.** 2864.)

Difficultly sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.)

Very easily sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Easily sol. in alcohol.

Easily sol. in acetone. (Krug and M'Elroy.

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Ammonium bismuth sulphocyanide, $(NH_4)_3Bi(SCN)_3$.

As K salt. (Rosenheim and Vogelgesang Z. anorg. 1906, **48.** 215.)

Ammonium cadmium sulphocyanide, $(NH_4)_2Cd(SCN)_4+2H_2O$.

Somewhat deliquescent.

Melts in crystal H_2O at 25°.

Insol. in alcohol. (Grossmann, B. 1902, **35.** 2667.)

Ammonium cadmium molybdenyl sulphocyanide, NH_4SCN, $Cd(SCN)_2$, $Mo(OH)(SCN)_3+3H_2O$.

(Maas and Sand, B. 1908, **41.** 1513.)

Ammonium cobaltous sulphocyanide, $(NH_4)_2Co(SCN)_4$.

Decomp. in moist air.

Cannot be recryst. from H_2O. (Treadwell, Z. anorg. 1901, **26.** 109.)

$+4H_2O$. Sol. in H_2O.

Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether + Aq.

Can be recryst. from H_2O or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, **27.** 289.)

Ammonium iron (ferric) sulphocyanide, $9NH_4SCN$, $Fe(SCN)_3+4H_2O$.

Deliquescent, and sol. in H_2O. (Krüss and Moraht, A. **260.** 207.)

$3NH_4SCN$, $Fe(SCN)_3$. Extremely deliquescent.

Ammonium mercuric sulphocyanide, $2NH_4SCN$, $Hg(SCN)_2$.

Easily sol. in H_2O. (Fleischer, A. **179.** 228.)

$NH_4Hg(SCN)_3$. Insol. in cold; sol. in hot H_2O. (Rosenheim, Z. anorg. 1901, **27.** 284.)

Ammonium molybdenyl sulphocyanide, $3NH_4SCN, Mo(OH)(SCN)_3+3H_2O$.

(Sand and Maas, B. 1907, **40.** 4507.)

Ammonium nickel sulphocyanide, $(NH_4)_4Ni(SCN)_6+4H_2O$.

Sol. in H_2O with decomp.

Sl. sol. in cold; easily sol. in hot alcohol. (Rosenheim, Z. anorg. 1901, **27.** 292.)

Ammonium silver sulphocyanide, NH_4SCN, $AgSCN$.

Decomp. by H_2O.

Ammonium vanadium sulphocyanide, $V(SCN)_3, 3NH_4SCN+4H_2O$.

Sol. in H_2O; sol. in alcohol; sl. sol. in ether. (Ciocci, Z. anorg. 1898, **19.** 311.)

Ammonium vanadyl sulphocyanide, $(NH_4)_2VO(SCN)_4+5H_2O$.

Sol. in H_2O, alcohol, ether, acetone, amyl alcohol and ethyl acetate. (Koppel, Z anorg. 1903, **36.** 290.)

Ammonium zinc sulphocyanide, $(NH_4)_2Zn(SCN)_4+3H_2O$.

Easily sol. in H_2O and in alcohol. (Walden, Z. anorg. 1900, **23.** 374.)

$+4H_2O$. Easily sol. in cold H_2O, acetone, alcohols and ether. (Rosenheim and Huldschinsky, B. 1901, **34.** 3913.)

Ammonium sulphocyanide mercuric bromide, $NH_4SCN, HgBr_2$.

Very sol. in H_2O.

Sol. in alcohol. (Grossmann, B. 1902, **35.** 2945.)

$2NH_4SCN, HgBr_2+H_2O$. Somewhat deliquescent.

Very sol. in H_2O.

Sol. in alcohol. (Grossmann.)

Arsenic sulphocyanide, $As(SCN)_3$.

Decomp. by H_2O. Insol. in all ordinary solvents. (Miguel, A. ch. (5) **11.** 341.)

Barium sulphocyanide, $Ba(SCN)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol. Boiling solution in alcohol contains 32.8% anhydrous salt. Solution sat. at 20° contains 30%. (Tscherniak, B. **16.** 349.)

Cryst. with $3H_2O$. (Tscherniak, B. **25.** 2627.)

Barium cadmium sulphocyanide, $4Ba(SCN)_2, Cd(SCN)_2+10H_2O$.

Deliquescent. (Grossmann, B. 1902, **36** 2669.)

Barium cæsium cuprous sulphocyanide, $Ba(SCN)_2, 3CsSCN, 2CuSCN$.

Rapidly decomp. by H_2O. (Wells, Am. Ch. J. 1902, **28.** 273.)

Barium cæsium silver sulphocyanide, $Ba(SCN)_2, 3CsSCN, 2AgSCN$.

100 pts. H_2O dissolve 92 pts. at 19°.

Decomp. by much H_2O. (Wells, Am. Ch. J. 1902, **28.** 272.)

Barium cobaltous sulphocyanide, $BaCo(SCN)_4+8H_2O$.

Ppt. (Rosenheim, Z. anorg. 1901, **27.** 290.)

Barium mercuric sulphocyanide, $BaHg(SCN)_4$.

Very sol. in H_2O and in alcohol. (Rosenheim, Z. anorg. 1901, **27.** 286.)

$Ba[Hg(SCN)_3]_2+2H_2O$. Ppt. Nearly insol. in cold; easily sol. in hot H_2O. (Rosenheim.)

Barium potassium silver sulphocyanide, $Ba(SCN)_2, 4KSCN, 2AgSCN+H_2O$.

Very sol. in a little H_2O. Decomp. by much H_2O. (Wells, Am. Ch. J. 1902, **28.** 283.)

Barium rubidium silver sulphocyanide, $BaRb_2Ag_2(SCN)_6+2H_2O$.

Very sol. in H_2O. (Wells, Am. Ch. J. 1903, **30.** 186.)

$BaRb_4Ag_2(SCN)_8+H_2O$. Sol. in H_2O. (Wells.)

Barium silver sulphocyanide, $Ba(SCN)_2, 2AgSCN+2H_2O$.

Stable in the air. (Wells, Am. Ch. J. 1902, **28.** 269.)

Barium zinc sulphocyanide, $BaZn(SCN)_4+3H_2O$.

Easily sol. in alcohol. (Walden, Z. anorg. 1900, **23.** 374.)

Barium sulphocyanide mercuric bromide, $Ba(SCN)_2, 2HgBr_2+5H_2O$.

Very sol. in H_2O. (Grossmann, Z. anorg. 1903, **37.** 420.)

Bismuth sulphocyanide, basic, $Bi(OH)(SCN)_2+5H_2O$.

(Rosenheim and Vogelgesang, Z. anorg. 1906, **48.** 214.)

$Bi(SCN)_3, 2Bi_2O_3$. Insol. in H_2O, but when recently pptd. decomp. by boiling therewith. Insol. in HSCN+Aq. (Meitzendorf.)

Bismuth sulphocyanide, $Bi(SCN)_3$.

Insol. or sl. sol. in H_2O. Sol. in HNO_3, HCl, and HSCN+Aq. (Meitzendorf, Pogg. **56.** 83.)

Decomp. by cold H_2O. (Bender, B. **20** 723.)

$+14H_2O$. Extremely deliquescent.

Decomp. by H_2O. (Rosenheim and Vogelgesang, Z. anorg. 1906, **48.** 214.)

Bismuth potassium sulphocyanide, $K_3Bi(SCN)_6$.

Decomp. by H_2O. (Rosenheim and Vogelgesang, Z. anorg. 1906, **48.** 215.)

Not hydroscopic.

Decomp. by H_2O.

Easily sol. in alcohol. (Vanino, Z. anorg. 1901, **28.** 220.)

$Bi(SCN)_3$, 9KSCN. Very hydroscopic. Decomp. by H_2O.

Sol. in alcohol. (Vanino, Z. anorg. 1901, **28.** 221.)

Bismuth sodium sulphocyanide, $Na_3Bi(SCN)_6$.

As K salt. (Rosenheim and Vogelgesang, Z. anorg. 1906, **48.** 215.)

Boron sulphocyanide, $B(SCN)_3$.

Sol. in benzene and ether. (Cocksedge, Chem. Soc. 1908, (2) **93.** 217.)

Cadmium sulphocyanide, $Cd(SCN)_2$.

Sl. sol. in H_2O. Sol. in NH_4OH+Aq with combination.

Cadmium cæsium sulphocyanide, $CsCd(SCN)_3$.

Recryst. from H_2O. (Wells, Am. Ch. J. 1903, **30.** 148.)

$Cs_4Cd(SCN)_6+2H_2O$. Very sol. in H_2O. Can be recryst. from conc. solution but decomp. on dilution to $CsCd(SCN)_3$. (Wells.)

Cadmium cæsium silver sulphocyanide, $Cs_2CdAg_2(SCN)_6$.

(Wells.)

$+2H_2O$. (Wells.)

$Cs_2CdAg_4(SCN)_8+2H_2O$. (Wells.)

$Cs_4Cd_3Ag_{10}(SCN)_{20}+6H_2O$. (Wells.)

Cadmium mercuric sulphocyanide, $Cd(SCN)_2$, $Hg(SCN)_2$.

Very sol. in hot H_2O. (Grossmann, Z. anorg. 1903, **37.** 414.)

Cadmium molybdenum sulphocyanide, $Cd(SCN)_2$, $Mo(SCN)_4+2H_2O$.

(Maas and Sand, B. 1908, **41.** 1513.)

$+3H_2O$. (Maas and Sand.)

Cadmium molybdenyl potassium sulphocyanide, KSCN, $4Cd(SCN)_2$, $3Mo(OH)(SCN)_3+18H_2O$.

(Mass and Sand, B. 1908, **41.** 1513.)

Cadmium molybdenyl sulphocyanide ammonia, $3Cd(SCN)_2$, $2Mo(OH)(SCN)_3$, $13NH_3$.

(Mass and Sand, B. 1908, **41.** 1512.)

$+2H_2O$. (Maas and Sand.)

Cadmium potassium sulphocyanide, $K_2Cd(SCN)_4+2H_2O$.

Very sol. in H_2O. (Grossmann, B. 1902, **35.** 2668.)

Cadmium rubidium sulphocyanide, $Rb_2Cd(SCN)_4+2H_2O$.

Very sol. in H_2O. (Grossmann, B. 1902, **35.** 2668.)

Cadmium sodium sulphocyanide, $NaCd(SCN)_3+3H_2O$.

(Grossmann, B. 1902, **35.** 2668.)

Cadmium sulphocyanide ammonia, $Cd(SCN)_2$, NH_3.

Decomp. by H_2O. (Grossmann, B. 1902, **35.** 2666.)

$Cd(SCN)_2$, $2NH_3$. Decomp. by pure H_2O. (Grossmann.)

Cadmium sulphocyanide ammonium bromide, $Cd(SCN)_2$, NH_4Br+H_2O.

Can be recryst. from H_2O. Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, **37.** 425.)

$Cd(SCN)_2$, $2NH_4Br$. Easily splits off NH_4Br. (Grossmann.)

Cadmium sulphocyanide ammonium chloride, $Cd(SCN)_2$, $2NH_4Cl$.

Can be recryst from H_2O. Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, **37.** 423.)

Cadmium sulphocyanide potassium bromide, $Cd(SCN)_2$, $KBr+H_2O$.

Recryst. from H_2O. (Grossmann, Z. anorg. 1903, **37.** 425.)

$Cd(SCN)_2$, 2KBr. Recryst. from H_2O. (Grossmann.)

Cadmium sulphocyanide potassium chloride, $Cd(SCN)_2$, 2KCl.

Recryst. from H_2O. Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, **37.** 423.)

Cadmium sulphocyanide potassium iodide, $Cd(SCN)_2$, 2KI.

Recryst. from H_2O. (Grossmann.)

Cæsium calcium silver sulphocyanide, 2CsSCN, $Ca(SCN)_2$, $2AgSCN+2H_2O$.

Recryst. from H_2O. (Wells, Am. Ch. J. 1902, **28.** 275.)

Cæsium chromium sulphocyanide.
See **Chromisulphocyanide, cæsium.**

Cæsium cobaltous sulphocyanide, $Cs_2Co(SCN)_4+2H_2O$.
Stable in the air. (Shinn and Wells, Am. Ch. J. 1903, **29.** 476.)

Cæsium cobaltous silver sulphocyanide, $Cs_2CoAg_2(SCN)_6+2H_2O$.
Slowly attacked by H_2O; decomp. by boiling H_2O. Very sl. sol. in CsSCN or $Co(SCN)_2$ +Aq. (Shinn and Wells, Am. Ch. J. 1903, **29.** 478.)

Cæsium cuprous sulphocyanide, CsSCN, CuSCN.
H_2O separates CuSCN. (Roberts, Am. Ch. J. 1902, **28.** 262.)

Cæsium cuprous nickel sulphocyanide, 2CsSCN, $Ni(SCN)_2$, $2CuSCN+2H_2O$.
Sl. sol. in H_2O. (Roberts and Wells, Am. Ch. J. 1902, **28.** 277.)

Cæsium cuprous strontium sulphocyanide, 3CsSCN, 2CuSCN, $Sr(SCN)_2$.
As Ba salt. (Wells, Am. Ch. J. 1902, **28.** 275.)

Cæsium magnesium silver sulphocyanide, 2CsSCN, $Mg(SCN)_2$, $2AgSCN+2H_2O$.
As Ca comp. (Wells, Am. Ch. J. 1902, **28.** 275.)

Cæsium manganous silver sulphocyanide, $Cs_2MnAg_2(SCN)_6+2H_2O$.
Rather sl. sol. in H_2O. (Wells.)

Cæsium mercuric sulphocyanide, CsSCN, $Hg(SCN)_2$.
Sl. sol. in hot H_2O. (Bristol and Wells, Am. Ch. J. 1902, **28.** 260.)

Cæsium mercuric sulphocyanide, 2CsSCN, $Hg(SCN)_2+H_2O$.
Moderately sol. in H_2O, especially when warm. Recryst. without decomp. (Bristol and Wells, Am. Ch. J. 1902, **28.** 260.)

Cæsium nickel silver sulphocyanide, $Cs_2NiAg_2(SCN)_6+2H_2O$.
Slowly decomp. by hot H_2O. (Wells, Am. Ch. J. 1902, **28.** 277.)

Cæsium silver sulphocyanide, CsSCN, AgSCN.
Easily forms supersat. solution. (Wells, Am. Ch. J. 1902, **28.** 264.)
2CsSCN, AgSCN. Stable in the air. (Wells.)
3CsSCN, AgSCN. Stable in the air. (Wells.)

Cæsium silver strontium sulphocyanide, 3CsSCN, 2AgSCN, $Sr(SCN)_2$.
As Ba comp. (Wells.)

Cæsium silver zinc sulphocyanide, $CsZnAg(SCN)_4+H_2O$.
(Wells.)
$Cs_2ZnAg(SCN)_5$. Ppt. Stable in the air. (Wells.)
$CsZn_2Ag_8(SCN)_8$. Decomp. by cold, more rapidly by hot H_2O. (Wells.)
$CsZn_2Ag_4(SCN)_9$. Slowly decomp. by H_2O (Wells.)

Cæsium zinc sulphocyanide, $Cs_2Zn(SCN)_4+2H_2O$.
Moderately sol. in H_2O and can be recryst. therefrom. (Wells.)

Calcium sulphocyanide, $Ca(SCN)_2+3H_2O$.
Deliquescent. Very sol. in H_2O and alcohol.

Calcium silver sulphocyanide, $Ca(SCN)_2$, $2AgSCN+2H_2O$.
(Wells.)

Calcium stannic sulphocyanide, $CaSn(SCN)_6+7H_2O$.
Very sol. in H_2O. Can be recryst. therefrom. Sol. in alcohol and acetone. (Weinland and Bames, Z. anorg. 1909, **62.** 258.)

Cerous sulphocyanide, $Ce(SCN)_3+7H_2O$.
Deliquescent. Sol. in H_2O and alcohol. (Jolin, Bull. Soc. (2) **21.** 534.)

Chromous sulphocyanide *with* **MSCN.**
See **Chromosulphocyanide, M.**

Chromic sulphocyanide, $Cr(SCN)_3$.
Deliquescent, and sol. in H_2O.
Somewhat sol. in organic solvents. (Speransky, C. C. **1897,** I. 141.
See also **Chromisulphocyanhydric acid.**

Chromic sulphocyanide *with* **MSCN.**
See **Chromisulphocyanide, M.**

Cobaltous sulphocyanide, $Co(SCN)_2+\frac{1}{2}H_2O$.
Sol. in H_2O and alcohol; also in ether. Sol. in liquid SO_2. (Walden, B. 1899, **32.** 2864.)
Sol. in acetone. (Krug and M'Elroy.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)
$+3H_2O$. Sol. in H_2O and in alcohol. (Rosenheim and Cohn, Z. anorg. 1901, **27.** 288.)

Cobaltous mercuric sulphocyanide, $Co(SCN)_2$, $Hg(SCN)_2$.
Very sl. sol. in H_2O and dil. HCl+Aq. Easily sol. in HNO_3+Aq. (Cleve, J. pr. **91.** 227.)

Cobaltous potassium sulphocyanide, $CoK_2(SCN)_4$.

Decomp. by H_2O. (Treadwell, Z. anorg. 1901, **26.** 109.)

$+4H_2O$. Sol. in H_2O. Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether+Aq. Can be recryst. from H_2O or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, **27.** 289.)

Cobaltous silver sulphocyanide, $CoAg(SCN)_3+2H_2O$.

Decomp. by H_2O. (Shinn and Wells, Am. Ch. J. 1903, **29.** 476.)

$Ag_2Co(SCN)_4$. Almost insol. in H_2O and in alcohol. (Rosenheim, Z. anorg. 1901, **27.** **291.**)

Cobaltous sodium sulphocyanide, $Na_2Co(SCN)_4+8H_2O$.

Sol. in H_2O and in alcohol. (Rosenheim.)

Cobaltous sulphocyanide ammonia, $Co(SCN)_2$, $2NH_3$ and $Co(SCN)_2$, $6NH_3$.

(Peters, B. 1908, **41.** 3178.)

$Co(SCN)_2$, $4NH_3$. Sol. in H_2O and alcohol. (Sand, B. 1903, **36.** 1439.)

Cobaltous sulphocyanide mercuric chloride, $2Co(SCN)_2$, $2HgCl_2$.

(Hantzsch and Shibata, Z. anorg. 1912, **78.** 320.)

$2Co(SCN)_2$, $3HgCl_2$. Easily decomp. (Hantsch and Shibata.)

Cuprous sulphocyanide, CuSCN.

1 l. H_2O at 18° dissolves 0.004 mg. mols. or 0.5 mg. CuSCN. (Kohlrausch and Rose, Z. phys. Ch. 1893, **12.** 241.)

Insol. in dil. acids. Sl. sol. in cold, easily in warm conc. HCl+Aq. Decomp. by conc. H_2SO_4 or HNO_3+Aq. Sol. with combination in NH_4OH+Aq. Insol. in KSCN+Aq.

Less sol. in H_2SO_3 and H_2SO_4+Aq than in HNO_3. (Kuhn, Ch. Z. 1908, **32.** 1056.)

Sol. in $Fe_2(SO_4)_3$+Aq. (Johnson, J. Soc. Chem. Ind. 1889, **8.** 603.)

KSCN+Aq (85–90 g. in 50 g. H_2O) dissolves 18 g. CuSCN. (Thurnauer, B. 1890, **23.** 770.)

Sol. in ether. (Skey, C. N. 1867, **16.** 201.)

Cupric sulphocyanide, $Cu(SCN)_2$.

Decomp. by H_2O to cuprous salt. Sol. in warm HCl, H_2SO_4, or HNO_3+Aq. Sol. in MSCN+Aq, but solutions decomp. by dilution. Sol. in NH_4OH+Aq.

Solubility in NH_4OH+Aq at 25° and at 40°.

At 25°.

Sp. gr. 25°/25°	One gram of solution contains			1000 mols. H_2O dissolve		Composition of solid salt in contact with solution
	g. NH_3	g. $Cu(SCN)_2$	g. H_2O	Mols. NH_3	Mols. $Cu(SCN)_2$	
0.99853	0.2147	0.1522	0.6331	358.04	24.09	$Cu(SCN)_2$, $4NH_3$
0.99871	0.1655	0.1124	0.7221	242.02	15.60	
1.00703	0.0993	0.0798	0.8209	127.76	9.74	
1.01336	0.0639	0.0659	0.8702	77.51	7.59	
1.01506	0.0535	0.0622	0.8843	64.05	7.04	
1.01705	0.0426	0.0596	0.8978	50.21	6.65	
1.02132	0.0250	0.0511	0.9239	28.55	5.55	$Cu(SCN)_2$, $2NH_3$
1.01661	0.0198	0.0408	0.9394	22.27	4.35	
1.00816	0.0079	0.0245	0.9676	18.61	2.54	

At 40°.

	0.1802	0.1976	0.6222	306.28	31.83	$Cu(SCN)_2$, $4NH_3$
	0.1398	0.1658	0.6944	213.10	23.93	
	0.0758	0.1299	0.7943	101.00	16.38	
	0.0550	0.1207	0.8243	70.59	14.67	
	0.0435	0.1178	0.8388	54.82	14.07	
	0.0352	0.0876	0.8772	42.53	10.00	
	0.0257	0.0655	0.9088	30.00	7.22	$Cu(SCN)_2$, $2NH_3$
	0.0177	0.0418	0.9405	19.86	4.46	
	0.0094	0.0281	0.9625	10.31	2.93	

(Horn, Am. Ch. J. 1907, **37.** 471.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Cuprocupric sulphocyanide, $Cu(SCN)_2$, $Cu_2(SCN)_2$.

Not attacked by hot HCl+Aq. Insol. in KSCN+Aq.

Cupric mercuric sulphocyanide, $CuHg(SCN)_4$.
Almost insol. in cold H_2O and in alcohol; sl. sol. in boiling H_2O. (Rosenheim, Z. anorg. 1901, **27.** 286.)

Cuprous potassium sulphocyanide, $CuSCN, 6KSCN$.
Deliquescent. Decomp. by H_2O. (Thurnauer, B. 1890, **23.** 770.)

Cuprous sulphocyanide ammonia, $Cu_2(SCN)_2, 2NH_3$.
Decomp. in the air. (Richards, Z. anorg. 1898, **17.** 247.)
$Cu_2(SCN)_2, 5NH_3$. Very unstable in the air. (Richards.)

Cupric sulphocyanide ammonia, $Cu(SCN)_2, 2NH_3$.
Sol. in little H_2O, but decomp. by dilution with pptn. of basic salt. Sol. in NH_4OH+Aq.
By long standing a small amount dissolves in H_2O with separation of CuSCN. (Litterscheid, Arch. Pharm. 1901, **239.** 337.)
Insol. in H_2O. Sol. in H_2O containing a small amount of ammonia. (Horn, Am. Ch. J. 1907, **37.** 477.)
$Cu(SCN)_2, 4NH_3$. Very unstable in the air.
Sol. in H_2O, but decomp. by much H_2O with pptn. of a basic salt. (Horn.)
100 pts. N/10 NH_4OH+Aq dissolve 10.4 pts. anhydrous salt at 25°. (Pudschies, Dissert.)
Loses NH_3 in the air.
Sol. in H_2O. (Kohlschütter, B. 1904, **37.** 1156.)
Decomp. in the air and by H_2O and dil. and conc. acids; sol. in cold conc. HNO_3 and NH_4OH+Aq. Sol. in boiling conc. HCl. (Richards, Z. anorg. 1898, **17.** 250.)

Didymium sulphocyanide, $Di(SCN)_3+6H_2O$.
Deliquescent, and sol. in H_2O.

Erbium sulphocyanide, $Er(SCN)_3+6H_2O$.
Deliquescent. Sol. in H_2O. (Höglund.)

Glucinum sulphocyanide, $Gl(SCN)_2$ (?).
Sol. in H_2O. (Hermes, J. pr. **97.** 465.)

Gold (aurous) potassium sulphocyanide, AuSCN, KSCN.
Easily sol. in H_2O, less in absolute alcohol. (Cleve, J. pr. **94.** 16.)

Gold (aurous) potassium sulphocyanide ammonia, $KAu(SCN)_2, 5NH_3$.
(Peters, B. 1908, **41.** 3178.)

Gold (auric) potassium sulphocyanide ammonia, $KAu(SCN)_4, 4NH_3$.
(Peters.)

Gold (aurous) silver sulphocyanide, AuSCN, AgSCN.
Insol. in H_2O. Sol. in NH_4OH+Aq.

Gold (auric) potassium sulphocyanide.
Sol. in H_2O, alcohol, and ether. (Cleve.)

Gold (aurous) sulphocyanide ammonia, $AuSCN, NH_3$.
Very sl. sol. in cold, decomp. by hot H_2O.

Iron (ferrous) sulphocyanide, $Fe(SCN)_2+3H_2O$.
Very sol. in H_2O, alcohol, or ether.
Sol. in acetone. (Krug and M'Elroy.)

Iron (ferric) sulphocyanide, $Fe(SCN)_3+3H_2O$.
Deliquescent. Very sol. in H_2O, alcohol, or ether. Ether extracts the salt from $Fe(SCN)_3$+Aq. Decomp. by much H_2O if pure. Not decomp. by monobasic acids, but conc. H_2SO_4, and H_3PO_4, also oxalic, tartaric, malic, etc., acids destroy the colour.

Iron (ferric) lithium sulphocyanide, $Fe(SCN)_3, 9LiSCN+4H_2O$.
More deliquescent than the other ferric sulphocyanides. (Krüss and Moraht.)

Iron (ferrous) mercuric sulphocyanide, $Fe(SCN)_2, Hg(SCN)_2+2H_2O$.
Moderately sol. in hot H_2O. (Cleve, J. pr. **91.** 227.)

Iron (ferric) potassium sulphocyanide, $Fe(SCN)_3, 3KSCN+xH_2O$.
Extremely deliquescent, and sol. in H_2O. (Krüss and Moraht.)
$Fe(SCN)_3, 9KSCN+4H_2O$. Hygroscopic. Sol. in H_2O without decomp. Insol. in pure anhydrous ether, but decomp. by ether containing traces of H_2O into $Fe(SCN)_3$ and KSCN. (Krüss and Moraht, A. **260.** 204.)

Iron (ferrous) sodium sulphocyanide, $Na_4Fe(SCN)_6+12H_2O$.
Sol. in H_2O and alcohol. (Rosenheim, Z. anorg. 1901, **27.** 299.)

Iron (ferric) sodium sulphocyanide, $Fe(SCN)_3, 9NaSCN+4H_2O$.
Less deliquescent than the corresponding NH_4 or K salt. (Krüss and Moraht.)
$Na_3Fe(SCN)_6+12H_2O$. (Rosenheim, Z. anorg. 1901, **27.** 297.)

Lanthanum sulphocyanide, $La(SCN)_3+7H_2O$.
Deliquescent; sol. in H_2O. (Cleve.)

Lead sulphocyanide, basic, $6PbO, Pb(SCN)_2+2H_2O$. Ppt.
$Pb(SCN)_2, PbO+H_2O$. Insol. in H_2O. (Strömholm, Z. anorg. 1904, **38.** 440.)

Lead sulphocyanide, $Pb(SCN)_2$.

Nearly insol. in cold, decomp. by boiling H_2O. (Liebig.)

Sl. sol. in H_2O.

4.5×10^{1} g. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Lead sulphocyanide bromide, $Pb(SCN)_2$, $8PbBr_2$.

(Grissom and Thorp, Am. Ch. J. **10.** 219.)

Lead sulphocyanide chloride, PbSCNCl.

Sl. sol. in cold, easily sol. in hot H_2O. (Murtry, Chem. Soc. **55.** 50.)

Sol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Lead sulphocyanide iodide, $3Pb(SCN)_2$, PbI_2.

Sol. in H_2O. (Grissom and Thorp, Am. Ch. J. **10.** 229.)

Lithium sulphocyanide, LiSCN.

Very deliquescent. Sol. in H_2O and alcohol. (Hermes, Z. Ch. **1866.** 417.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Magnesium sulphocyanide, $Mg(SCN)_2 + 4H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Magnesium stannic sulphocyanide, $MgSn(SCN)_6 + 6H_2O$.

Hygroscopic. Sol. in H_2O, alcohol and acetone. (Weinland and Bames, Z. anorg. 1909, **62.** 258.)

Manganous sulphocyanide, $Mn(SCN)_2 + 3H_2O$.

Deliquescent. Easily sol. in H_2O and alcohol.

Mercurous sulphocyanide, $Hg_2(SCN)_2$.

Insol. in H_2O. Sol. in hot HCl+Aq. Slowly decomp. by hot aqua regia. Sol. in hot KSCN+Aq.

Mercuric sulphocyanide, basic, $Hg(SCN)_2$, $3HgO$.

Insol. in H_2O. Easily sol. in HCl+Aq. Insol. in H_2SO_4 or HNO_3+Aq. (Fleischer.)

$Hg(SCN)_2$, $2HgO$. Insol. in H_2O. Sl. attacked by acids. (Claus, J. pr. **15.** 401.)

Mercuric sulphocyanide, $Hg(SCN)_2$.

Very sl. sol. in cold, much more easily in hot H_2O. Easily sol. in dil. HCl+Aq. (Crookes, Chem. Soc. **4.** 18.)

Solubility in H_2O = 0.00218 mol. in 1 l. (Grossmann, Z. anorg. 1904, **43.** 358.)

More sol. in H_2O than in alcohol. (Peters, B. 1908, **41.** 3180.)

Very sl. sol. in H_2O at 25°. Appreciably sol. only in boiling H_2O. (Jander, Dissert. **1902.**)

Sol. in $Hg(NO_3)_2$ or KSCN+Aq, also in NH_4Cl+Aq. Sol. in many sulphocyanides +Aq.

Easily sol. in cold HCl, NH_4Cl, KCl or $BaCl_2$+Aq. (Hermes, J. pr. 1866, (1) **97.** 477.)

Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Mercuric hydrogen sulphocyanide, $Hg(SCN)_2$, 2HSCN.

Easily decomp. (Hermes, Dissert. **1866.**)

Mercuric nickel sulphocyanide, $Hg(SCN)_2$, $Ni(SCN)_2 + 2H_2O$.

Moderately sol. in hot H_2O. (Cleve, J. pr. **91.** 227.)

Very sol. in MSCN+Aq. (Orloff, C. C. **1906,** I. 1411.)

Mercuric potassium sulphocyanide, $Hg(SCN)_2$, KSCN.

Sol. in cold, more easily in hot H_2O. Sol. in alcohol and ether. Very sol. in NH_4Cl or KCl+Aq. (Claus.)

$K_2Hg(SCN)_4$. Very sol. in H_2O; sol. in alcohol.

Insol. in anhydrous ether. (Rosenheim, Z. anorg. 1901, **27.** 285.)

Mercuric rubidium sulphocyanide, $Hg(SCN)_2$, RbSCN.

Sol. in alcohol without decomp. Decomp. by H_2O.

$Hg(SCN)_2$, $2RbSCN + \frac{1}{2}H_2O$. Easily sol. in H_2O without decomp. (Grossmann, B. 1904, **37.** 1259.)

Mercuric sodium sulphocyanide, $Na_2Hg(SCN)_3$.

Very hydroscopic. (Rosenheim, Z. anorg. 1901, **27.** 286.)

Mercuric zinc sulphocyanide, $Hg(SCN)_2$, $Zn(SCN)_2$.

Scarcely sol. in cold H_2O. Easily sol. in HCl+Aq. (Cleve.)

Mercuric sulphocyanide ammonia, $2Hg(SCN)_2$, $3NH_3 + \frac{1}{2}H_2O$.

Decomp. by H_2O and alcohol.

$Hg(SCN)_2$, $4NH_3$. (Peters, B. 1908, **41.** 3178.)

Mercuric sulphocyanide ammonium bromide, $Hg(SCN)_2$, NH_4Br.

Decomp. by H_2O. Sol. in alcohol. (Grossmann, Z. anorg. 1903, **37.** 418.)

Mercuric sulphocyanide ammonium chloride, $Hg(SCN)_2, NH_4Cl$.

Deocmp. by H_2O. Sol. in warm alcohol from which it can be cryst. (Grossmann.)

Mercuric sulphocyanide bromide, HgSCNBr.

Insol. in cold H_2O; sol. in hot H_2O and in alcohol. (Rosenheim, Z. anorg. 1901, **27.** 282.)

Mercuric sulphocyanide chloride, HgSCNCl.

Insol. in cold H_2O.
Sol. in hot H_2O and alcohol. (Rosenheim.)

Mercuric sulphocyanide potassium bromide, $Hg(SCN)_2, 2KBr$.

Very sol. in H_2O. (Grossmann, Z. anorg. 1903, **37.** 418.)

Mercuric sulphocyanide potassium chloride, $Hg(SCN)_2, KCl$.

Decomp. by H_2O.
Not decomp. by recryst. from warm alcohol (Grossmann.)

Molybdenum sulphocyanide, $Mo(SCN)_3$(?).

Sol. in H_2O and ether. (Braun, Z. anal. **6.** 86.)

Molybdenum potassium sulphocyanide, $K_3Mo(SCN)_6+4H_2O$.

Cryst. from boiling H_2O and alcohol. (Chilesotti, Gazz. ch. it. 1904, **34.** (2) 493.)

Molybdenum sodium sulphocyanide, $Na_3Mo(SCN)_6+12H_2O$.

(Rosenheim, B. 1909, **42.** 154.)

Molybdenum thallous sulphocyanide, $MoTl_3(SCN)_6$.

(Rosenheim and Garfunkel, B. 1908, **41.** 2388.)

Molybdenum sulphocyanide zinc amine, $2Mo(SCN)_6, 3Zn(NH_3)_4$.

(Rosenheim and Garfunkel, B. 1908, **41.** 2390.)
$2Mo(SCN)_6(OH), Zn_3(NH_3)_{11}$. Can be cryst. from boiling NH_4OH+Aq. Air-dried salt probably has the composition $2Mo(SCN)_6(OH), 3Zn(NH_3)_4+2H_2O$. (Maas and Sand, B. 1908, **41.** 1510.)
$2Mo(SCN)_6(OH), Zn_3(NH_3)_{13}$. (Maas and Sand.)

Nickel sulphocyanide, $Ni(SCN)_2$.

Sol. in H_2O. (Grossmann, B. 1904, **37.** 565.)
$+\frac{1}{2}H_2O$. Sol. in H_2O and alcohol. Insol. in acetone. (Krug and M'Elroy.)
$+1\frac{1}{2}H_2O$. Sol. in H_2O. (Rosenheim and Cohn, Z. anorg. 1901, **27.** 292.)

Nickel potassium sulphocyanide, $K_4Ni(SCN)_6+4H_2O$.

Sol. in H_2O with decomp.
Sl. sol. in cold, easily sol. in hot alcohol. (Rosenheim, Z. anorg. 1901, **27.** 292.)

Nickel sodium sulphocyanide, $NiNa_2(SCN)_4+8H_2O$.

Sol. in H_2O with decomp.
Sl. sol. cold, readily sol. hot alcohol. (Rosenheim, Z. anorg. 1901, **27.** 292.)

Nickel sulphocyanide ammonia, $Ni(SCN)_2, 3NH_3$.

(Peters, B. 1908, **41.** 3178.)
$Ni(SCN)_2, 4NH_3$. Decomp. by H_2O.

Platinous sulphocyanide, $Pt(SCN)_2$(?).

Insol. in H_2O.
See **Platinosulphocyanides,** *and* **Platinososulphocyanides.**

Potassium sulphocyanide, KSCN.

Deliquescent. Very sol. in H_2O. 100 pts. H_2O dissolve 177.2 pts. at 0°, and 217.0 pts. at 20°.
100 g. sat. KSCN+Aq contain 70.5 g. KSCN at 25°. (Foote, Z. phys. Ch. 1903, **46.** 81.)
150 pts. KSCN+100 pts. H_2O at 10.8° lower the temp. 34.5°. (Rüdorff, B. **2.** 68.)

Solubility of KSCN+AgSCN at 25°.

% KSCN	% AgSCN	Solid phase
70.53	0.00	KSCN
66.55	9.32	KSCN+2KSCN, AgSCN
64.47	10.62	2KSCN, AgSCN
61.25	11.76	"
58.34	13.55	"
53.21	17.53	"
50.68	20.43	2KSCN, AgSCN+KSCN, AgSCN
49.43	20.32	KSCN, AgSCN
32.51	18.34	"
24.68	16.41	"
23.86	16.07	KSCN, AgSCN+AgSCN

(Foote, Z. phys. Ch. 1903, **46.** 81.)
See also AgSCN.

Sol. in alcohol, especially easily if boiling.
Sol. in acetone. (Krug and M'Elroy.)
Sol. in liquid SO_2. (Walden, Z. anorg. 1902, **30.** 160.)
100 g. acetone dissolve 20.75 g. KSCN at 22°, and 20.40 g. at 58°.
100 g. amyl alcohol dissolve 0.18 g. KSCN at 13°; 1.34 g. at 65°; 2.14 g. at 100°; 3.15 g. at 133.5.°
100 g. ethyl acetoate dissolve 0.44 g. KSCN at 0°; 0.40 g. at 14°; 0.20 g. at 79°.
100 g. pyridine dissolve 6.75 g. KSCN at 0°; 6.15 g. at 20°; 4.97 g. at 58°; 3.88 g. at

97°; 3.21 g. at 115°. (Laszcynski, B. 1894, **27.** 2285.)

100 g. acetonitrile dissolve 11.31 g. KSCN at 18°. (Naumann and Schier, B. 1914, **47.** 249.

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Potassium molybdenyl sulphocyanide, 3KSCN, $Mo(OH)(SCN)_3+4H_2O$.

Sol. in H_2O. (Sand and Maas, B. 1908, **41.** 1506.)

Potassium silver sulphocyanide, KSCN, AgSCN.

Decomp. by H_2O.

See Donk under KSCN.

2KSCN, AgSCN. Stable in the air. (Wells, Am. Ch. J. 1902, **28.** 265.)

See Donk under KSCN.

3KSCN, AgSCN. (Wells.)

Potassium stannic sulphocyanide, $K_2Sn(SCN)_6+4H_2O$.

Very sol. in H_2O.

Sol. in alcohol and acetone. (Weinland and Bames, Z. anorg. 1909, **62.** 258.)

Potassium titanyl sulphocyanide, 2KSCN, $TiO(SCN)_2+H_2O$.

Sol. in cold H_2O without immediate decomp. but slowly decomp. (Rosenheim and Cohn, Z. anorg. 1901, **28.** 169.)

Potassium vanadium sulphocyanide, 3KSCN, $V(SCN)_3+4H_2O$.

Sol. in H_2O. Sol. in alcohol with a green color. Sl. sol. in ether. (Ciocci, Z. anorg. 1898, **19.** 309.)

Sol. in H_2O with decomp.; stable in aq. solution in the presence of an excess of KSCN; sol. in alcohol. (Locke, Am. Ch. J. 1898, **20.** 604.)

Potassium vanadyl sulphocyanide, $K_2VO(SCN)_4+5H_2O$.

Sol. in H_2O, alcohol, ether, amyl alcohol and ethyl acetate. (Koppel, Z. anorg. 1903, **36.** 292.)

Potassium zinc sulphocyanide, 2KSCN, $Zn(SCN)_2+3H_2O$.

Easily sol. in alcohol. (Walden, Z. anorg. 1900, **23.** 374.)

Potassium sulphocyanide mercuric bromide, KSCN, $HgBr_2$.

Very sol. in H_2O.

Sol. in alcohol. (Grossmann, B. 1902, **35.** 2945.)

2KSCN, $HgBr_2$. Very sol. in H_2O. Sol. in alcohol. (Grossman.)

Potassium sulphocyanide mercuric iodide, 2KSCN, HgI_2.

Undecomp. by solution in conc. alcohol, or in KSCN+Aq. (Grossmann, Z. anorg. 1903, **37.** 421.)

$+2H_2O$. Decomp. by H_2O. (Philipp, Pogg, 1867, **131.** 94.)

Silicon sulphocyanide, $Si(SCN)_4$.

Decomp. by H_2O and alcohol.

Sol. in CS_2, $CHCl_3$ and ligroin, (Reynolds, Proc. Chem. Soc. 1906, **22.** 17.)

Silver sulphocyanide, AgSCN.

1 l. H_2O dissolves 1.08×10^{-6} g. mols. AgSCN at 25°. (Küster and Thiel, Z. anorg. 1902, **33.** 139.)

1 l. H_2O. dissolves 1.25×10^{-6} gram-atoms of silver at 25°. (Abegg and Cox, Z. phys. Ch. 1903, **46.** 11.)

Sl. sol. in H_2O. 1 liter of sat. solution at 19.96° contains 1.37×10^{-4} g. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

6.4 milligrams are dissolved in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1906, **56.** 93.)

Solubility product of AgSCN is 0.49 and 1.16×10^{-12} mols. per l. at 18° and 25° respectively. (Kirschner, Z. phys. Ch. 1912, **79.** 245.)

Solubility in $H_2O=1.2\times10^{-6}$ g. mol. per liter at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, **30.** 74.)

1 l. H_2O dissolves 0.00025 g. AgSCN at 21°. (Whitby, Z. anorg. 1910, **67.** 108.)

Insol. in acids, excepting conc. H_2SO_4 or HNO_3. Insol. in dil., sol. in conc. NH_4OH+Aq. Sol. in KSCN+Aq. Insol. in $AgNO_3$ or NH_4SCN+Aq. Sol. in $Hg_2(NO_3)_2$+Aq.

Solubility in KSCN at 25°.

Mol. KSCN in 1 litre	g. AgSCN in 1 litre
1.25	22.34
1.20	19.93
1.12	16.18
1.066	14.10
0.626	2.80
0.573	2.06

(Hellwig, Z. anorg. 1900, **25.** 184.)

Solubility in N/10 KSCN+Aq at 18°$=2.5\times10^{-4}$. (Kirschner, Z. phys. Ch. 1912, **79.** 247.)

See also KSCN.

1 l. of a 3-N solution of $AgNO_3$ dissolves 0.432 g. AgSCN at 25°. Nearly insol. in less dil. solution. (Hellwig, Z. anorg. 1900, **25.** 179.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Hamers, Dissert. **1906**; Naumann, B. 1910, **43.** 314.)

Silver strontium sulphocyanide, $2AgSCN, Sr(SCN)_2+2H_2O$.
Stable in the air. (Wells, Am. Ch. J. 1902, **28.** 270.)

Silver zinc sulphocyanide, $2AgSCN, Zn(SCN)_2$.
Decomp. by hot H_2O. (Wells.)

Silver sulphocyanide ammonia, $AgSCN, 2NH_3$.
Decomp. by H_2O.

Samarium sulphocyanide, $Sm(SCN)_3+6H_2O$.
Very deliquescent. (Cleve.)

Sodium sulphocyanide, $NaSCN$.
Very deliquescent. Very sol. in H_2O and alcohol.
Sol. in benzonitrile. (Naumann, B. 1914, **47.** 1369.)
Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3789.)

Sodium stannic sulphocyanide, $Na_2Sn(SCN)_6+6H_2O$.
Very sol. in H_2O. Sol. in alcohol and acetone. (Weinland and Bames, Z. anorg. 1909, **62.** 257.)

Sodium vanadium sulphocyanide, $3NaSCN, V(SCN)_3+12H_2O$.
Very hygroscopic. Sol. in H_2O and alcohol. (Ciocci, Z. anorg. 1898, **19.** 313.)

Strontium sulphocyanide, $Sr(SCN)_2+3H_2O$.
Very deliquescent, and sol. in H_2O and alcohol.

Strontium stannic sulphocyanide, $SrSn(SCN)_6+12H_2O$.
Sol. in H_2O, alcohol and acetone. (Weinland and Bames, Z. anorg. 1909, **62.** 259.)

Thallium sulphocyanide, $TlSCN$.
Sl. sol. in H_2O. 3.15 g. are contained in 1 liter of sat. solution at 20°; 3.905 g. at 25°; 7.269 g. at 39.75°. Insol. in alcohol. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

Titanyl sulphocyanide, $TiO(SCN)_2+2H_2O$.
Sol. in cold H_2O.

Tin (stannous) sulphocyanide, $Sn(SCN)_2$.
Sol. in H_2O and alcohol. (Classen, J. pr. **96.** 349.)
Sol. in cold H_2O. (Rosenheim, Z. anorg. 1901, **28.** 168.)

Yttrium sulphocyanide, $Y(SCN)_3+6H_2O$.
Not deliquescent. Very sol. in H_2O, alcohol, or ether.

Zinc sulphocyanide, $Zn(SCN)_2$.
Less sol. in H_2O and alcohol than most other cyanides.

Zinc sulphocyanide ammonia, $Zn(SCN)_2, 12NH_3$.
Decomp. by H_2O. Sol. in NH_4OH+Aq.

Sulphocyanoplatinic acid.
See **Platinosulphocyanhydric acid.**

Sulphocyanoplatinous acid.
See **Platinososulphocyanhydric acid.**

Sulphohypophosphoric acid.

Aluminum sulphohypophosphate, $Al_2(PS_3)_3$.
Unstable in the air. Sol. in H_2O with decomp. (Friedel, C. R. 1894, **119.** 262.)

Cadmium ——, $Cd_2P_2S_6$.
Partially decomp. in moist air. Decomp. by H_2O, cold HNO_3 or alkalis+Aq. (Ferrand, A. ch. 1899, (7) **17.** 423; Bull. Soc. 1895, (3) **13.** 116.)

Chromium ——, $Cr_2P_2S_6$.
Insol. in HNO_3. Very sl. attacked by aqua regia. (Ferrand.)

Cupric ——, $Cu_2P_2S_6$.
Ppt. (Friedel, C. R. 1894, **119.** 262.)

Iron (ferrous) ——, $Fe_2P_2S_6$.
Sol. in HNO_3 and in a mixture of HNO_3 with $KClO_3$. (Friedel.)

Lead ——, $Pb_2P_2S_6$.
Not decomp. by boiling H_2O. (Friedel.)

Mercuric ——, $Hg_2P_2S_6$.
Slowly decomp. by boiling H_2O, more rapidly by KOH+Aq. (Friedel.)

Nickel ——, $Ni_2P_2S_6$.
Not attacked by boiling H_2O or hot or cold acids. Sl. attacked by aqua regia. (Ferrand, A. ch. 1899, (7) **17.** 416.)

Silver ——, $Ag_4P_2S_6$.
Ppt. (Friedel, C. R. 1894, **119.** 263.)

Tin (stannous) hypophosphate ——, $SnPS_3$.
Decomp. by boiling H_2O. Sol. in dil. KOH+Aq. (Friedel, C. R. 1894, **119.** 264.)

Tin (stannic) ——, SnP_2S_6.
Easily decomp. by boiling H_2O. Sol. in dil. KOH+Aq. (Friedel.)

Zinc sulphohypophosphate, $Zn_2P_2S_6$.

Decomp. in moist air. Insol. in H_2O. Partially decomp. by boiling H_2O. Violently attacked by HNO_3. Sol. in aqua regia. Not attacked by HCl. (Ferrand, A. ch. 1899, (7) **17.** 421.)

Zinc ——, $Zn_2P_2S_8$.

Insol. in H_2O. Partly decomp. by boiling H_2O. Not decomp. by HCl or HNO_3 but by aqua regia. (Ferrand, Bull. Soc. 1895, (3) **13.** 115.)

Sulphomolybdic acid.

Ammonium sulphomolybdate, $(NH_4)_2MoS_4$.

Easily sol. in H_2O; very sl. sol. in alcohol. (Berzelius, Pogg. **83.** 261.)

Ammonium cupric sulphomolybdate.

Sl. sol. in H_2O. (Debray, C. R. **96.** 1616.)

Barium sulphomolybdate, $BaMoS_4$.

More sol. in H_2O than $BaMo_3S_{10}$. Known only in solution. (Berzelius.)

$BaS, 3MoS_3 = BaMo_3S_{10}$. Sl. sol. in cold, easily sol. in hot H_2O. Not decomp. by conc. cold HNO_3+Aq, but more easily by dil. HNO_3+Aq. (Berzelius.)

Cadmium sulphomolybdate.

Insol. in H_2O. (Berzelius.)

Cæsium sulphomolybdate, $Cs_2S, 3MoS_4 + 7H_2O$.

As Rb comp. (Herschfinkel, Dissert. **1907.**)

$3Cs_2S, 5MoS_4$. (Herschfinkel.)

Calcium sulphomolybdate, $CaS, 3MoS_3$.

Sol. in H_2O. (Berzelius.)

$CaMoS_4$. More sol. in H_2O than $CaS, 3MoS_3$. Known only in solution. (Berzelius.)

Cerium sulphomolybdate.

Precipitate. (Berzelius.)

Cobalt sulphomolybdate, $CoMoS_4$.

Sol. in K_2MoS_4+Aq. (Berzelius.)

Cupric sulphomolybdate.

(Debray, C. R. **96.** 1616.)

Ferrous sulphomolybdate, $FeMoS_4$.

Sol. in H_2O. (Berzelius.)

Ferric sulphomolybdate, $Fe_2(MoS_4)_3$.

Sol. in K_2MoS_4+Aq.

Lead sulphomolybdate.

Ppt. (Berzelius.)

Lithium sulphomolybdate.

Not deliquescent, but very easily sol. in H_2O. (Berzelius.)

Magnesium sulphomolybdate, $MgMoS_4$.

Sol. in K_2MoS_4+Aq. (Berzelius.)

Manganous sulphomolybdate, $MnMoS_4$.

Sol. in H_2O. (Berzelius.)

Mercurous sulphomolybdate, Hg_2MoS_4 (?).

Ppt.

Mercuric sulphomolybdate, $HgMoS_4$.

Insol. in K_2MoS_4+Aq.

Nickel sulphomolybdate, $NiMoS_4$.

Sol. in K_2MoO_4+Aq. (Berzelius.)

Potassium sulphomolybdate, basic, $K_6Mo_2S_9$.

Easily sol. in H_2O. Insol. in alcohol and ether. (Kruss, B. **16.** 2050.)

Potassium sulphomolybdate, K_2MoS_4.

Sol. in H_2O, from which it is precipitated by alcohol. (Berzelius.)

Rubidium sulphomolybdate, $3Rb_2S, 8MoS_3 + 30H_2O$.

Very sl. sol. in H_2O. Sol. by addition of NH_3. (Herschfinkel, Dissert. **1907.**)

$5Rb_2S, 6MoS_2$. (Herschfinkel.)

Silver sulphomolybdate, Ag_2MoS_4.

Ppt.

Sodium sulphomolybdate, Na_2MoS_4.

Sol. in H_2O, and not precipitated by alcohol from aqueous solution. (Berzelius.)

Strontium sulphomolybdates.

Exactly analogous to the Ba salts, which see. (Berzelius.)

Zinc sulphomolybdate.

Ppt. Insol. in H_2O. (Berzelius.)

*Mono*sulphomolybdic acid.

Sodium *mono*sulphomolybdate, Na_2MoO_3S.

Rather hygroscopic. Sol. in H_2O; forms deep blue solution with H_2SO_4. Sol. in $HC_2H_3O_2$+Aq. (Krüss, A. **225.** 1.)

*Di*sulphomolybdic acid.

Ammonium *di*sulphomolybdate, $(NH_4)_2MoO_2S_2$.

Sl. sol. in cold, easily in hot H_2O. Insol. in sat. NH_4Cl+Aq and absolute alcohol.

Aqueous solution is decomp. by boiling. (Bodenstab, J. pr. **78.** 186.)

Potassium *di*sulphomolybdate, $K_2MoO_2S_2$.
Very sol. in H_2O and alcohol. Sol. in $HC_2H_3O_2$+Aq. (Krüss, B. **16.** 2046.)

*Tri*sulphomolybdic acid.

Ammonium hydrogen *tri*sulpho*pyro*molybdate, $NH_4HMo_2O_4S_3$.
Precipitate. Insol. in alcohol or CS_2. (Krüss, B. **16.** 2047.)

Potassium hydrogen *tri*sulpho*pyro*molybdate, $KHMo_2O_4S_3$.
Very easily sol. in H_2O. (Krüss, B. **16.** 2048.)

Sodium hydrogen *tri*sulpho*pyro*molybdate, $NaHMo_2O_4S_3$.
Precipitate. Much more sol. in H_2O than the NH_4 compound. (Krüss, B. **16.** 2047.)

Potassium sulphomolybdate, $K_8Mo_4S_9O_7$.
Sol. in H_2O, $HC_2H_3O_2$, and H_2SO_4. (Krüss, B. **17.** 1771.)

*Penta*sulphomolybdic acid.

Potassium *penta*sulphomolybdate, $KMoS_5$.
Sol. in warm H_2O. (Hofmann, Z. anorg. 1896, **12.** 62.)

*Per*sulphomolybdic acid, H_2MoS_5.

Precipitate. Insol. in H_2O, alcohol, ether, CS_2, and acetic acid.
Decomp. slowly by hot H_2SO_4. Sol. in warm KOH+Aq, and cold K_2S+Aq. Not attacked by cold KSH+Aq, but dissolves on warming. (Krüss, B. **17.** 1773.)

Ammonium *per*sulphomolybdate, $(NH_4)_2MoS_5$.
Very sl. sol. in cold, more easily in hot H_2O. Insol. in NH_4OH+Aq. (Berzelius.)

Barium ——, $BaMoS_5$.
Insol. in boiling H_2O or dil. HCl+Aq. (Berzelius.)

Calcium ——.
Difficultly sol. in H_2O. (Berzelius.)

Cerium ——.
Precipitate. (Berzelius.)

Ferrous ——.
Insol. in Fe salts+Aq, but sol. in K_2MoS_5+Aq. (Berzelius.)

Ferric ——.
Ppt.

Lithium *per*sulphomolybdate.
Sl. sol. in cold, easily sol. in hot H_2O. (Berzelius.)

Magnesium ——.
Insol. precipitate. (Berzelius.)

Nickel ——.
Ppt. Sol. in K_2MoS_5+Aq, from which it separates in 24 hours. (Berzelius.)

Potassium ——, K_2MoS_5.
Almost insol. in cold, more sol. in hot H_2O. Insol. in cold KOH+Aq. (Berzelius.)

Potassium hydrogen ——, $KHMoS_5$.
Sol. in H_2O. (Krüss.)

Sodium ——, Na_2MoS_5.
Sl. sol. in cold, easily in hot H_2O. (Berzelius.)

Sodium hydrogen ——, $NaHMoS_5$.
(Krüss.)

*Per*sulphomolybdic acid, $HMoS_6$.

Sol. in H_2O. (Hofmann, Z. anorg. 1896, **12.** 59.)

Ammonium ——, $NH_4MoS_6+H_2O$.
Sl. sol. in H_2O and in alcohol with decomp. (Hofmann.)

Cæsium ——, $CsMoS_6$
Almost insol. in H_2O. (Hofmann.)

Potassium ——, $KMoS_6$.
Sol. in H_2O. (Hofmann,)

Thallium ——, $TlMoS_6$.
Insol. in H_2O. (Hofmann.)

Sulphonosmic acid.

Potassium sulphonosmate, $7K_2O, 4OsO_3, 10 SO_2$.
Sol. in H_2O. (Rosenheim, Z. anorg. 1899, **21.** 127.)
$+3H_2O$. Sol. in H_2O. (Rosenheim.)
$+7H_2O$. Easily sol. in H_2O; decomp. in aq. solution at 70°. (Rosenheim.)
$11K_2O, 4OsO_3, 14SO_2+7H_2O$. Sol. in H_2O. (Rosenheim.)

Sodium sulphonosmate, $3Na_2O, OsO_3, 4SO_2+5H_2O$.
Easily sol. in H_2O; decomp. in aq. solution. (Rosenheim.)

Sulphopalladic acid.

Potassium palladious sulphopalladate, K_2S, Pd_2S, $PdS_2 = K_2Pd_3S_4$.

Insol. in H_2O. Moderately conc. $HCl+Aq$ dissolves out K without evolution of H_2S. (Schneider, Pogg. **141.** 526.)

Silver sulphopalladate, Ag_2PdS_3.

(Schneider.)

Silver palladious sulphopalladate, Ag_2S, Pd_2S, $PdS_2 = Ag_2Pd_3S_4$.

Extraordinarily stable. (Schneider.)

Sodium sulphopalladate, Na_2PdS_3.

Slowly sol. in H_2O. Insol. in alcohol. (Schneider, Pogg. **141.** 520.)

Sulphophosphide *of* M.

See **M phosphosulphide.**

Sulphophosphamic acid, $PS\begin{smallmatrix}(OH)_2\\NH_2\end{smallmatrix}$(?).

See **Thiophosphamic acid.**

Sulphophospho*di*amic acid, $PS\begin{smallmatrix}OH\\(NH_2)_2\end{smallmatrix}$(?).

See **Thiophospho*di*amic acid.**

Sulphophospho*tri*amide, $PS(NH_2)_3$.

See **Thiophosphoryl *tri*amide.**

Sulphophosphoric acid, H_3PSO_3.

See **Thiophosphoric acid.**

H_3PS_4. Known only in its salts.

Ammonium sulphophosphate, $(NH_4)_3PS_4$.

Stable in the air. (Ephraim, B. 1911, **44.** 3408.)

Antimony sulphophosphate, $SbPS_4$.

Insol. in H_2O, alcohol, ether, CS_2, $HCl+Aq$, dil. H_2SO_4+Aq, C_6H_6, or $HC_2H_3O_2$. Decomp. by boiling with conc. HNO_3+Aq, H_2SO_4, aqua regia, KOH, NaOH or NH_4OH+Aq. (Glatzel, B. **24.** 3886.)

Arsenic sulphophosphate, $AsPS_4$.

Insol. in H_2O, alcohol, $HCl+Aq$, etc. Decomp. by warm HNO_3, aqua regia, dil. H_2SO_4; also sol. in KOH or NH_4OH+Aq. (Glatzel, Z. anorg. **4.** 186.)

Barium sulphophosphate, $Ba_3(PS_4)_2+xH_2O$.

(Ephraim, B. 1911, **44.** 3409.)

Bismuth sulphophosphate, $BiPS_4$.

Insol. in H_2O, alcohol, ether, CS_2, benzene, $HC_2H_3O_2$, or dil. H_2SO_4+Aq. Decomp. by boiling $HCl+Aq$, conc. H_2SO_4, HNO_3, or aqua regia; also by NaOH, KOH, or NH_4OH+Aq. (Glatzel, Z. anorg. **4.** 186.)

Cadmium sulphophosphate, $Cd_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, benzene, CS_2, and $HC_2H_3O_2$. Decomp. by hot $HCl+Aq$. Very sl. attacked by dil. H_2SO_4+Aq. Slowly sol. in hot HNO_3, rapidly in aqua regia or hot conc. H_2SO_4. (Glatzel, Z. anorg. **4.** 186.)

Cuprous sulphophosphate, Cu_3PS_4.

Insol. in H_2O, alcohol, etc.; also in HCl or dil. H_2SO_4+Aq. Decomp. by HNO_3, aqua regia, etc., not by KOH or $NaOH+Aq$. (Glatzel.)

Ferrous sulphophosphate, $Fe_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, etc.; insol. in HCl or hot dil. H_2SO_4+Aq. Decomp. by HNO_3, aqua regia, or conc. H_2SO_4. Not attacked by KOH or NH_4OH+Aq. (Glatzel.)

Lead sulphophosphate, $Pb_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc. Decomp. by warm $HCl+Aq$, conc. HNO_3+Aq; not attacked by NH_4OH+Aq; sl. decomp. by $KOH+Aq$. (Glatzel.)

Manganous sulphophosphate, $Mn_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, benzene, CS_2, or $HC_2H_3O_2$. Not attacked by $HCl+Aq$. Sol. in HNO_3 or aqua regia, with separation of S. Not attacked by dil. H_2SO_4+Aq. (Glatzel, Z. anorg. **4.** 186.)

Mercuric sulphophosphate, $Hg_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc.; also in HCl, dil. HNO_3, or H_2SO_4+Aq. Not attacked by conc. HNO_3 or aqua regia; easily sol. in HNO_3+Br_2+Aq. (Glatzel.)

Nickel sulphophosphate, $Ni_3(PS_4)_2$.

As the ferrous salt. (Glatzel.)

Potassium sulphophosphate, $K_3PS_4+H_2O$.

Easily sol. in H_2O. (Ephraim, B. 1911, **44.** 3407.)

Silver sulphophosphate, Ag_3PS_4.

Insol. in H_2O, alcohol, etc.; also in HCl, HNO_3, or dil. H_2SO_4+Aq. Decomp. by conc. H_2SO_4, and aqua regia. (Glatzel.)

Sodium sulphophosphate, $Na_3PS_4+8H_2O$.

Decomp. by H_2O.

Sol. in Na_2S+Aq. (Glatzel, Z. anorg. 1905, **44.** 65.)

Thallous sulphophosphate, Tl_3PS_4.

Insol. in H_2O, alcohol, etc. Sol. in HCl, dil. H_2SO_4+Aq, etc. Not attacked by NH_4OH+Aq; sl. decomp. by conc. $KOH+Aq$. (Glatzel.)

Tin (stannous) sulphophosphate, $Sn_3(PS_4)_2$.

Insol. in H_2O, alcohol, etc. Insol. in dil. H_2SO_4 or HCl+Aq. Decomp. by HNO_3+Aq, aqua regia, NH_4OH, or KOH+Aq. (Glatzel.)

Zinc sulphophosphate, $Zn_3(PS_4)_2$.

Insol. in H_2O, alcohol, ether, etc. Sol. in HCl+Aq or dil. H_2SO_4+Aq. Easily attacked by KOH+Aq; sl. decomp. by NH_4OH+Aq. (Glatzel.)

Sulpho*pyro*phosphoric acid.

Aluminum sulpho*pyro*phosphate, $Al_2P_2S_7$.

Decomp. in moist air.

Violently decomp. by H_2O or acids. (Ferrand, A. ch. 1899, (7) 429.)

Cadmium ——, $Cd_2P_2S_7$.

Decomp. in moist air.

Not attacked by cold acids. (Ferrand.)

Chromium ——, $Cr_2P_2S_7$.

Decomp. in moist air.

Not readily attacked by acids. (Ferrand.)

Cuprous ——, $Cu_4P_2S_7$.

Not attacked by cold H_2SO_4 or boiling HCl. (Ferrand.)

Sol. in hot conc. HNO_3. (Ferrand.)

Sol. in alkalies, and in all acids except HCl. (Ferrand, C. R. 1896, **122.** 886.)

Ferrous ——, $Fe_2P_2S_7$.

Insol. in cold acids.

Sl. attacked by boiling HCl or hot KOH+Aq.

Decomp. by fused KOH. (Ferrand, A. ch. 1899, (7) **17.** 410.)

Lead ——, $Pb_2P_2S_7$.

Not attacked by cold HNO_3. (Ferrand,)

Mercurous ——, $Hg_4P_2S_7$.

Decomp. by moist air or hot HNO_3. (Ferrand.)

Almost insol. in acids; decomp. by H_2O and moist air. (Ferrand, C. R. 1896, **122.** 888.)

Nickel ——, $Ni_2P_2S_7$.

Decomp. by H_2O and by conc. HNO_3 at 150° in a sealed tube. (Ferrand, A. ch. 1899, (7) **17.** 418.)

Silver ——, $Ag_4P_2S_7$.

Not decomp. by H_2O.

Decomp. by aqua regia.

Not attacked by HNO_3. (Ferrand.)

Zinc ——, $Zn_2P_2S_7$.

Decomp. in moist air.

Decomp. by H_2O.

Violently attacked by cold HNO_3. (Ferrand.)

Sulphophosphorous acid,

$$H_3PSO_2 = SPO\overset{H}{\underset{OH}{H}}(?).$$

See **Thiophosphorous acid.**

H_3PS_3. Known only in its salts.

Aluminum sulphophosphite, $Al_3(PS_3)_3$.

Very unstable.

Decomp. in the air. (Ferrand, C. R. 1896, **122.** 622.)

Barium sulphophosphite, $Ba_3(PS_3)_2+xH_2O$.

Sol. in dil. acids.

Insol. in alcohol. (Ephraim, B. 1911, **44.** 3412.)

Chromous sulphophosphite, $Cr_3(PS_3)_2$.

Easily attacked by hot conc. HNO_3 or aqua regia.

Decomp. by boiling NaOH+Aq. (Ferrand, A. ch. 1899, (7) **17.** 419.)

Quite stable in moist air; very slowly attacked by acids. (Ferrand, C. R. 1896, **122.** 622.)

Cuprous sulphophosphite, Cu_3PS_3.

Not attacked by H_2O or hot conc. HCl.

Sl. attacked by cold fuming HNO_3.

Violently attacked by HNO_3, aqua regia and boiling conc. H_2SO_4

Not attacked by boiling NaOH+Aq. (Ferrand, A. ch. 1899, (7) **17.** 398.)

Fairly stable; decomp. by damp air. (Ferrand, C. R. 1896, **122.** 621.)

Iron (ferrous) sulphophosphite, $Fe_3(PS_3)_2$.

Very stable and resists the action of alkalies and acids. (Ferrand, C. R. 1896, **122.** 622.)

Insol. in cold acids or hot NCl.

Sol. in hot fuming HNO_3.

Insol. in hot 40% KOH+Aq. (Ferrand, A. ch. 1899, (7) **17.** 412.)

Mercuric sulphophosphite, $Hg_3(PS_3)_2$.

Decomp. in moist air.

Not attacked by cold HNO_3. Decomp. by hot HNO_3. (Ferrand.)

Unstable in the air.

Very slowly attacked by acids. (Ferrand, C. R. 1896, **122.** 622.)

Nickel sulphophosphite, $Ni_3(PS_3)_2$.

Unstable in the air.

Attacked slowly by HNO_3. (Ferrand.)

Silver sulphophosphite, Ag_3PS_3.

Insol. in most reagents. (Ferrand, C. R. 1896, **122.** 622.)

Not decomp. by H_2O.

Not easily attacked by acids. (Ferrand, A. ch. 1899, (7) **17.** 414.)

Sodium sulphophosphite, $Na_3PS_3+xH_2O$.

Very sol. in H_2O, probably with decomp. (Ephraim, B. 1911, **44.** 3410.)

Zinc sulphophosphite, $Zn_3(PS_3)_2$.

Decomp. in moist air.

Sl. attacked by H_2O.

Decomp. by HNO_3. (Ferrand, A. ch. 1899, (7) **17.** 422.)

Very unstable in the air, and attacked violently by acids. (Ferrand, C. R. 1896, **122.** 622.)

Sulphoplatinic acid, $H_2Pt_4S_6$.

Insol. in H_2O, but decomp. on air. (Schneider, Pogg. **138.** 604.)

$H_4Pt_3S_6$. Insol. in H_2O, but decomp. very rapidly on air. (Schneider.)

Copper sulphoplatinate, $2CuS, 2PtS, PtS_2$.

Insol. in H_2O. HCl, HNO_3, or aqua regia dissolve out part of the Cu. (Schneider, Pogg. **139.** 661.)

Lead sulphoplatinate, $2PbS, 2PtS, PtS_2$.

Insol. in hot or cold H_2O or HCl+Aq. HNO_3+Aq dissolves out Pb partly; aqua regia dissolves completely with difficulty. (Schneider, Pogg. **139.** 662.)

Mercuric sulphoplatinate chloride, $2HgS, 2PtS, PtS_2, 2HgCl_2$.

Insol. in H_2O; not attacked by HCl+Aq, and only partially sol. in boiling aqua regia. (Schneider.)

Potassium sulphoplatinate, $K_2Pt_4S_6$.

Insol. in H_2O. HCl+Aq dissolves out K without evolution of H_2S.

Composition its potassium platinous sulphoplatinate, $K_2S, 3PtS, PtS_2$. (Schneider, Pogg. **138.** 604.)

K_2PtS_2.

Silver sulphoplatinate, $2Ag_2S, 2PtS, PtS_2$.

Insol. in H_2O or HCl+Aq. HNO_3+Aq dissolves out Ag on warming. Aqua regia decomp. with formation of AgCl. (Schneider, Pogg. **138.** 664.)

Sodium sulphoplatinate, $Na_4Pt_3S_6=2Na_2S, 2PtS, PtS_2$.

Decomp. by hot H_2O, with residue of PtS_2. (Schneider.)

$Na_2Pt_3S_6=Na_2S, PtS, 2PtS_2$. Insol. in H_2O. (Schneider, J. pr. (2) **48.** 418.)

Thallium sulphoplatinate, $2Tl_2S, 2PtS, PtS_2$.

Insol. in cold H_2O. Dil. acids dissolve out all the thallium. (Schneider, Pogg. **138.** 626.)

Sulphoplatinous acid, H_2PtS_2.

Known only in solution in H_2O, which soon decomposes. (Schneider, J. pr. (2) **48.** 424.)

Sodium sulphoplatinite, Na_2PtS_2.

Sol. in H_2O with decomp. (Schneider, J. pr. (2) **48.** 420.)

$H_4Na_2(PtS_2)_3$. Sol. in H_2O, from which it is pptd. by alcohol. (Schneider.)

Sulphoselenantimonous acid.

See **Selenosulphantimonous acid.**

Sulphoselenarsenic acid.

See **Selenosulpharsenic acid.**

Sulphoselenostannic acid.

See **Selenosulphostannic acid.**

Sulphoselenoxyarsenic acid.

See **Selenosulphoxyarsenic acid.**

Sulphoselenyl chloride, $SSeO_3Cl_4$.

Deliquescent; decomposed by H_2O. (Clausnitzer, B. **11.** 2007.)

*Meta*sulphosilicic acid.

Sodium *meta*sulphosilicate, Na_2SiS_3.

Decomp. by H_2O. (Hempel, Z. anorg. 1900, **23.** 41.)

Sulphostannic acid, H_2SnS_3.

Ppt. (Kühn, A. **84.** 110.)

Does not exist. (Storch, W. A. B. **98.** **2b.** 236.)

Ammonium sulphostannate, $(NH_4)_2S, 3SnS_2+6H_2O$.

Easily sol. in H_2O, and easily decomp. (Ditte, C. R. **95.** 641.)

$(NH_4)_2SnS_3+3H_2O$, and $+7H_2O$. Decomp. by acid. (Stanek, Z. anorg. 1898, **17.** 124.)

Barium sulphostannate, $BaSnS_3+8H_2O$.

Sol. in cold H_2O. (Ditte, C. R. **95.** 641.)

Calcium sulphostannate, $2CaS, SnS_2+14H_2O$.

Sol. in H_2O. (Ditte, C. R. **95.** 641.)

***Tetra*platinous sulphostannate,** $4PtS, SnS_2$.

Not decomp. by acids. (Schneider, J. pr. (2) **7.** 214.)

Platinum potassium sulphostannate, $3PtS, K_2S, SnS_2$.

Insol. in cold H_2O. Dil. HCl or $HC_2H_3O_2$ +Aq dissolves out all the potassium. (Schneider, Pogg. **136.** 109.)

Platinum sodium sulphostannate, $3PtS, Na_2S, SnS_2$.
Insol. in cold H_2O. (Schneider, Pogg. **136.** 109.)

Potassium sulphostannate, K_2SnS_3.
Sol. in H_2O. (Kühn, A. **84.** 110.)
$+3H_2O$. (Ditte, C. R. **95.** 641.)
$K_4SnS_4+4H_2O$. Sol. in H_2O pptd. by alcohol. (Weinland, Z. anorg. 1898, **17.** 419.)

Sodium sulphostannate, $Na_2SnS_3+2H_2O$.
Sl. sol. in H_2O. (Kühn, A. **84.** 110.)
$+3H_2O$. (Ditte, C. R. **95.** 641.)
$+7H_2O$. Sol. in H_2O. (Höring, Zeitsch. Pharm. **1851.** 120.)
$Na_4SnS_4+12H_2O$. Melts in crystal H_2O on heating. Very sol. in H_2O. (Kuhn.)

Strontium sulphostannate, $SrSnS_3+12H_2O$.
Sol. in H_2O. (Ditte, C. R. **95.** 641.)

Thallium sulphostannate, Tl_4SnS_4.
Ppt. Practically insol. in H_2O. (Hawley, J. Am. Chem. Soc. 1907, **29.** 1011.)

*Di*sulphopersulphuric acid.

Sodium *di*sulphopersulphate, $Na_2S_4O_8$.
Sol. in H_2O. Cryst. in cold with $2H_2O$. (Villiers, C. R. **106.** 851, 1354.)
Contains 4H more and is sodium tetrathionate, NaS_4O_6, $2H_2O$. (Villiers, C. R. **108.** 402.)

Sulphotelluric acid.

Mercurous sulphotellurate, $3Hg_2S, TeS_2$.
Ppt.

Mercuric ——, $3HgS, TeS_2$.
Ppt. (Berzelius.)

Potassium ——, K_2TeS_4.
Sol. in H_2O. (Oppenheim, J. pr. **71.** 279.)

Sodium ——.
Sol. in H_2O. (Oppenheim.)

Sulphotellurous acid.

Ammonium sulphotellurite, $3(NH_4)_2S, TeS_2$.
Decomp. on air. Sol. in H_2O.

Barium ——.
Very slowly sol. in H_2O.

Calcium ——.
Somewhat sol. in H_2O.

Cerium ——.
Insol. ppt.

Cobalt sulphotellurite, Co_3TeS_5.
Ppt.

Copper ——, Cu_3TeS_5.
Ppt.

Ferrous ——.
Ppt.

Ferric ——.
Ppt

Lead ——.
Ppt.

Lithium ——.
Sol. in H_2O.

Magnesium ——.
Sol. in H_2O and alcohol.

Manganous ——.
Ppt.

Potassium ——, $3K_2S, TeS_2$.
Sol. in H_2O.

Silver ——, $3Ag_2S, TeS_2$.
(Berzelius.)

Sodium ——.
Sol. in H_2O.

Strontium ——.
Sol. in H_2O.

Zinc ——, $3ZnS, TeS_2$.
Ppt. (Berzelius.)

Sulphotungstic acid.

Ammonium sulphotungstate, $(NH_4)_2WS_4$.
Very deliquescent. Easily sol. in H_2O, and still more easily in NH_4OH+Aq. (Corleis, A. **232.** 244.)
More sol. in pure H_2O than in H_2O acidified with HCl. Decomp. slowly on air. (Berzelius.)

Barium ——.
Sol. in $BaS+Aq$.

Cadmium ——, $CdWS_4$.
Ppt. (Berzelius.)

Calcium ——.
Sol. in H_2O and alcohol. (Berzelius.)

Cobalt ——, $CoWS_4$.
Sl. sol. in H_2O.

Copper sulphotungstate, $CuWS_4$.
Ppt.

Glucinum ——, $GlWS_4$.
Sol. in H_2O(?).

Ferrous ——, $FeWS_4$.
Sol. in H_2O.

Ferric ——.
Ppt.

Lead ——, $PbWS_4$.
Ppt. (Berzelius.)

Magnesium ——, $MgWS_4$.
Easily sol. in H_2O or alcohol.

Manganous ——, $MnWS_4$.
Sol. in H_2O. (Berzelius.)

Mercurous ——.
Ppt. (Berzelius.)

Mercuric ——, $HgWS_4$.
Ppt. (Berzelius.)

Nickel ——, $NiWS_4$.
Ppt. (Berzelius.)

Potassium ——, K_2WS_4.
Sol. in H_2O. Alcohol precipitates from aqueous solutions, but is not entirely insol. in alcohol. (Berzelius.)
Very sol. in H_2O. (Corleis, A. **232.** 264.)

Potassium —— nitrate, K_2WS_4, KNO_3.
Very sol. in cold or hot H_2O, from which it is precipitated by alcohol. (Berzelius.)

Potassium —— tungstate, $K_2WO_2S_2 = K_2WS_4, K_2WO_4$.
Easily sol. in H_2O. Not precipitated by alcohol. (Berzelius.)
Is potassium *tri*sulphotungstate, K_2WOS_3, which see. (Corleis, A. **232.** 244.)

Silver ——, Ag_2WS_4.
Ppt. (Berzelius.)

Sodium ——, Na_2WS_4.
Very sol. in H_2O; less sol. in alcohol. (Berzelius.)
Very deliquescent. (Corleis, A. **232.** 264.)

Strontium ——.
Sol. in H_2O, and in $SrS+Aq$.

Stannous ——, $SnWS_4$.
Ppt. (Berzelius.)

Stannic ——, $SnWS_5$.
Ppt. (Berzelius.)

Zinc sulphotungstate, $ZnWS_4$.
Sol. in H_2O with subsequent pptn. (Berzelius.)

*Mono*sulphotungstic acid.

Potassium *mono*sulphotungstate, K_2WOS+H_2O.
Deliquescent in moist air. Very sol. in H_2O. (Corleis, A. **232.** 244.)

*Di*sulphotungstic acid.

Ammonium *di*sulphotungstate, $(NH_4)_2WO_2S_2$.
Sol. in H_2O and alcohol. (Berzelius.)
Decomp. easily when moist. (Corleis, A. **232.** 264.)

*Tri*sulphotungstic acid.

Potassium *tri*sulphotungstate, $K_2WOS_3+H_2O$.
Hygroscopic. Effloresces on dry air and easily decomposed. Easily sol. in H_2O. (Corleis, A. **232.** 244.)

Sulphovanadic acid, $V_2O_5, 3SO_3+3H_2O$.
See **Vanadiosulphuric acid,** *and* **Sulphate, vanadium.**

Sulphovanadates.
Alkali sulphovanadates are sol. in H_2O. Ca, Sr, and Ba sulphovanadates are sl. sol. in H_2O, and all other sulphovanadates are insol. in H_2O. (Berzelius.)

Ammonium sulphovanadate, $(NH_4)_3VS_4$.
Easily sol. in H_2O. Very sl. sol. in conc. NH_4SH+Aq. Insol. in ether, CS_2, or $CHCl_3$. (Krüss and Ohnmais, A. **263.** 46.)
See also **Sulphoxyvanadic acid.**

Sodium *penta*sulpho*pyro*vanadate, $Na_4V_2O_2S_5$.
Hydroscopic; sol. in H_2O with rapid decomp. (Locke, Am. Ch. J. 1898, **20.** 375.)

Sulphoxyantimonic acid.

Potassium sulphoxyantimonate, $K_2HSbO_2S_2+2H_2O$.
Sol. in hot, less sol. in cold H_2O. Decomp. by cold H_2O. (Weinland and Gutmann, Z. anorg. 1898, **17.** 414.)

Sulphoxyarsenic acid, H_3AsO_3S.
Known only in aqueous solution. (McCay, Am. Ch. J. **10.** 459.)

Ammonium *mono*sulphoxyarsenate, $(NH_4)_3AsSO_3+3H_2O$.
Decomp. in the air; sol. in H_2O, decomp. on boiling. (Weinland, B. 1896, **29.** 1009.)

Very sol. in H_2O; insol. in alcohol; decomp. in aq. solution and also in the air. (Weinland, Z. anorg. 1897, **14.** 53.)

Decomp. in the air. (McLauchlan B. 1901, **34.** 2166.)

Ammonium hydrogen ***mono*****sulphoxyarsenate,** $(NH_4)_2HAsSO_3$.

Ppt. (McLauchlan, B. 1901, **34.** 2168.)

Barium ***mono*****sulphoxyarsenate,** $BaHAsO_3+10H_2O$.

(Preis, A. **257.** 184.)

$Ba_3(AsSO_3)_2+6H_2O$. Ppt. (Weinland Z. anorg. 1897, **14.** 54.)

Barium ***di*****sulphoxyarsenate,** $Ba_3(AsS_2O_2)_2+4H_2O$.

Ppt (Preis, A. **257.** 185.)

$+6H_2O$. (Weinland and Rumpf, Z. anorg. 1897, **14.** 64.)

Barium potassium ***tri*****sulphoxyarsenate,** $KBaAsS_3O+7H_2O$.

Ppt. (McCay, Z. anorg. 1904, **41.** 469.)

Barium sodium ***mono*****sulphoxyarsenate,** $BaNaAsSO_3+9H_2O$.

Ppt. (Weinland, Z. anorg. 1897, **14.** 55.)

Barium sodium sulphoxyarsenate, $Ba_7Na_2As_5O_7S_{14}+12H_2O$.

(McCay and Foster, Z. anorg. 1904, **41.** 467.)

Calcium ***tri*****sulphoxyarsenate,** $Ca_3(AsS_3O)_2+20H_2O$.

Ppt. (McCay and Foster, Z. anorg. 1904, **41.** 463.)

Potassium ***mono*****sulphoxyarsenate,** K_3AsSO_3.

Hydroscopic. (Weinland, B. 1896, **29.** 109.)

Sol. in conc. KOH+Aq, free from carbonate; very hydroscopic. (Weinland, Z. anorg. 1897, **14.** 51.)

Potassium hydrogen ***mono*****sulphoxyarsenate,** $K_2HAsSO_3+2\frac{1}{2}H_2O$.

Very hygroscopic. (Weinland and Rumpf, Z. anorg. 1897, **14.** 59.)

KH_2AsSO_3. Sol. in H_2O; solution slowly decomp. on standing. (McCay, Am. Ch. J. **10.** 459.)

Formula given by Bouquet and Cloez (A. ch. (3) **13.** 44) is $K_2H_4As_2S_3O_5$.

Potassium ***di*****sulphoxyarsenate,** $K_3AsS_2O_2+10H_2O$.

Very hydroscopic; decomp. by H_2O. (Weinland, Z. anorg. 1897, **14.** 63.)

Potassium ***tri*****sulphoxyarsenate,** $K_3AsS_3O+7H_2O$.

Yellow oil which cryst. at $-20°$. (McCay and Foster, Z. anorg. 1904, **41.** 468.)

Sodium ***mono*****sulphoxyarsenate,** $Na_3AsSO_3+12H_2O$.

Easily sol. in H_2O. (Preis, A. **257.** 180.) (McLaughlan, B. 1901, **34.** 2170.)

Sol. in H_2O. (Weinland, B. 1896, **29.** 1009.)

Sl. efflorescent. Insol. in alcohol. (McCay, Z. anorg. 1902, **29.** 42.)

Sol. in NaOH+Aq; decomp. by boiling with conc. NaOH (Weinland, Z. anorg. 1897, **14.** 49.)

Sodium hydrogen ***mono*****sulphoxyarsenate,** NaH_2AsSO_3.

Decomp. by H_2O; insol. in alcohol. (Weinland, Z. anorg. 1897, **14.** 58.)

$Na_2HAsSO_3+8H_2O$. Easily sol. in H_2O. (Preis.)

Sodium ***di*****sulphoxyarsenate,** $Na_3AsS_2O_2+10H_2O$.

Easily sol. in H_2O. (Preis.)

Sol. in H_2O; pptd. by alcohol. (McCay, B. 1899, **32.** 2472.)

Not decomp. by boiling NaOH+Aq. (Weinland, Z. anorg. 1897, **14.** 62.)

Insol. in alcohol. (McCay, Z. anorg. 1900, **25.** 461.)

$+11H_2O$. (McLaughlan, B. 1901, **34.** 2170.)

Insol. in alcohol. (McCay, Z. anorg. 1902, **29.** 46.)

Sodium ***tri*****sulphoxyarsenate,** $Na_3AsS_3O+11H_2O$.

Decomp. by H_2O. (McCay and Foster, Z. anorg. 1904, **41.** 454.)

Sodium ***tri*****sulphoxy*****di*****arsenate,** $As_2O_2S_3$, $3Na_2O+24H_2O$.

Easily sol. in H_2O. (Geuther, A. **240.** 208.)

$2As_2O_2S_3$, Na_2O+7H_2O. Sol. in H_2O. (Nilson, J. pr. (2) **14.** 14.)

Correct composition is $Na_8As_{18}S_{24}O_7+30H_2O$. (Preis.)

Sodium sulphoxyarsenate, $Na_8As_{18}S_{24}O_7+30H_2O=4Na_2O$, $6As_2S_2$, $3As_2S_4O+30H_2O$.

Decomp. by H_2O. Sol. in NH_4OH or KOH +Aq. (Preis, A. **257.** 187.)

=Sodium oxy*tri*sulpharsenate of Nilson.

Sodium ***penta*****sulphoxy*****tetr*****arsenate,** $Na_{12}As_4S_5O_{11}+48H_2O$.

Less sol. in H_2O than other sulphoxyarsenates. (Preis.)

Sodium strontium ***tri*****sulphoxyarsenate,** $NaSrAsS_3O+10H_2O$.

Unstable. (McCay and Foster, Z. anorg. 1904, **41.** 462.)

***Tri*sulphoxyazotic acid,** $ON(SO_3H)_3$.

Known only in its salts. (Claus, A., **158.** 52 and 194.)

Has the formula $(SO_3H)_3N{<}^{O}_{O}{>}N(SO_3H)_3$. (Raschig, A. **241.** 161.)

Potassium *tri*sulphoxyazotate, $ON(SO_3K)_3+H_2O=(SO_3K)_3N{<}^{O}_{O}{>}N(SO_3K)_3$.

Easily sol. in H_2O without decomp., even on boiling. (Claus, A. **157.** 210.)

Sulphoxyphosphorous acid,

$H_3PS_2O = OPSH$ (?), with H above and SH below the P.

See **Thiophosphorous acid.**

Sulphoxyvanadic acid.

Ammonium *pyrohexa*sulphoxyvanadate, $(NH_4)_4V_2S_6O$.

Sol. in H_2O. (Krüss and Ohnmais, A. **263.** 53.)

Potassium *pyrohexa*sulphoxyvanadate, $K_4V_2S_6O+3H_2O$.

Melts in crystal H_2O. (Krüss and Ohnmais.)

$K_8V_4S_{12}O_2+3H_2O$. More sol. in H_2O than preceding comp. (K. and O.)

Sodium *orthotri*sulphoxyvanadate, $Na_3VS_3O+5H_2O$.

Very deliquescent, and easily sol. in H_2O Somewhat sol. in alcohol. (Krüss and Ohnmais.)

Sodium *orthomono*sulphoxyvanadate, $Na_3VSO_3+10H_2O$.

Less sol. in H_2O than other sulphoxyvanadates. (K. and O.)

Sulphur, S.

The various modifications of sulphur have been classified in many different ways, and there is a difference of opinion as to whether certain forms are true allotropic modifications or not.

The data, as far as concerns the solubility, may be arranged as follows:—

A. *Sol. in* CS_2. 1. Rhombic, octahedral, or alpha sulphur, ordinary sulphur. Easily sol. in CS_2, etc. *See* below for solubility in various solvents.

2. Prismatic, monoclinic, or beta sulphur. Sol. in CS_2, but is converted into A, 1. Prismatic sulphur obtained by melting brimstone is not wholly sol. in CS_2 on account of admixture of gamma sulphur.

Monoclinic modification is more sol. than rhombic in $CHCl_3$, ether and benzene. (Meyer C. C. **1903,** II. 481.)

3. Soft sulphur, milk of sulphur.

4. Amorphous sol. sulphur is also a separate modification, according to Berthollet.

B. Soft sulphur, obtained by strongly heating and quickly cooling, is sol. in CS_2, but becomes insol. therein by repeatedly dissolving and evaporating. More easily sol. in CS_2 than A, 1.

C. *Insol. in* CS_2. 1. By action of strong light on S in CS_2.

2. By heating to b.-pt., cooling suddenly, and allowing to stand until hard. Has been called gamma sulphur, but is a mixture of $^2/_3$ A, 4 and $^1/_3$ insol. S.

3. Insol. S in flowers of sulphur. Converted into A. 1 by standing 3 days with alcohol.

According to Berthelot (A. ch. (3) 49. 430) there are only two varieties of S. I. "Octahedral," II. "Amorphous."

I. *Octahedral.* Sol. in CS_2. Scarcely acted upon by $KHSO_3$+Aq. Converted by oxidising agents into II.

II. *Amorphous.* Insol. in neutral solvents, viz. H_2O, alcohol, ether, CS_2, etc.

Sol. with tolerable rapidity in $KHSO_3$+Aq. By long action of Na_2S+Aq, a portion is dissolved, and the remainder converted into I. Less easily oxidised by HNO_3+Aq than I. Some varieties of this modification are sol. to a certain extent in alcohol and ether, and by boiling the rest of the sulphur is converted into I; also by long-continued contact with cold alcohol. Berthelot holds that the modification is changed before dissolving. Solutions of the alkalies, alkali salts, and alkali sulphides change insol. into sol. sulphur. (Berthelot.)

Elastic sulphur obtained by pouring molten sulphur at a temp. of over 260° into H_2O contains 35% or more of a modification of S which is insol. in CS_2, hot or cold, but sol. in absolute alcohol; this modification can be converted back into ord. sulphur by heating to 100°. (Pelouze and Fremy.) (*See* C. 2.)

This modification can be obtained also by action of HCl on thiosulphates. (Fordos and Gélis.)

The soft pasty sulphur obtained by decomposition of H_2S by SO_2 forms an almost clear emulsion (pesudo-solution) with H_2O, from which it is pptd. by various salts and substances which have no chemical affinity for it. 23 pts. S combine in this way with 100 pts. H_2O. When pptd. by saline solutions, some of the S remains in solution. When solution is exposed to the light, S gradually separates out; also on boiling the same takes place. The above pseudo-solution is pptd. by mineral acids, and the pptd. S may still be dissolved in fresh water, if not left in contact for some time with the acid. Also pptd. by K salts, with loss of power of forming pseudo-solutions. Pptd. by NH_4 and Na salts without losing that power.

Alkali hydrates, carbonates, or sulphides convert it into insol. S.

The solution may be mixed with alcohol without change. Decomp. by long shaking with napthha or oil of turpentine. The pseudo-solution combines with CS_2, forming an emulsion which subsequently decomposes. The S itself is only partially sol. in CS_2. (Selmi, J. pr. 57. 49.)

By treatment of amorphous "insoluble" S with CS_2 or CCl_4, a small part goes into solution, the amount being dependent on the time of contact with the temp., and nature of the solvent, but independent of the amount of the solvent. It is assumed that this is due to a partial change of the "insoluble" into soluble S. (Wigand, Z. phys. Ch. 1910, **75.** 235.)

"Delta" sulphur. Partly sol. in H_2O. (Debus, Chem. Soc. **53.** 18.)

A colloidal form wholly sol. in H_2O exists, which, however, decomposes very easily. (Engel, C. R. **112.** 866.)

Black sulphur. Insol. in alcohol, ether, CS_2, fatty oils even at 200°, cold alkali hydroxides +Aq, H_2SO_4, HNO_3, or aqua regia. (Knapp, J. pr. (2) **43.** 305.)

Green modification. Five times more sol. than ordinary sublimed sulphur in a mixture of salicylaldehyde and benzene. (Orloff, C. C. **1902,** I. 1264.)

The following data relate to octahedral or ordinary sulphur (A. 1):—

Sol. in warm liquid H_2S (Niemann); warm P_2S_3, SBr_2, SCl_2, Br_2, NCl_3, BaS+Aq (Dumas); in alcoholic solution of K_2S_5, but is repptd. by addition of H_2O to sat. solution.

Sol. in liquid SO_2.

Sol. in aqueous solution of alkali sulphates, especially when hot. Sl. sol. in boiling conc. HSCN+Aq, from which it mostly separates on cooling.

Na_2CO_3+Aq (5.6% Na_2CO_3) dissolves no S at 20°; 0.06775% at 100°. (Pohl, Dingl. **197.** 508.)

The solubility of S in Na_2S+Aq between 0° and 50° diminishes slightly with increase in temp., but increases with dilution of the solution, having its largest value in a N/16 solution of Na_2S+Aq when the relation of Na_2S to dissolved S equals about 1:4. (Küster, Z. anorg. 1905, **43.** 56.)

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913, **84.** 27.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

Sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 822.)

Sol. in liquid NH_3. 1 gr. S is sol. in 3–4 ccm. liquid NH_3. (Hugot, A. ch. 1900, (7) **21.** 32.)

The solubility of S in liquid NH_3 is constant from —23° to —84° and equals 39%. (Ruff, Z. angew. Ch. 1910, **23.** 1830.)

Solubility in liquid NH_3.
(g. S in 100 g. solution.)

t°	S	t°	S
—78	38.6	16.4	25.65
—20.5	38.1	30	21.0
0	32.34	40	18.5

(Ruff and Hecht, Z. anorg. 1911, **70.** 62.)

Sl. sol. in liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

S_2Cl_2 dissolves 66.74% S at ord. temp. to form a liquid of 1.7 sp. gr. (Rose.)

Solubility of S in S_2Cl_2 varies according to the variety of sulphur used. Aten has published an extended investigation on the subject, which see for details. (Z. phys. Ch. 1905–14, **54.** 86, 124; **81.** 268; **83.** 443; **86.** 1; **88.** 321.)

Solubility in $SnCl_4$.

100 g. $SnCl_4$ dissolve at:

99°	101°	110°	110°
5.8	6.2	8.7	9.1 pts. solid S,

112°	112°	121°
9.4	9.9	17.0 pts. liquid S.

(Gerardin.)

Sol. in alkalies+Aq with decomp.

Sol. in 1926.7 pts. absolute alcohol at 15°. (Pohl, W. A. B. **6.** 600.)

Sol. in 20 pts. hot nearly absolute alcohol, less sol. in weaker alcohol. (Laurogais.)

Sol. in 600 pts. boiling alcohol of 40° B. (Chevallier, J. ch. méd. **2.** 587); in 500 pts. alcohol (Meissner); 200 pts. alcohol (Pelouze and Fremy).

100 pts. absolute alcohol dissolve 0.42 pt. at b.-pt., and 0.12 pt. S at 16°; 100 pts. ether dissolve 0.54 pt. at b.-pt., and 0.19 pt. S at 16°; 100 pts. benzene dissolve 17.04 pts. at b.-pt., and 1.79 pts. S at 16°; 100 pts. oil of turpentine dissolve 16.16 pts. at b.-pt., and 1.35 pts. S at 16°; 100 pts. CS_2 dissolve 73.46 pts. at b.-pt., and 38.70 pts. S at 16°; 100 pts. naphtha dissolve 10.56 pts. at b.-pt., and 2.77 pts. S at 16°; 100 pts. tar-oil dissolve 26.98 pts. at b.-pt., and 1.51 pts. S at 16°. (Payen, C. R. **34.** 456.)

100 pts. absolute methyl alcohol dissolve 0.028 pt. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.053 pt. at 18.5°. (de Bruyn, Z. phys. Ch. **10.** 781.)

Solubility in amyl alcohol.

95°	110°	110°
1.5	2.1	2.2 pts. solid S,

112°	112°	120°	131°
2.6	2.7	3.0	5.3 pts. liquid S.

(Gerardin, A. ch. (4) **5.** 134.)

Quickly sol. in 12.5 pts. ether. (Favre.)

100 pts. benzene dissolve 0.965 pt. S at 26°; 100 pts. benzene dissolve 4.377 pts. S at 71°; 100 pts. toluene dissolve 1.479 pts. S at 23°; 100 pts. ethyl ether dissolve 0.972 pt. S at

23.5°; 100 pts. chloroform dissolve 1.205 pts. S at 22°; 100 pts. phenol dissolve 16.35 pts. S at 174°; 100 pts. aniline dissolve 85.27 pts. S at 130°. (Cossa, B. 1. 139.)

Solubility in benzene at t°.

t°	g. S in 10 g. of solution
15.17	0.1480
19.29	0.1692

(Brönsted, Z. phys. Ch. 1906, **55.** 377.)

A mixture of S and toluene separates into two layers containing 33 and 92.5% S respectively. (Haywood, J. phys. Ch. 1897, **1.** 232.)

CS_2 dissolves 0.35 pt. ordinary sulphur; some varieties of S, however, are not entirely sol. in CS_2, thus—

Variety of Sulphur	Pts. sol. in 1 pt. CS_2	Fraction of original wt. insol. in CS_2
Octahedral, from Sicily	0.335	0.000
Crystallised in dry way, recently prepared	0.415	0.029
Do., prepared 8 years	0.33	0.004
Do., prepared 9 years	. . .	0.020
Do., prepared 15 years	. . .	0.051
Red needles, recently prepared	0.382	0.023
Soft yellow, do.	. . .	0.353
Do., prepared 2 years	0.316	0.157
Soft red, recently prepared	0.374	0.157
Do., prepared 5 years	. . .	0.181
Flowers of sulphur	0.351	0.113
Do., another sample	. . .	0.234
Roll brimstone, outside	. . .	0.029
Do., inside	. . .	0.073

(Deville, A. ch. (3) **47.** 99.)

The pt. insol. in CS_2 is sol. in hot absolute alcohol, crystallising on cooling; less sol. in chloroform or ether. (Deville.)

100 pts. pure CS_2 dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S
—11	16.54	22	46.05
— 6	18.75	38	94.57
0	23.99	48.5	146.21
+15	37.15	55	181.34
18.5	41.65	. . .	. . .

(Cossa, B. **1.** 138.)

Neither ordinary stick S nor flowers of S is completely sol. in CS_2. Pptd. S is completely sol. in 5 pts. CS_2. (Tittenger, C. C. **1894,** II. 267.)

2.99 g. S are sol. in 100 grams CS_2 at —116°. (Arctowski, C. R. **1895, 121.** 124.)

Solubility in CS_2.

100 g. of the sat. solution contain at:

—77°	—84.5°	—89°	—116°
4.84	4.46	4.29	2.99 g. S.

(Arctowski, Z. anorg. 1896, **11.** 274.)

When 20 pts. S dissolve in 50 pts. CS_2 at 22° the temp. is lowered 5°. (Cossa.)

Sat. solution of S in CS_2 boils at 55°. (Cossa.)

Sp. gr. of S dissolved in CS_2 at 15°.

(Pts. S per 100 pts. CS_2.)

Sp. gr.	Pts. S	Sp. gr.	Pts S	Sp. gr.	Pts. S
1.271	0.0	1.312	9.9	1.352	19.6
1.272	0.2	1.313	10.2	1.353	19.9
1.273	0.4	1.314	10.4	1.354	20.1
1.274	0.6	1.315	10.6	1.355	20.4
1.275	0.9	1.316	10.9	1.356	20.6
1.276	1.2	1.317	11.1	1.357	21.0
1.277	1.4	1.318	11.3	1.358	21.2
1.278	1.6	1.319	11.6	1.359	21.5
1.279	1.9	1.320	11.8	1.360	21.8
1.280	2.1	1.321	12.1	1.361	22.1
1.281	2.4	1.322	12.3	1.362	22.3
1.282	2.6	1.323	12.6	1.363	22.7
1.283	2.9	1.324	12.8	1.364	23.0
1.284	3.1	1.325	13.1	1.365	23.2
1.285	3.4	1.326	13.3	1.366	23.6
1.286	3.6	1.327	13.5	1.367	24.0
1.287	3.9	1.328	13.8	1.368	24.3
1.288	4.1	1.329	14.0	1.369	24.8
1.289	4.4	1.330	14.2	1.370	25.1
1.290	4.6	1.331	14.5	1.371	25.6
1.291	4.8	1.332	14.7	1.372	26.0
1.292	5.1	1.333	15.0	1.373	26.5
1.293	5.3	1.334	15.2	1.374	26.9
1.294	5.6	1.335	15.4	1.375	27.4
1.295	5.8	1.336	15.6	1.376	28.1
1.296	6.0	1.337	15.9	1.377	28.5
1.297	6.3	1.338	16.1	1.378	29.0
1.298	6.5	1.339	16.4	1.379	29.7
1.299	6.7	1.340	16.6	1.380	30.2
1.300	7.0	1.341	16.9	1.381	30.8
1.301	7.2	1.342	17.1	1.382	31.4
1.302	7.5	1.343	17.4	1.383	31.9
1.303	7.8	1.344	17.6	1.384	32.6
1.304	8.0	1.345	17.9	1.385	33.2
1.305	8.2	1.346	18.1	1.386	33.8
1.306	8.5	1.347	18.4	1.387	34.5
1.307	8.7	1.348	18.6	1.388	35.2
1.308	8.9	1.349	18.9	1.389	36.1
1.309	9.2	1.350	19.0	1.390	36.7
1.310	9.4	1.351	19.3	1.391	37.2
1.311	9.7	. . .	. . .	. . .	. . .

(Mascagno, C. N. **43.** 192.)

Sp. gr. of S dissolved in CS_2 at 15°. Water at 4° = 1.

Sp. gr.	% S	Sp. gr.	% S	Sp. gr.	% S
1.2708	0.0	1.2736	0.6	1.2764	1.2
1.2717	0.2	1.2745	0.8	1.2774	1.4
1.2727	0.4	1.2755	1.0	1.2783	1.6
1.2792	1.8	1.3096	8.0	1.3409	14.2
1.2802	2.0	1.3105	8.2	1.3419	14.4
1.2812	2.2	1.3115	8.4	1.3430	14.6
1.2822	2.4	1.3125	8.6	1.3440	14.8
1.2832	2.6	1.3135	8.8	1.3450	15.0
1.2842	2.8	1.3145	9.0	1.3460	15.2
1.2852	3.0	1.3155	9.2	1.3471	15.4
1.2862	3.2	1.3165	9.4	1.3481	15.6
1.2872	3.4	1.3175	9.6	1.3491	15.8
1.2882	3.6	1.3185	9.8	1.3502	16.0
1.2892	3.8	1.3195	10.0	1.3512	16.2
1.2901	4.0	1.3205	10.2	1.3522	16.4
1.2911	4.2	1.3215	10.4	1.3532	16.6
1.2921	4.4	1.3226	10.6	1.3543	16.8
1.2930	4.6	1.3236	10.8	1.3553	17.0
1.2940	4.8	1.3246	11.0	1.3563	17.2
1.2949	5.0	1.3256	11.2	1.3573	17.4
1.2959	5.2	1.3266	11.4	1.3584	17.6
1.2969	5.4	1.3277	11.6	1.3594	17.8
1.2978	5.6	1.3287	11.8	1.3604	18.0
1.2988	5.8	1.3297	12.0	1.3615	18.2
1.2998	6.0	1.3307	12.2	1.3625	18.4
1.3008	6.2	1.3317	12.4	1.3635	18.6
1.3017	6.4	1.3328	12.6	1.3646	18.8
1.3027	6.6	1.3338	12.8	1.3656	19.0
1.3037	6.8	1.3348	13.0	1.3667	19.2
1.3047	7.0	1.3358	13.2	1.3677	19.4
1.3056	7.2	1.3368	13.4	1.3688	19.6
1.3066	7.4	1.3379	13.6	1.3698	19.8
1.3076	7.6	1.3389	13.8	1.3709	20.0
1.3086	7.8	1.3399	14.0	. .	. . .

(Pfeiffer, Z. anorg. 1897, **15.** 200.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Solubility of S in acetone+Aq at 25°.

S = millimols. g. S in 100 cc. of the solution.
A = g. acetone in 100 g. acetone+Aq.

A	S	Sp. gr.
100	65.0	0.78540
95.36	45.0	0.79114
90.62	33.0	0.81654
85.38	25.3	0.82958

(Herz and Knoch, Z. anorg. 1905, **45.** 263.)

Solubility in organic solvents.

Solvent	t°	Sat. solution contains % S
CS_2	—61	3.6
	—55	4.4
	—19	10.6
	—18	10.8
	—17	11.5
	—13	12.4
	—11	13.3
	—11	13.5
	— 2	17.2
	+ 3	19.5
	9	23.1
	11	23.7
	14	25.9
	17	27.2
	19	28.9
	20	28.5
	21	29.7
	26	33.4
	27	34.6
	29	37.8
	30.5	39.7
	33	42.2
	40	48.7
	44	53.2
	46	56.2
	48	57.5
	53	60.0
	54	60.6
	65	67.9
	77.5	76.4
	81.0	79.4
	92.0	87.8
	98.0	90.1
Ethylene dibromide	9	1.7
	22	2.4
	40	4.4
	50	6.4
	72	12.4
	95	30.2
	108	60.0
Benzene	8	1.2
	10	1.3
	21	1.8
	30	2.6
	39	3.3
	47	4.0
	54	4.9
	65	6.8
	72	8.6
	100	17.5
	123	31.9
	127	34.0
	150	36.8
Hexane	—20	0.07
	0	0.16
	+26	0.41
	+68	1.2
	+130	5.2
	+142	6.2
	+184	8.3

(Étard, A. ch. 1894, (7) **2.** 571.)

Solubility in $CHCl_3$ at t°.

t°	g. S in 10 g. of solution
12.25	0.0744
19.29	0.0918

(Brönsted, Z. phys. Ch. 1906, **55.** 377.)

Solubility of octahedral and prismatic S in organic solvents at t°.

Solvent	t°	% prismatic S	% octahedral S
Benzene	18.6	2.004	1.512
	25.3	2.335	1.835
Chloroform	0	1.101	0.788
	15.5	1.658	1.253
	40	2.9	2.4
Ethyl ether	0	0.113	0.080
	25.3	0.253	0.200
Ethyl bromide	0	0.852	0.611
	25.3	1.676	1.307
Ethyl formate	0	0.028	0.019
Ethyl alcohol	25.3	0.066	0.052

(Brönsted, Z. phys. Ch. 1906, **55.** 377.)

Solubility in organic solvents at 25°. (G. S dissolved in 1 g. mol. of solvent.)

Solvent	g. S
Ethylene chloride	0.831
Tetrachlorethane	2.063
Dichlorethylene	1.237
Pentachlorethane	2.421
Trichlorethylene	2.43
Perchlorethylene	2.537
Carbon tetrachloride	1.354

(Hoffmann et al. 1910, B. **43.** 188.)

100 g. trichlorethylene dissolve 1.19 g. S at 15°. (Wester and Bruins, Pharm. Weekbl. 1914, **51.** 1443.)

Solubility in benzyl chloride at t°.

t°	g. S per 100 g. of solution	
	in upper layer	in lower layer
0	0.99	
17	1.78	
35	2.57	
46.1	3.64	
63.3	6.15	
78.0	9.88	
99.1	19.89	
109.6	...	90.62
114.6	...	87.99
118.8	37.29	...
121.4	40.04	85.02
130.0	49.71	80.07
134.2	56.20	72.23

Above 134.2° sulphur is miscible with benzyl chloride in all proportions; below this temp. two layers are formed. (Bogusky, J. Russ. Phys. Chem. Soc. 1905, **37.** 92–99; C. C. **1905,** I. 1207.)

Easily sol. in boiling acetic anhydride. (Rosenfeld, B. **13.** 1475.)

Sol. in considerable amount in warm conc. $HC_2H_3O_2$+Aq, but very sl. sol. if dil. (Liebermann, B. **10.** 866.)

Sol. in stearic acid+Aq. (Vulpius, Arch. Pharm. (3) **13.** 38.)

Acetic ether dissolves 6% S. (Favre.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Sl. sol. in benzonitrile at ord. temp., much more sol. at higher temp. (Naumann, B. 1914, **47.** 1369.)

Sol. in 12 pts. hot petroleum from Amiano, but nearly insol. in cold. (de Saussure.)

100 pts. nicotine at 100° dissolve 10.58 pts. S, but this separates out as the solution cools. (Klever, C. C. **1872.** 434.)

Sol. in warm aniline. (Barral, A. ch. (3) **20.** 352.)

Easily sol. in hot, less sol. in cold aniline. (Fritzsche.)

Very sol. in aniline and quinoline, especially when warm. (Hofmann.)

Sol. in quinoline but reacts with the solvent with evolution of H. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

½ ccm. oleic acid dissolves 0.0335 g. S in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Sol. in 2.6 pts. of boiling, sl. sol. in cold creosote.

Sol. by digestion in 2 pts. oil of turpentine.

Sol. in hot oil of copaiba, crystallising on cooling.

Sol. in hot oil of mandarin, crystallising on cooling.

Sol. in hot oil of caraway, crystallising on cooling.

Somewhat sol. in hot, less in cold wood-spirit.

Sl. sol. in lignone, bromoform, cold benzene, but easily in hot benzene. (Mansfield, Chem. Soc. **1.** 262.)

Sol. in ethyl sulphide, and carbon chloride. (Rathke, A. **152.** 187.)

Sol. in mercuric methyl.

Sol. in 20 pts. ethyl nitrate, from which is is not pptd. by H_2O.

Sol. in naphtha, aldehyde, iodal, bromal, chloroform, warm chloral, sinkaline+Aq, ethyl chloride, warm benzoyl chloride.

100 pts. methylene iodide dissolve 10 pts. S at 10°. Melted sulphur is miscible with hot methylene iodide. (Retgers, Z. anorg. **3.** 343.)

S dissolves in 2000 pts. glycerine. (Cap and Garot, J. Pharm. (3) **26.** 81.)

Glycerine dissolves 0.10% S. (Klever, C. C. **1872.** 434.)

100 g. glycerine dissolve 0.14 g. at. 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Sol. in butyl sulphydrate, and warm retinole.

Sol. in ethyl sulphydrate.

Very sol. in coniine, hexyl alconol, warm allyl sulphocyanide, cacodyl oxide. Somewhat sol. in hot styrene, separating out on cooling.

Readily sol. in warm, less readily in cold toluene or resin-oil.

Sol. in olive oil at 115°, from which it mostly separates on cooling.

Sol. in hot oil of amber, crystallising upon cooling. Sol. in 2 pts. hot, sl. sol. in cold caoutchin.

Insol. in valerianic acid, amyl valerate, valeryl hydride.

Linseed oil dissolves % S at t°.

t°	% S	t°	% S	t°	% S
25	0.630	95	2.587	160	9.129
60	1.852	130	4.935	..	...

(Pohl.)

Solubility in olive oil (sp. gr.=0.885).
100 pts. dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S	t°	Pts. S
15	2.3	65	20.6	110	30.3
40	5.6	100	25.0	130	43.2

(Pelouze, C. R. **68.** 1179.)

Solubility in 100 pts. coal-tar oil at t°.

t°	Pts. S in		
	Oil of 0.870 sp. gr. B.-pt. 80-100°	Oil of 0.880 sp. gr. B.-pt. 85-120°	Oil of 0.882 sp. gr. B.-pt. 120-200°
15	2.1	2.3	2.5
30	3.0	4.0	5.3
50	5.2	6.1	8.3
80	11.8	13.7	15.2
100	15.2	18.7	23.0
110	...	23.0	26.2
120	...	27.0	32.0
130	...	...	38.7

t°	Pts. S in		
	Oil of 0.885 sp. gr. B.-pt. 150-200°	Oil of 1.010 sp. gr. B.-pt. 210-300°	Oil of 1.020 sp. gr. B.-pt. 220-300°
15	2.6	6.0	7.0
30	5.8	8.5	8.5
50	8.7	10.0	12.0
80	21.0	37.0	41.0
100	26.4	52.5	54.0
110	31.0	105.0	115.0
120	38.0	∞	∞
130	43.8	∞	∞

(Pelouze, C. R. **69.** 56.)

Sulphur bromide, S_2Br_2.

Decomp. gradually with H_2O. Dissolves S on warming, which crystallises out on cooling. Sol. in CS_2.

Decomp. by current of dry air into S and Br. (Hannay, Chem. Soc. **35.** 16.)

Decomp. slowly by cold H_2O, rapidly by hot H_2O. Decomp. by dil. KOH+Aq or $NaHCO_3$+Aq. (Korndörfer, Arch. Pharm. 1904, **242.** 156.)

A study of the mpt. curve of a series of mixtures of sulphur and bromine gave no evidence for the existence of the compounds SBr_2 and SBr_4. (Ruff, B. 1903, **36.** 2446.)

Sulphur ***mono*****chloride,** S_2Cl_2.

Slowly decomp. by H_2O. Miscible with CS_2 and C_6H_6. Sol. in alcohol and ether with subsequent decomposition. Sol. in oil of turpentine.

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Sol. in CCl_4, and C_6H_6. (Oddo, Gazz. ch. it. 1899, **29.** (2) 318.)

Sulphur ***di*****chloride,** SCl_2.

Decomp. slowly with H_2O, immediately by alcohol or ether.

Sulphur ***tetra*****chloride,** SCl_4.

Violently decomp. by H_2O. Decomp. at temperatures above —22°. (Michaelis, A. **170.** 1.)

Sulphur stannic chloride, $2SCl_4$, $SnCl_4$.

Decomp. by H_2O. Sol. in dil. HNO_3+Aq. Forms a mass with fuming HNO_3 which is sol. in HNO_3+Aq. Sol. in $POCl_3$. (Casselmann.)

Very hydroscopic. Fumes in moist air. Very easily sol. in dry abs. ether and in benzene. Sol. in $CHCl_3$, SO_2Cl_2, CS_2, $POCl_3$ ligroin and petroleum ether. (Ruff, B. 1904, **37.** 4517.)

Sulphur titanium chloride, SCl_4, $2TiCl_4$.

Very deliquescent. Easily sol. in dil. HNO_3+Aq. (Weber, Pogg. **132.** 454.)

SCl_4, $TiCl_4$. Sol. in SO_2Cl_2, $CHCl_3$, CS_2 and petroleum ether. (Ruff, B. 1904, **37.** 4516.)

Sulphur chloride ammonia, S_2Cl_2, $4NH_3$.

Insol. in H_2O, but gradually decomp. thereby; sol. without decomp. in absolute alcohol, from which it is pptd. by H_2O. (Mertens.)

Does not exist. (Fordos and Gélis, C. R. **31.** 702.)

SCl_2, $2NH_3$. Decomp. by H_2O. Sol. in alcohol or ether. (Soubeiran, A. ch. **67.** 71.) Not a true chemical compound, but a mixture. (Fordos and Gélis, C. R. **31.** 702.)

SCl_2, $4NH_3$. Decomp. by H_2O. Sl. sol. in absolute alcohol and ether (Soubeiran, A. ch. **67.** 71); mixture (Fordos and Gélis).

Sulphur chloride nitrogen sulphide.
See **Nitrogen sulphochloride.**

Sulphur *per*fluoride, SF_6.

Very sl. sol. in H_2O; sl. sol. in alcohol. (Moissan, C. R. 1900, **130.** 868.)

Sulphur *mono*iodide, S_2I_2.

Insol. in H_2O. Decomp. by alcohol, which dissolves out I_2. Sl. sol. in cold caoutchin, the solution decomposing when boiled. Freely sol. in glycerine. Sol. in 60 pts. glycerine, and 82 pts. olive oil. (Cap and Garot, J. Pharm. (3) **26.** 81.)
Very sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)
Sol. in CS_2. (Linebarger, Am. Ch. J. 1895, **17.** 58.)

Sulphur *hex*iodide, SI_6.

Decomp. on air. Alcohol or alkalies dissolve out iodine. (vom Rath, Pogg. **110.** 116.)
Does not exist. (M'Leod, Rep. Brit. Assn. Advn. Sci. **1892.** 690.)

Sulphur stannic iodide.
See **Tin sulphur iodide.**

Sulphur *sesqui*oxide, S_2O_3.

Deliquescent. Violently decomp. by H_2O at ordinary temp. Sol. in fuming H_2SO_4. Insol. in SO_3. Decomp. by alcohol or other. (Weber, Pogg. **156.** 531.)

Sulphur *di*oxide, SO_2.

Liquid. Insol. in H_2O if brought in contact therewith below the b.-pt. of SO_2.
Sol. in 3 vols. CS_2 on warming, separating out on cooling. Dissolves some P, little S, and no sulphuric or phosphoric acids.
Dissolves ether, chloroform, P, Br, S, I, CS_2, colophonium, and other gums; also benzene when warmed. (Sestini, Bull. Soc. (2) **10.** 226.)
Miscible with liquid SO_3, but not with H_2SO_4.
Gas.

1 vol. H_2O absorbs 30 vols. SO_2 gas at 18° (Davy); 20 vols. at ord. temp. (Dalton); 43.78 vols. at ord. temp. (de Saussure); 50 vols. at 20° and 760 mm. (Pelouze and Fremy); 33 vols. at ord. temp. (Thomson).
1 pt. SO_2 (by weight) is sol. in 0.1429 pt. H_2O at 5°, and the solution has 1.020 sp. gr.
1 pt. SO_2 is sol. in 0.0400 pt. H_2O at ord. temp. (Priestley); in 0.0909 pt. H O at 16°, and sp. gr. of the solution = 1.0513 (Thomson).
Sol. in 2 pts. H_2O at 10°. (Pierre, A. ch. (3) **23.** 421.)
100 vols. H^2O at 18° and 760 mm. absorb 4378 vols. SO_2 gas; 100 vols. alcohol of 0.84 sp. gr. at 760 mm. absorb 11,577 vols. (de Saussure, **1814.**)

Solubility of SO_2 gas in H_2O. t° = temp.; V = vols. SO_2 reduced to 0° and 760 mm. contained in 1 vol. sat. SO_2+Aq; V_1 = vols. SO_2 gas reduced to 0° and 760 mm. dissolved by 1 vol. H_2O under 760 mm. pressure.

t°	V	V_1	t°	V	V_1
0	68.861	79.789	21	34.986	37.970
1	67.003	77.210	22	33.910	36.617
2	65.169	74.691	23	32.847	35.302
3	63.360	72.230	24	31.800	34.026
4	61.576	69.828	25	30.766	32.786
5	59.816	67.485	26	29.748	31.584
6	58.080	65.200	27	28.744	30.422
7	56.369	62.973	28	27.754	29.314
8	54.683	60.805	29	26.788	28.210
9	53.021	58.697	30	25.819	27.161
10	51.383	56.647	31	24.873	26.151
11	49.770	54.655	32	23.942	25.178
12	48.182	52.723	33	23.025	24.244
13	46.618	50.849	34	22.122	23.347
14	45.079	49.033	35	21.234	22.489
15	43.564	47.276	36	20.361	21.668
16	42.073	45.578	37	19.502	20.886
17	40.608	43.939	38	18.658	20.141
18	39.165	42.360	39	17.827	19.435
19	37.749	40.838	40	17.013	18.766
20	36.206	39.374	..	...	

(Schönfeld, A. **95.** 5.)

This table may be formulated as follows: 1 vol. H_2O absorbs 79.789 − 2.6077t + 0.029349t² vols. SO_2 at temp. between 0° and 20°, or 1 vol. sat. solution contains 68.861 — 1.87025t + 0.01225t² vols. SO_2. Coefficient of absorption between 21° and 40° = 75.182 — 2.1716t + 0.01903t² vols. SO_2 or 1 vol. sat. solution between 21° and 40° contains 60.952 — 1.38898t + 0.00726t² vols. SO_2.

Solubility of SO_2 in H_2O at various temps. and 760 mm. t° = temp.; G = grammes SO_2 dissolved in 1 g. H_2O; V = vols. SO_2 dissolved in 1 g. H_2O.

t°	G	V	t°	G	V
8	0.168	58.7	30	0.078	27.3
10	0.154	53.9	32	0.073	25.7
12	0.142	49.6	34	0.069	24.3
14	0.130	45.6	36	0.065	22.8
16	0.121	42.2	38	0.062	21.6
18	0.112	39.3	40	0.058	20.4
20	0.104	36.4	42	0.055	19.3
22	0.098	34.2	44	0.053	18.4
24	0.092	32.3	46	0.050	17.4
26	0.087	30.5	48	0.047	16.4
28	0.083	28.9	50	0.045	15.6

(Sims, A. **118.** 340.)

Solubility of SO_2 in H_2O at various pressures. P = "partial pressure," *i. e.* the total pressure minus the tension of aqueous vapour at given temp.; G at P = weight SO_2 in grammes, which is dissolved in 1 g. H_2O at pressure P; G at 760 = calculated weight SO_2 that would be contained in 1 g. H_2O at 760 mm. if the absorption were proportional to the pressure; V = the volume of G grammes of SO_2 at 0° and 760 mm.

P	7°			
	G at P	G at 760	V at P	V at 760
30	0.010	0.263	3.634	92.06
40	0.013	0.212	4 451	84.55
50	0.015	0.223	5.129	77.95
60	0.017	0.818	6.024	76.28
70	0.020	0.213	6.868	74.55
80	0.022	0.210	7.743	73.55
90	0.025	0.208	8.598	72.62
100	0.027	0.205	9.421	71.60
120	0.032	0.201	11 09	70.20
140	0.036	0.197	12.71	69.00
160	0.041	0.195	14.34	68.15
180	0.046	0.193	15.97	67.40
200	0.050	0.191	17.59	66.83
220	0.055	0.190	19.19	66.30
240	0.059	0.188	20.79	65.84
260	0.064	0.187	22.40	65.44
280	0.069	0.186	23.99	65.10
300	0.073	0.185	25.59	64.81
350	0.085	0.184	29.55	64.16
400	0.096	0.182	33.51	63.65
450	0.107	0.181	37.44	63.25
500	0.118	0.180	41.42	62.94
550	0.130	0.179	45.31	62.60
600	0.141	0.178	49.20	62.32
650	0.152	0.178	53.10	62.09
700	0.163	0.177	56.98	61.86
750	0.174	0.176	60.88	61.69
760	0.176	0.176	61.65	61.65
800	0.185	0.176	64.74	61.50
850	0.196	0.175	68.57	61.30
900	0.207	0.175	72.41	61.15
950	0.218	0.175	76.25	61.00
1000	0.229	0.174	80.01	60.88
1050	0.240	0.174	83.97	60.77
1100	0.251	0.174	87.80	60.65
1200	0.273	0.173	95.45	60.45
1300	0.295	0.172	103.00	60.25

P	20°			
	G at P	G at 760	V at P	V at 760
40	0.007	0.143	2.637	50.09
50	0.009	0.138	3.171	48.20
60	0.011	0.135	3.718	47.10
70	0.012	0.131	4.205	45.64
80	0.013	0.127	4.663	44.30
90	0.015	0.125	5.169	43.65
100	0.016	0.124	5.692	43.25
120	0.019	0.121	6.683	42.33
140	0.022	0.119	7.690	41.75
160	0.025	0.118	8.666	41.17
180	0.028	0.117	9.652	40.75
200	0.030	0.116	10.62	40.35
220	0.033	0.115	11.59	40.03
240	0.036	0.114	12.54	39.70
260	0.038	0.112	13.45	39.30
280	0.041	0.112	14.41	39.10
300	0.044	0.111	15.34	38.87
350	0.050	0.110	17.66	38.35
400	0.059	0.109	20.56	38.10
450	0.064	0.108	22.37	37.77
500	0.071	0.107	24.67	37.50
550	0.077	0.106	26.93	37.20
600	0.083	0.105	29.14	36.90
650	0.090	0.105	31.39	36.70
700	0.096	0.105	33.62	36.50
750	0.103	0.104	35.94	36.43
760	0.104	0.104	36.43	36.43
800	0.110	0.104	38.32	36.40
1000	0.137	0.104	47.85	36.37
1300	0.178	0.104	62.10	36.31
1600	0.218	0.104	76.35	36.27
1900	0.259	0.104	90.53	36.21

P	39.8°			
	G at P	G at 760	V at P	V at 760
200	0.016	0.062	5.675	21.57
300	0.024	0.061	8.368	21.20
400	0.031	0.060	11.03	20.95
500	0.039	0.059	13.67	20.77
600	0.047	0.059	16.29	20.64
760	0.059	0.059	20.50	20.50
800	0.062	0.059	21.58	20.50
1000	0.077	0.058	26.84	20.40
1500	0.113	0.057	39.65	20.09
2000	0.149	0.057	52.11	19.80

P	50°			
	G at P	G at 760	V at P	V at 760
200	0.012	0.045	4.156	15.97
400	0.024	0.045	8.275	15.72
600	0.035	0.045	12.36	15.65
760	0.045	0.045	15.62	15.62
800	0.047	0.045	16.43	15.60
1000	0.059	0.045	20.51	15.59
1500	0.088	0.044	30.73	15.57
2000	0.012	0.044	39.07	15.55

(Sims, A. **118.** 340.)

*1 g. H_2O dissolves 0.0909 g. SO_2 = 34.73 cc. (at 25°) at 25° and 748 mm. pressure. (Walden and Centnerszwer, Z. phys. Ch. 1901, **42.** 462.)

Solubility of SO_2 in H_2O at t° and 760 mm. pressure.

t°	G. SO_2 per 1 g. H_2O	t°	G. SO_2 per 1 g. H_2O
0	0.236	7	0.176
2	0.218	8	0.168
4	0.201	10	0.154
6	0.184	12	0.142

(Roozeboom, R. t. c. 1884, **3.** 29.)

From a gas containing 10% by vol. of SO_2 at 10°, 1.63% by wt. is dissolved by 1 litre of H_2O; if the pressure is increased to 5 atmospheres, 8.14% by wt. is dissolved. (Harpf, Chem. Zeitschr., 1905, **4.** 136.)

Solubility of SO_2 in H_2O at t°.
C = g. SO_2 in 1 cc. of the solution.
P = Pressure in mm. of Hg.

t°	C	P	$\frac{C}{P} \times 10^4$
0	0.000537	0.4	13.4
"	0.00237	3.5	6.78
"	0.01227	29.4	4.17
"	0.03894	109.4	3.48
25	0.000534	1.4	3.81
"	0.00234	11.75	2.00
"	0.01212	87.9	1.379
"	0.03750	313.0	1.198
50	0.000525	4.9	1.07
"	0.002276	30.5	0.746
"	0.01181	204.5	0.577
"	0.03628	696.0	0.521

(Lindner, M. 1912, **33.** 645.)

Sp. gr. of sat. solution at—

0°	10°	20°	40°
1.06091	1.05472	1.02386	0.95548

(Bunsen and Schönfeld, A. **95.** 2.)

Sat. SO_2+Aq has sp. gr. = 1.0040. (Berthollet.)

Sp. gr. of sat. SO_2+Aq at t°.

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	1.0609	9	1.0548	17	1.0358
1	1.0596	10	1.0547	18	1.0321
2	1.0585	11	1.0528	19	1.0281
3	1.0576	12	1.0505	20	1.0239
4	1.0569	13	1.0481	21	1.0195
5	1.0562	14	1.0454	22	1.0147
6	1.0557	15	1.0424	23	1.0099
7	1.0552	16	1.0392	24	0.9991
8	1.0549	..	...	..	...

(Schiff, A. **107.** 312.)

Sp. gr. of SO_2+Aq at 4°.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1.0024	8	1.0217	15	1.0445
2	1.0049	9	1.0247	16	1.0480
3	1.0075	10	1.0278	17	1.0517
4	1.0102	11	1.0311	18	1.0553
5	1.0130	12	1.0343	19	1.0591
6	1.0158	13	1.0376	20	1.0629
7	1.0187	14	1.0410	21	1.0667

(Schiff, calculated by Gerlach, Z. anal. **8.** 292.)

Sp. gr. of SO_2+Aq.

% SO_2	Temp.	Sp. gr.
0.99	15.5°	1.0051
2.05	"	1.0102
2.87	"	1.0148
4.04	"	1.0204
4.99	"	1.0252
5.89	"	1.0297
7.01	"	1.0353
8.08	"	1.0399
8.68	"	1.0438
9.80	"	1.0492
10.75	"	1.0541
11.65	12.5°	1.0597
13.09	11.0°	1.0668

(Giles and Schearer, Jour. Soc. Ch. Ind. **4.** 303.)

Sp. gr. of SO_2+Aq.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1.0052	4	1.0167	7	1.0283
2	1.0094	5	1.0208	8	1.0329
3	1.0134	6	1.0242	9	1.0402

(Anthon.)

Sp. gr. of SO_2+Aq.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
1	1.0042	5	1.0210	8	1.0348
2	1.0083	6	1.0252	9	1.0392
3	1.0125	7	1.0295	10	1.0438
4	1.0167	..	...	..	...

(Hager, Adjumenta varia, Leipzig, **1876.** 146.)

Sp. gr. of SO_2+Aq at 15°.

% SO_2	Sp. gr.	% SO_2	Sp. gr.	% SO_2	Sp. gr.
0.5	1.0028	4.0	1.0221	7.5	1.0401
1.0	1.0056	4.5	1.0248	8.0	1.0426
1.5	1.0085	5.0	1.0275	8.5	1.0450
2.0	1.0113	5.5	1.0302	9.0	1.0474
2.5	1.0141	6.0	1.0328	9.5	1.0497
3.0	1.0168	6.5	1.0353	10.0	1.0520
3.5	1.0194	7.0	1.0377	...	...

(Scott, Polyt. Centralbl. **1873.** 826.)

Conc. H_2SO_4 absorbs 0.009 pt. by weight (58 vols.), and SO_2 is more soluble in dilute H_2SO_4+Aq, the more H_2O there is present. (Kolb, Dingl. **209.** 270.)

Solubility in H_2SO_4.

Sp. gr. of H_2SO_4	Absorbs SO_2 per kg.	Absorbs SO_2 per litre
1.841	0.009	5.8
1.839	0.014	8.9
1.540	0.021	11.2
1.407	0.032	15.9
1.227	0.068	29.7
1.020	0.135	49.0

(Kolb, Bull. Soc. Ind. Mullhouse, **1872.** 224.)

Coefficient of absorption for H_2SO_4 (1.841 sp. gr. at 15° and 760 mm.) is 28.14 at 17°, and 28.86 at 16°. (Dunn, C. N. **43.** 121.)

Solubility of SO_2 in H_2SO_4 of 1.84 sp. gr.

t°	Sp. gr. of sat. solution	Coeff. of absorption (760 mm.)	t°	Sp. gr. of sat. solution	Coeff. of absorption (760 mm.)
0	...	53	50	1.8186	9.5
10	1.8232	35.0	60	1.8165	7.0
20	1.8225	25.0	70	1.8140	5.5
25	1.8221	21.0	80	1.8112	4.5
30	1.8216	18.0	90	1.8080	4.0
40	1.8205	13.0	..	..	...

(Dunn, C. N. 1882, **45.** 272. Calc. by Seidell, Solubilities, 1st Ed.)

Solubility of SO_2 in H_2SO_4+Aq.

t°	Sp. gr. of H_2SO_4 solution	Approx. % H_2SO_4	Coeff. of absorption	t°	Sp. gr. % H_2SO_4 solution	Approx. % H_2SO_4	Coeff. of absorption
6.9	1.139	20	48.67	15.2	1.173	25	31.82
6.9	1.300	40	45.38	16.8	1.151	21	31.56
8.6	1.482	58	39.91	14.8	1.277	36	30.41
9.8	1.703	78	29.03	15.1	1.458	56	29.87
5.5	1.067	10	36.78	15.6	1.609	70	25.17
6.6	1.102	15	34.08	15.0	1.739	81	20.83

(Dunn, C. N. 1882, **45.** 272; Seidell, Solubilities, 1st Ed.)

Coefficient of absorption in H_2SO_4 (sp. gr. = 1.841) = 5.8; (sp. gr. = 1.839) = 8.9. (Lunge.)

Solubility in salts+Aq at 35°.

l = coefficient of absorption of SO_2 in the given salt solution at 35°.
lo = coefficient of absorption of SO_2 in water at 35° = 22.43.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	l	45.43	41.87	38.04	34.64	30.25	26.30
	l–lo	23.00	19.44	15.61	12.21	7.82	3.87
KBr	l	36.14	34.12	31.93	29.64	27.49	24.83
	l–lo	13.71	11.69	9.50	7.21	5.01	2.40
KCl	l	30.02	28.93	27.94	26.54	25.15	23.74
	l–lo	7.59	6.50	5.31	4.11	2.72	1.31
KCNS	l	42.94	38.13	35.05	32.03	28.79	25.63
	l–lo	18.51	15.70	12.62	9.60	6.36	3.20
NH_4NO_3	l	27.43	26.66	25.57	24.78	24.23	23.35
	l–lo	5.00	4.23	3.14	2.35	1.80	0.92
KNO_3	l	27.33	26.54	25.72	24.79	24.03	23.27
	l–lo	4.90	4.11	3.29	2.36	1.60	0.84

Solubility in salts+Aq at 35°.—*Continued.*

l= coefficient of absorption of SO_2 in the given salt solution at 35°.
lo= coefficient of absorption of SO_2 in water at 35°=22.43.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
$\frac{1}{2}(NH_4)_2SO_4$	l	24.60	24.23	23.93	23.49	23.14	22.91
	l-lo	2.17	1.80	1.50	1.06	0.71	0.48
$\frac{1}{2}CdI_2$	l	24.30	23.99	23.71	23.38	23.06	22.75
	l-lo	1.87	1.56	1.28	0.95	0.63	0.32
$\frac{1}{2}Na_2SO_4$	l	19.27	19.79	20.20	20.81	21.35	21.88
	l-lo	—3.16	—2.64	—2.23	—1.62	—1.08	—0.55
$\frac{1}{2}CdBr_2$	l	19.17	19.70	20.60	20.81	21.46	21.88
	l-lo	—3.26	—2.73	—1.83	—1.62	—0.97	—0.55
$\frac{1}{2}CdCl_2$	l	18.68	19.23	20.02	20.55	21.23	21.73
	l-lo	—3.75	—3.20	—2.41	—1.88	—1.20	—0.70
$\frac{1}{2}CdSO_4$	l	16.25	17.41	18.31	19.42	20.43	21.45
	l-lo	—6.81	—5.02	—4.12	—3.01	—2.00	—0.98

Solubility in salts+Aq at 25°.

l=coefficient of absorption of SO_2 in the given solution at 25°.
lo=coefficient of absorption of SO_2 in water at 25°=32.76.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	l	68.36	62.63	56.75	50.58	44.76	38.66
	l-lo	35.60	29.87	23.99	17.82	12.00	5.90
$\frac{1}{2}CdI_2$	l	35.77	34.98	34.74	34.16	33.76	33.27
	l-lo	3.01	2.22	1.98	1.40	1.00	0.51
NH_4Br	l	52.25	49.17	46.06	42.78	39.46	36.28
	l-lo	19.49	16.41	13.30	10.02	6.70	3.52
KBr	l	52.26	48.87	44.96	42.41	39.11	35.94
	l-lo	19.00	15.71	12.70	9.15	6.35	3.18
NaBr	l	37.74	36.84	36.26	35.27	34.54	33.76
	l-lo	4.98	4.08	3.50	2.51	1.78	1.00
$\frac{1}{2}CdBr_2$	l	27.46	28.15	29.27	30.17	31.01	31.91
	l-lo	—5.30	—4.61	—3.49	—2.59	—1.75	—0.85
NH_4Cl	l	42.78	41.37	39.76	38.06	36.37	34.58
	l-lo	10.02	8.61	7.00	5.30	3.61	1.80
KCl	l	42.27	40.96	39.32	37.76	36.05	34.42
	l-lo	9.51	8.20	6.56	5.00	3.29	1.66

Solubility in salts+Aq at 25°—*Continued.*

l= coefficient of absorption of SO_2 in the given solution at 25°.
lo= coefficient of absorption of SO_2 in water at 25°=32.76.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
NaCl	l	31.36	31.51	31.76	31.96	32.25	32.46
	l-lo	—1.40	—1.25	—1.00	—0.80	—0.51	—0.30
½$CdCl_2$	l	26.06	27.09	28.16	29.46	30.55	31.66
	l-lo	—6.70	—5.67	—4.60	—3.30	—2.21	—1.10
NH_4CNS	l	61.46	57.01	52.26	47.26	42.74	37.78
	l-lo	28.70	24.25	19.50	14.50	9.98	5.02
KCNS	l	61.26	55.87	51.86	47.02	42.38	37.57
	l-lo	28.50	23.11	19.10	14.26	9.62	4.81
NaCNS	l	48.34	45.86	43.37	40.78	38.24	35.44
	l-lo	15.58	13.10	10.61	8.02	5.48	2.68
NH_4NO_3	l	39.14	38.01	37.27	36.28	35.07	33.96
	l-lo	6.38	5.25	4.51	3.52	2.31	1.20
KNO_3	l	38.52	37.57	36.66	35.77	34.79	33.80
	l-lo	5.76	4.81	3.90	3.01	2.03	1.04
½$(NH_4)_2SO_4$	l	35.96	35.47	34.95	34.34	33.82	33.35
	l-lo	3.20	2.71	2.19	1.58	1.06	0.59
½K_2SO_4	l	...	...	...	...	33.61	33.20
	l-lo	...	...	...	...	0.85	0.48
½Na_2SO_4	l	28.44	28.66	29.51	30.45	31.14	31.96
	l-lo	—4.32	—4.10	—3.25	—2.31	—1.62	—0.80
½$CdSO_4$	l	23.76	25.14	26.58	28.24	29.71	31.11
	l-lo	—9.00	—7.62	—6.18	—4.52	—3.05	—1.85

(Fox, Z. phys. Ch. 1902, **41.** 462.)

Sol. in Cl_2+Aq. Sol. in Br_2. Solidification curves determined. (Van der Goot, Z. phys. Ch. 1913, **84.** 419.)

Solubility of SO_2 in alcohol. 1 vol. alcohol at t° and 760 mm. dissolves V vols. SO_2 gas at 0° and 760 mm.

t°	V	t°	V	t°	V
0	328.62	9	201.33	17	130.61
1	311.98	10	190.31	18	124.58
2	295.97	11	179.91	19	119.17
3	280.58	12	170.13	20	114.48
4	265.81	13	160.98	21	110.22
5	251.67	14	152.45	22	106.68
6	238.16	15	144.55	23	103.77
7	225.26	16	137.27	24	101.47
8	212.98	..	...	..	...

(Bunsen's Gasometry.)

100 pts. absolute methyl alcohol dissolve 247 pts. SO_2 at 0° and 760 mm.; 47 pts. at 26° and 760 mm.; 100 pts. absolute ethyl alcohol dissolve 115 pts. SO_2 at 0° and 760 mm.; 32.3 pts. at 26° and 760 mm. (de Bruyn, Z. phys. Ch. **10.** 783.)

Sol. in ether.

Absorbed by oil of turpentine.

Rapidly absorbed by anhydrous aldehyde in the cold, 11 pts. aldehyde absorbing 19 pts. SO_2.

Absorption coefficient of aldehyde for SO_2 is 1.4 times greater than that of alcohol, and 7 times greater than that of H_2O. (Geuther and Cartmell, Proc. Roy. Soc. **10.** 111.)

1 pt. camphor dissolves 0.880 pt. by weight (=308 vols.) SO_2 at 0° and 725 mm.; 1 pt. glacial $HC_2H_3O_2$ dissolves 0.961 pt. by weight (=318 vols.) SO_2 at 0° and 725 mm.; 1 pt. formic acid dissolves 0.821 pt. by weight (=351 vols.) SO_2 at 0° and 725 mm.; 1 pt. acetone dissolves 2.07 pts. by weight (=589 vols.) SO_2 at 0° and 725 mm.; 1 pt. sulphuryl chloride dissolves 0.323 pt. by weight (=187 vols.) SO_2 at 0° and 725 mm. (Schulze, J. pr. (2) **24.** 168.)

Solubility of SO_2 in $CHCl_3$.

C = g. SO_2 in 1 cc. of the solution.
P = Pressure in mm. Hg.

t°	C	P	$\frac{C}{P}\times 10^4$
0	0.000701	2.7	2.6
"	0.001790	5.6	3.14
"	0.006982	22.0	3.17
"	0.03097	90.2	3.43
"	0.08217	219.6	3.74
25	0.000669	5.7	1.17
"	0.001712	12.9	1.37
"	0.006723	48.0	1.40
"	0.02954	206.2	1.47
"	0.07839	488.8	1.60

(Lindner, M. 1912, **33.** 645.)

Distribution of SO_2 between H_2O and $CHCl_3$ at 20°.

c_1 = g. SO_2 per l. of H_2O solution.
c_2 = g. SO_2 per l. of $CHCl_3$ solution.

C_1	C_2	C_1/C_2
1.738	1.123	1.55
1.753	1.122	1.56
2.326	1.704	1.37
2.346	1.703	1.38
2.628	1.897	1.38
3.039	2.395	1.27
3.058	2.385	1.28
3.686	3.063	1.20
3.735	3.062	1.22
4.226	3.626	1.17
5.269	4.798	1.10
5.372	4.813	1.12
6.588	6.183	1.07
31.92	33.84	0.94
33.26	37.25	0.89

(McCrae, Z. anorg. 1903, **35.** 12.)

Distribution of SO_2 between HCl+Aq and $CHCl_3$ at 20°.

c_1 = g. SO_2 per l. of HCl+Aq solution.
c_2 = g. SO_2 per l. of $CHCl_3$ solution.
HCl = normality of HCl+Aq used.

HCl	C_1	C_2	C_1/C_2
0.05–N	1.86	1.46	1.28
	3.076	2.830	1.08
	4.277	4.07	1.04
	5.340	5.42	0.96
0.1 –N	1.25	1.41	0.88
	1.324	1.416	0.93
	2.78	3.08	0.90
	3.86	4.08	0.94
	5.161	5.715	0.90
0.2 –N	1.268	1.509	0.84
	1.914	2.274	0.84
	2.464	3.040	0.81
	3.967	4.898	0.81
0.4 –N	1.202	1.614	0.79
	1.894	2.263	0.83

(McCrae, Z. anorg. 1903, **35.** 14.)

Sulphur *dioxide* ammonia, SO_2, NH_3.

Very hydroscopic. Easily sol. in H_2O with decomp. (Schumann, Z. anorg. 1900, **23.** 49.)

SO_2, $2NH_3$. Somewhat hydroscopic.

Sol. in H_2O with evolution of NH_3. (Schumann, Z. anorg. 1900, **23.** 50.)

$5SO_2$, $4NH_3$. Very deliquescent.

Very sol. in H_2O. (Divers and Ogawa, Chem. Soc. 1901, **79.** 1103.)

Sulphur *trioxide*, SO_3.

Fumes on air. Miscible with H_2O, with evolution of much heat. Sol. in H_2SO_4. Decomp. by alcohol and ether.

Exists in two modifications, one of which is liquid and miscible with H_2SO_4, while the solid form is only slowly sol. therein.

Miscible with CS_2 at 30°, but at 15° CS_2 dissolves only $^1/_8$ pt. SO_3, and SO_3, $^1/_8$ pt. CS_2. (Schultz-Sellack, Pogg. **139.** 480.)

There is only one modification, the liquid, which absorbs H_2O and becomes solid. (Rebs, A. **246.** 356.)

Miscible with liquid SO_2. (Schultz-Sellack.)

See also **Sulphuric acid.**

Sulphur *hept*oxide, S_2O_7.

Fumes on air. Slowly decomp. at 0°, instantaneously on warming. Sol. in conc. H_2SO_4. (Berthelot, J. pr. (2) **17.** 48.)

Forms compound S_2O_7, $2H_2O_2$.

Formula is SO_4, according to Traube (B. **24.** 1764), and S_2O_7 is SO_3+SO_4.

See also Marshall (Chem. Soc. **59.** 771).

Traube (B. **26.** 148) denies the existence of SO_4.

Sulphur oxybromide, $SOBr_2$.

See **Thionyl bromide.**

Sulphur oxychloride, $SOCl_2$.

See **Thionyl chloride.**

SO_2Cl_2. *See* **Sulphuryl chloride.**

$S_2O_5Cl_2$. *See* ***Pyro*Sulphuryl chloride.**

HSO_3Cl. *See* **Sulphuryl hydroxyl chloride.**

S_2OCl_4. Decomp. by H_2O and alcohol. (Ogier, C. R. **94.** 446.)

Mixture of about $17SCl_2+2SOCl_2$ and $5SO_2Cl_2$. (Knoll, B. 1898, **31.** 2183.)

Sulphur oxy*tetra*chloride, $S_2O_3Cl_4$.

Violently decomp. by H_2O, dil. acids, or alcohol. (Millon, A. ch. (3) **29.** 327.)

Sol. in warm S_2Cl_2. (Carius, A. **106.** 295.)

Decomp. violently with CS_2.

Sulphur oxyfluoride, SO_2F_2.

See **Sulphuryl fluoride.**

SOF_2. *See* **Thionyl fluoride.**

Sulphur *di*phosphide, P_2S.

See **Phosphorus *mono*sulphide.**

Sulphur *tetra*phosphide, P_4S.

See **Phosphorus *semi*sulphide.**

Sulphuretted hydrogen, H_2S.

See **Hydrogen sulphide.**

Sulphuric acid, H_2SO_4.

Miscible with H_2O in all proportions.

Sp. gr. of H_2SO+Aq.

Baume degrees	Sp. gr.	% H_2SO_4	Baume degrees	Sp. gr.	% H_2SO_4
66	1.842	100	66	1.844	100
60	1.725	84.22	60	1.717	82.34
55	1.618	74.32	55	1.618	74.32
50	1.524	66.45	54	1.603	72.70
45	1.466	58.02	53	1.586	71.17
40	1.375	50.41	52	1.566	69.30
35	1.315	43.21	51	1.550	68.03
30	1.260	33.52	50	1.532	66.45
25	1.210	30.12	49	1.515	64.37
20	1.162	24.01	48	1.500	62.80
15	1.114	17.39	47	1.482	61.32
10	1.076	11.73	46	1.466	59.85
5	1.023	6.60	45	1.454	58.02

(Vauquelin, A. ch. **76.** 260.) (Darcet, A. ch. (2) **1.** 198.)

Sp. gr. of H_2SO_4+Aq.

% H_2SO_4	Sp. gr. at 15°	Sp. gr. at 25°	% H_2SO_4	Sp. gr. at 15°	Sp. gr. at 25°
0	0.9986	0.9955	50	1.3866	1.3780
2.5	...	1.0115	55	1.4347	...
5	1.0284	1.0272	60	1.4860	1.4767
10	1.0659	1.0604	65	1.5402	....
15	1.0998		70	1.5946	1.5863
20	1.1378	1.3311	75	1.6534	...
25	1.1767	.	80	1.7092	1.6996
30	1.2154	1.2078	85	1.7602	....
35	1.2562		90	1.8050	1.7940
40	1.2976	1.2868	95	1.8318	...
45	1.3409	..	100	1.8406	1.8286

(Delezenne, **1823.**)

Sp. gr. at 15.56°, and b.-pt. of H_2SO_4+Aq.

Sp. gr.	% SO_3	B.-pt.	Sp. gr.	% SO_3	B.-pt.
1.850	81	326°	1.769	67	217°
1.849	80	318	1.757	66	210
1.848	79	310	1.744	65	205
1.847	78	301	1.730	64	200
1.845	77	293	1.715	63	195
1.842	76	285	1.699	62	190
1.838	75	277	1.684	61	186
1.833	74	268	1.670	60	182
1.827	73	260	1.650	58.6	177
1.819	72	253	1.520	50	143
1.810	71	245	1.408	40	127
1.801	70	238	1.300	30	115
1.791	69	230	1.200	20	107
1.780	68	224	1.100	10	103

(Dalton, N. Syst **2.** 210.)

Sp. gr. of H_2SO_4+Aq at 15°.

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1.8485	81.54	100	1.5975	57.08	70
1.8460	79.90	98	1.5760	55.45	68
1.8410	78.28	96	1.5503	53.82	66
1.8336	76.65	94	1.5280	52.18	64
1.8233	75.02	92	1.5066	50.55	62
1.8115	73.39	90	1.4860	48.92	60
1.7962	71.75	88	1.4660	47.29	58
1.7774	70.12	86	1.4460	45.66	56
1.7570	68.49	84	1.4265	44.03	54
1.7360	66.86	82	1.4073	42.40	52
1.7120	65.23	80	1.3884	40.77	50
1.6870	63.60	78	1.3697	39.14	48
1.6630	61.97	76	1.3530	37.51	46
1.6415	60.34	74	1.3345	35.88	44
1.6204	58.71	72	1.3165	34.25	42

Sp. gr. of H_2SO_4+Aq at 15°.—*Continued.*

Sp. gr.	% SO_4	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1.2999	32.61	40	1.1410	16.31	20
1.2826	30.98	38	1.1246	14.68	18
1.2654	29 35	36	1.1090	13.05	16
1.2490	27.72	34	1.0953	11 41	14
1 2334	26.09	32	1.0809	9.78	12
1.2184	24.46	30	1.0682	8 15	10
1.2032	22 83	28	1.0544	6.52	8
1.1876	21 20	26	1 0405	4 89	6
1.1706	19 57	24	1.0268	3.26	4
1 1549	17.94	22	1.0140	1 63	2

(Ure, Schw. J. **35**. 444.)

Sp. gr. of H_2SO_4+Aq.

Degrees Baume	Sp. gr.	At 0°		At 15°	
		% SO_3	% H_2SO_4	% SO_3	% H_2SO_4
5	1.036	5 1	4 2	5.4	4.5
10	1 075	10 3	8 4	10 9	8 9
15	1.116	15 5	12 7	16 3	13.3
20	1 161	21 2	17 3	22 4	18 3
25	1 209	27.2	22 2	28 3	23.1
30	1.262	33 6	27 4	34 8	28 4
33	1 296	37.6	30 7	38 9	31.8
35	1 320	40 4	33 0	41 6	34 0
36	1 332	41 7	34 1	43 0	35 1
37	1 345	43 1	35 2	44 3	36 2
38	1.357	44.5	36.3	45 5	37.2
39	1.370	45 9	37 5	46 9	38 3
40	1 383	47 3	38 6	48 4	39.5
41	1.397	48 7	39 7	49 9	40 7
42	1 410	50 0	40 8	51 2	41 8
43	1.424	51 4	41 9	52 5	42 9
44	1.438	52 8	43 1	54 0	44 1
45	1 453	54 3	44 3	55 4	45.2
46	1.468	55 7	45 5	56 9	46 4
47	1.483	57 1	46.6	58 2	47 5
48	1 498	58 5	47 8	59 6	48 7
49	1 514	60 0	49 0	61 1	50 0
50	1.530	61 4	50 1	62 6	51.1
51	1.546	62 9	51.3	63 9	52 2
52	1.563	64 4	52 6	65 4	53.4
53	1.580	65.9	53 8	66 9	54.6
54	1.597	67.4	55.0	68 4	55 8
55	1.615	68 9	56.2	70 0	57 1
56	1 634	70.5	57 5	71.6	58 4
57	1 652	72 1	58 8	73 2	59 7
58	1.671	73 6	60.1	74.7	61 0
59	1 691	75 2	61 4	76.3	62.3
60	1.711	76 9	62 8	78 0	63 6
61	1 732	78 6	64 2	79 8	65 1
62	1 753	80.4	65.7	81 7	66.7
63	1 774	82 4	67 2	83 9	68 5
64	1.796	84 6	69 0	86 3	70 4
65	1 819	87 4	71 3	89 5	73 0
66 5	1 830	89 1	72 2	91 8	74 9
65 8	1.837	90.4	73.8	94.5	77
66	1.842	91 3	74 5	100.0	81.6
66.2	1 846	92.5	75.5	....	....
66.4	1.852	95 0	77.5	....	....
66.6	1.857	100.0	81.6	....	....

(Bineau A. ch. (3) **26**. 124.)

The sp. gr. found at t° can be reduced to sp. gr. at 0° by multiplying by $\frac{144.38}{144.38\text{-}t}$, or by using the following table. (Bineau.)

Correction of sp. gr. for temperature, to be added for a lowering of the temp. of 10°, or subtracted for a corresponding increase.

Sp. gr. of acid at 0°	Corr.	Sp. gr. of acid at 0°	Corr.	Sp. gr. of acid at 0°	Corr.
1.04	0.002	1.15	0.005	1.45	0.008
1.07	0.003	1 20	0.006	1 70	0.009
1.10	0.004	1.30	0.007	1 85	0 0096

(Bineau.)

Sp. gr. of H_2SO_4+Aq at 15°. a = %; b = sp. gr. if % is SO_3; c = sp. gr. if % is H_2SO_4.

a	b	c	a	b	c
1	1.009	1.0064	51	1.530	1.408
2	1.017	1.013	52	1.545	1.418
3	1.025	1.019	53	1.556	1.428
4	1.034	1.0256	54	1.573	1.438
5	1.041	1.032	55	1.585	1.448
6	1.049	1.039	56	1.600	1.4586
7	1.058	1.0464	57	1.615	1.469
8	1.067	1.0536	58	1.627	1.480
9	1.076	1.061	59	1.642	1.490
10	1.085	1.068	60	1.656	1.510
11	1.095	1.0756	61	1.675	1.512
12	1.104	1.083	62	1.689	1.523
13	1.114	1.091	63	1.701	1.534
14	1.123	1.098	64	1.716	1.545
15	1.133	1.106	65	1.730	1.557
16	1.142	1.1136	66	1.742	1.578
17	1.150	1.121	67	1.755	1.580
18	1.160	1.129	68	1.770	1.592
19	1.170	1.136	69	1.781	1.604
20	1.180	1.144	70	1.792	1.615
21	1.190	1.1516	71	1.802	1.627
22	1.200	1.159	72	1.810	1.639
23	1.210	1.167	73	1.819	1.651
24	1.220	1.174	74	1.825	1.663
25	1.229	1.182	75	1.830	1.675
26	1.239	1.190	76	1.834	1.686
27	1.248	1.198	77	1.837	1.698
28	1.258	1.2066	78	1.839	1.710
29	1.268	1.215	79	1.841	1.722
30	1.278	1.223	80	1.842	1.734
31	1.288	1.231	81	...	1.745
32	1.300	1.239	82	...	1.756
33	1.310	1.2476	83	...	1.767
34	1.320	1.256	84	...	1.777
35	1.332	1.264	85	...	1.786
36	1.344	1.272	86	...	1.794
37	1.354	1.281	87	...	1.802
38	1.367	1.289	88	...	1.809
39	1.378	1.2976	89	...	1.816
40	1.390	1.306	90	...	1.822
41	1.401	1.315	91	...	1.827
42	1.415	1.324	92	...	1.831
43	1.427	1.333	93	...	1.834
44	1.440	1.342	94	...	1.8356
45	1.451	1.351	95	...	1.8376
46	1.465	1.361	96	...	1.8384
47	1.478	1.370	97	...	1.840
48	1.490	1.379	98	...	1.8406
49	1.501	1.3886	99	...	1.842
50	1.517	1.398	100	...	1.8426

(Bineau, calculated by Gerlach, Z. anal. **8**. 292.)

Sp. gr. of H_2SO_4+Aq at 15°; H_2O at 0°=1.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
1	1.006	35	1.264	68	1.592
2	1.012	36	1.272	69	1.604
3	1.018	37	1.281	70	1.615
4	1.025	38	1.290	71	1.626
5	1.032	39	1.298	72	1.638
6	1.039	40	1.307	73	1.650
7	1.046	41	1.316	74	1.662
8	1.053	42	1.324	75	1.674
9	1.061	43	1.333	76	1.684
10	1.069	44	1.342	77	1.697
11	1.076	45	1.352	78	1.710
12	1.084	46	1.361	79	1.721
13	1.091	47	1.370	80	1.732
14	1.099	48	1.379	81	1.743
15	1.106	49	1.389	82	1.753
16	1.114	50	1.399	83	1.763
17	1.122	51	1.409	84	1.773
18	1.129	52	1.418	85	1.783
19	1.137	53	1.428	86	1.792
20	1.145	54	1.438	87	1.800
21	1.153	55	1.448	88	1.807
22	1.161	56	1.459	89	1.814
23	1.168	57	1.469	90	1.820
24	1.176	58	1.480	91	1.825
25	1.184	59	1.491	92	1.8294
26	1.191	60	1.501	93	1.8339
27	1.199	61	1.512	94	1.8372
28	1.207	62	1.523	95	1.8390
29	1.215	63	1.535	96	1.8406
30	1.223	64	1.546	97	1.8410
31	1.231	65	1.558	98	1.8412
32	1.239	66	1.569	99	1.8403
33	1.247	67	1.580	100	1.8384
34	1.256	.	..	...	...

(From 1–91 % according to Kolb, calculated by Gerlach; from 92–100% according to Lunge and Naef, calculated by Gerlach, Z. anal. **27.** 316.)

Sp. gr. of H_2SO_4 at 15° compared with H_2O at 4° and 0 mm. pressure.

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1.000	0.07	0.09	1.075	8.90	10.90
1.005	0.68	0.83	1.080	9.47	11.60
1.010	1.28	1.57	1.085	10.04	12.30
1.015	1.88	2.30	1.090	10.60	12.99
1.020	2.47	3.03	1.095	11.16	13.67
1.025	3.07	3.76	1.100	11.71	14.35
1.030	3.67	4.49	1.105	12.27	15.07
1.035	4.27	5.23	1.110	12.82	15.71
1.040	4.87	5.96	1.115	13.36	16.36
1.045	5.45	6.67	1.120	13.89	17.01
1.050	6.02	7.37	1.125	14.42	17.66
1.055	6.59	8.07	1.130	14.95	18.31
1.060	7.16	8.77	1.135	15.48	18.96
1.065	7.73	9.47	1.140	16.01	19.61
1.070	8.32	10.19	1.145	16.54	20.26

Sp. gr. of H_2SO_4, etc.—*Continued.*

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1.150	17.07	20.91	1.455	45.31	55.50
1.155	17.59	21.55	1.460	45.69	55.97
1.160	18.11	22.19	1.465	46.07	56.43
1.165	18.64	22.83	1.470	46.45	56.90
1.170	19.06	23.47	1.475	46.83	57.37
1.175	19.69	24.12	1.480	47.21	57.83
1.180	20.21	24.76	1.485	47.57	58.28
1.185	20.73	25.40	1.490	47.95	58.74
1.190	21.26	26.04	1.495	48.34	59.22
1.195	21.78	26.68	1.500	48.73	59.70
1.200	22.30	27.32	1.505	49.12	60.18
1.205	22.82	27.95	1.510	49.51	60.65
1.210	23.33	28.58	1.515	49.89	61.12
1.215	23.84	29.21	1.520	50.28	61.59
1.220	24.36	29.84	1.525	50.66	62.06
1.225	24.88	30.48	1.530	51.04	62.53
1.230	25.39	31.11	1.535	51.43	63.00
1.235	25.88	31.70	1.540	51.78	63.43
1.240	26.35	32.28	1.545	52.12	63.85
1.245	26.83	32.86	1.550	52.46	64.26
1.250	27.29	33.40	1.555	52.79	64.67
1.255	27.76	34.00	1.560	53.12	65.08
1.260	28.22	34.57	1.565	53.46	65.49
1.265	28.69	35.14	1.570	53.80	65.90
1.270	29.15	35.71	1.575	54.13	66.30
1.275	29.62	36.29	1.580	54.46	66.71
1.280	30.10	36.87	1.585	54.80	67.13
1.285	30.57	31.45	1.590	55.18	67.59
1.290	31.04	38.03	1.595	55.55	68.05
1.295	31.52	38.61	1.600	55.93	68.51
1.300	31.99	39.19	1.605	56.30	68.97
1.305	32.46	39.77	1.610	56.68	69.43
1.310	32.94	40.35	1.615	57.05	69.89
1.315	33.41	40.93	1.620	57.40	70.32
1.320	33.88	41.50	1.625	57.75	70.74
1.325	34.35	42.08	1.630	58.09	71.16
1.330	34.80	42.66	1.635	58.43	71.57
1.335	35.27	43.20	1.640	58.74	71.99
1.340	35.71	43.74	1.645	59.10	72.40
1.345	36.14	44.28	1.650	59.45	72.88
1.350	36.58	44.82	1.655	59.78	73.23
1.355	37.02	45.35	1.660	60.11	73.64
1.360	37.45	45.88	1.665	60.46	74.07
1.365	37.89	46.41	1.670	60.82	74.51
1.370	38.32	46.94	1.675	61.20	74.97
1.375	38.75	47.47	1.680	61.57	75.42
1.380	39.18	48.00	1.685	61.93	75.86
1.385	39.62	48.53	1.690	62.29	76.30
1.390	40.05	49.06	1.695	62.64	76.73
1.395	40.48	49.59	1.700	63.00	77.17
1.400	40.91	50.11	1.705	63.35	77.60
1.405	41.33	50.63	1.710	63.70	78.04
1.410	41.76	51.15	1.715	64.07	78.48
1.415	42.17	51.66	1.720	64.43	78.92
1.420	42.57	52.15	1.725	64.78	79.36
1.425	42.96	52.63	1.730	65.14	79.80
1.430	43.36	53.11	1.735	65.50	80.24
1.435	43.75	53.59	1.740	65.86	80.68
1.440	44.14	54.07	1.745	66.22	81.12
1.445	44.53	54.55	1.750	66.58	81.56
1.450	44.92	55.03	1.755	66.94	82.00

Sp. gr. of H_2SO_4, etc.—*Continued.*

Sp. gr.	% SO_3	% H_2SO_4	Sp. gr.	% SO_3	% H_2SO_4
1.760	67.30	82.44	1.829	75.03	91.90
1.765	67.65	82.88	1.830	75.19	92.10
1.770	68.02	83.32	1.831	75.35	92.30
1.775	68.49	83.90	1.832	75.53	92.52
1.780	68.98	84.50	1.833	75.72	92.75
1.785	69.74	85.10	1.834	75.96	93.05
1.790	69.96	85.70	1.835	76.27	93.43
1.795	70.45	86.30	1.836	76.57	93.80
1.800	70.94	86.90	1.837	76.90	94.20
1.805	71.50	87.60	1.838	77.23	94.60
1.810	72.08	88.30	1.839	77.55	95.00
1.815	72.69	89.05	1.840	78.04	95.60
1.820	73.51	90.05	1.8405	78.33	95.95
1.821	73.63	90.20	1.8415	79.19	97.00
1.822	73.80	90.40	1.8410	79.76	97.70
1.823	73.96	90.60	1.8415	80.16	98.20
1.824	74.12	90.80	1.8400	80.57	98.70
1.825	74.29	91.00	1.8400	80.98	99.20
1.826	74.49	91.25	1.8395	81.18	99.45
1.827	74.69	91.50	1.8390	81.39	99.70
1.828	74.86	91.70	1.8385	81.59	99.95

(Lunge and Isler, Zeit. angew. Ch. **9.** 129.)

Sp. gr. of conc. H_2SO_4+Aq at 15°.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
100	1.8384	99.02	1.8417
99.98	1.8385	98.98	1.8418
99.96	1.8386	98.94	1.8419
99.94	1.8387	98.84	1.8420
99.92	1.8388	98.84	1.8421
99.90	1.8389	98.78	1.8422
99.88	1.8390	98.71	1.8423
99.86	1.8391	98.63	1.8424
99.84	1.8392	98.56	1.8425
99.81	1.8393	98.48	1.8426
99.78	1.8394	98.40	1.8427
99.76	1.8395	98.32	1.8428
99.73	1.8396	98.22	1.8429
99.70	1.8397	98.08	1.8430
99.67	1.8398	97.85	1.8431
99.64	1.8399	97.50	1.8432
99.61	1.8400	97.10	1.8431
95.58	1.8401	96.93	1.8430
99.55	1.8402	96.76	1.8429
99.52	1.8403	96.65	1.8428
99.49	1.8404	96.55	1.8427
99.46	1.8405	96.46	1.8426
99.43	1.8406	96.39	1.8425
99.40	1.8407	96.31	1.8424
99.37	1.8408	96.24	1.8423
99.33	1.8409	96.16	1.8422
99.29	1.8410	96.09	1.8421
99.25	1.8411	96.02	1.8420
99.22	1.8412	95.95	1.8419
99.19	1.8413	95.88	1.8418
99.16	1.8414	95.81	1.8417
99.11	1.8415	95.74	1.8416
99.06	1.8416	95.67	1.8415

Sp. gr. of conc. H_2SO_4, etc.—*Continued.*

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
95.61	1.8414	93.32	1.8352
95.55	1.8413	93.29	1.8351
95.50	1.8412	93.26	1.8350
95.45	1.8411	93.23	1.8349
95.40	1.8410	93.20	1.8348
95.35	1.8409	93.17	1.8347
95.30	1.8408	93.14	1.8346
95.25	1.8407	93.12	1.8345
95.21	1.8406	93.09	1.8344
95.16	1.8405	93.06	1.8343
95.12	1.8404	93.00	1.8342
95.08	1.8403	92.98	1.8341
95.04	1.8402	92.95	1.8339
95.00	1.8401	92.93	1.8338
94.96	1.8400	92.90	1.8337
94.92	1.8399	92.87	1.8336
94.88	1.8398	92.84	1.8335
94.84	1.8397	92.82	1.8334
94.81	1.8396	92.79	1.8333
94.77	1.8395	92.77	1.8332
94.73	1.8394	92.73	1.8331
94.69	1.8393	92.71	1.8330
94.65	1.8392	92.69	1.8329
94.61	1.8391	92.66	1.8328
94.57	1.8390	92.63	1.8327
94.53	1.8389	92.61	1.8326
94.49	1.8388	92 59	1.8325
94.46	1.8387	92.56	1.8324
94.42	1.8386	92.54	1.8323
94.38	1.8385	92.52	1.8322
94.34	1.8384	92.49	1.8321
94.31	1.8383	92.46	1.8320
94.27	1.8382	92.44	1.8319
94.24	1.8381	92.41	1.8318
94.20	1.8380	92.39	1.8317
94.17	1.8379	92.37	1.8316
94.13	1.8378	92.34	1.8315
94.10	1.8377	92.32	1.8314
94.07	1.8376	92.29	1.8313
94.03	1.8375	92.27	1.8312
94.00	1.8374	92.24	1.8311
93.97	1.8373	92.22	1.8310
93.93	1.8372	92.19	1.8309
93.90	1.8371	92.17	1.8308
93.87	1.8370	92.15	1.8307
93.83	1.8369	92.12	1.8306
93.80	1.8368	92.10	1.8305
93 77	1.8367	92.07	1.8304
93.74	1.8366	92.05	1.8303
93.71	1.8365	92.02	1.8302
93.68	1.8364	92.00	1.8301
93.65	1.8363	91.98	1.8300
93.62	1.8362	91.95	1.8299
93.59	1.8361	91.93	1.8298
93.56	1.8360	91.91	1.8297
93.53	1.8359	91.88	1.8296
93.50	1.8358	91.86	1.8295
93.47	1.8357	91.84	1.8294
93.44	1.8356	91.81	1.8293
93.41	1.8355	91.78	1.8292
93.38	1.8354	91.76	1.8291
93.35	1.8353	91.74	1.8290

Sp. gr. of conc. H_2SO_4, etc.—*Continued.*

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
91.72	1.8298	90.78	1.8244
91.70	1.8288	90.76	1.8243
91.68	1.8287	90.74	1.8242
91.65	1.8286	90.72	1.8241
91.63	1.8285	90.70	1.8240
91.61	1.8284	90.68	1.8239
91.59	1.8283	90.66	1.8238
91.56	1.8282	90.64	1.8237
91.54	1.8281	90.62	1.8236
91.52	1.8280	90.60	1.8235
91.50	1.8279	90.59	1.8234
91.47	1.8278	90.57	1.8233
91.45	1.8277	90.55	1.8232
91.43	1.8276	90.53	1.8231
91.41	1.8275	90.51	1.8230
91.39	1.8274	90.49	1.8229
91.37	1.8273	90.47	1.8228
91.35	1.8272	90.46	1.8227
91.32	1.8271	90.44	1.8226
91.30	1.8270	90.42	1.8225
91.28	1.8269	90.40	1.8224
91.26	1.8268	90.38	1.8223
91.24	1.8267	90.37	1.8222
91.22	1.8266	90.35	1.8221
91.20	1.8265	90.33	1.8220
91.18	1.8264	90.31	1.8219
91.16	1.8263	90.29	1.8218
91.14	1.8262	90.28	1.8217
91.12	1.8261	90.26	1.8216
91.10	1.8260	90.24	1.8215
91.08	1.8259	90.23	1.8214
91.06	1.8258	90.20	1.8213
91.04	1.8257	90.18	1.8212
91.02	1.8256	90.17	1.8211
91.00	1.8255	90.15	1.8210
90.98	1.8254	90.13	1.8209
90.96	1.8253	90.11	1.8208
90.94	1.8252	90.10	1.8207
90.92	1.8251	90.08	1.8206
90.90	1.8250	90.06	1.8205
90.88	1.8249	90.04	1.8204
90.86	1.8248	90.02	1.8203
90.84	1.8247	90.01	1.8202
90.82	1.8246	89.99	1.8201
90.80	1.8245	89.97	1.8200

(Richmond [calculated from Pickering, Chem. Soc. **57**. 64], Jour. Soc. Ch. Ind. **9**. 479.)

Sp. gr. of conc H_2SO_4+Aq at 15°.

% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.
90	1.8185	96	1.8406
*90.20	1.8195	97	1.8410
91	1.8241	*97.70	1.8413
*91.48	1.8271	98	1.8412
92	1.8294	*98.39	1.8406
*92.83	1.8334	*98.66	1.8409
93	1.8339	99	1.8403
94	1.8372	*99.47	1.8395
*94.84	1.8387	100	1.8384
95	1.8390	*100.35	1.8411
*95.97	1.8406	...	...

*Determined by experiment.

(Lunge and Naef, Dingl. **248**. 91.)

Sp. gr. of H_2SO_4+Aq at room temp. containing:

7.875	15.50	23.429% H_2SO_4
1.0651	1.1305	1.2003

(Wagner, W. Ann. 1883, **18**. 265).

Sp. gr. of H_2SO_4+Aq at 25°.

Concentration of H_2SO_4+Aq	Sp. gr.
1—normal	1.0303
1/2— "	1.0154
1/4— "	1.0074
1/8— "	1.0035

(Wagner, Z. phys. Ch. 1890, **5**. 40.)

Sp. gr. of dil. H_2SO_4+Aq.

G.-equivalents H_2SO_4 per liter	t°	Sp. gr. t°/t°
0.005049	17.343	1.0002082
0.01009	17.360	1.0004020
0.01512	17.382	1.0005879
0.02014	17.398	1.000769
0.03014	17.419	1.001125
0.002526	18.039	1.0001065
0.005050	18.040	1.0002084
0.01006	18.040	1.0004009
0.02005	18.040	1.0007668
0.03001	18.039	1.0011208
0.04980	18.040	1.0018096
0.09864	18.048	1.003460
0.146560	18.070	1.005045
0.19354	18.060	1.006580
0.28942	18.052	1.009686
0.47466	18.055	1.015616
0.4980	17.73	1.01634
4.980	17.95	1.15234
0.005176	12.997	1.0002106
0.01035	13.020	1.000411
0.01551	13.005	1.000603
0.12648	13.031	1.004438
0.25151	13.011	1.008565
0.37672	13.007	1.012639
0.50503	12.998	1.016758

(Kohlrausch, W. Ann. 1894, **53**. 28.)

Sp. gr. of H_2SO_4+Aq.

% H_2SO_4	79.68	60.98	35.77
Sp. gr. 20°/20°	1.7383	1.5181	1.2719
% H_2SO_4	10.10	4.78	
Sp. gr. 20°/20°	[illegible]685	1.0317	

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 268.)

Sp. gr. of N-H_2SO_4+Aq at 18°/4° = 1.0306. (Loomis, W. Ann. 1896, **60.** 550.)

Sp. gr. of H_2SO_4+Aq at 19.4°, when p = percent strength of solution; d = observed density; w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w\right)$.

p	d	w
9[illegible]0	1.8380	1.7295
84[illegible]	1.7998	1.5223
73.08	1.6743	1.2235
61.35	1.5341	0.9412
40.72	1.3220	0.5383
31.94	1.2430	0.3970
23.77	1.1747	0.2792
14.72	1.1023	0.1623
9.802	1.0670	0.1046
4.826	1.0320	0.0498

(Barnes, J. Phys. Chem. 1898, **2.** 546.

Sp. gr. of H_2SO_4+Aq at 20°.

Normality of H_2SO_4+Aq	% H_2SO_4	Sp. gr.
11.53	70.07	1.6129
9.01	59.26	1.4901
6.95	49.10	1.3872
4.77	36.68	1.2756
3.008	25.00	1.1791
1.002	9.25	1.0612

(Forchheimer, Z. phys. Ch. 1900, **34.** 27.)

Sp. gr. of conc. and fuming H_2SO_4 at 15° and 45°

% H_2SO_4	Total SO_3 %	Free SO_3 %	Sp. gr. at 15°	Sp. gr. at 45°
95.98	78.35	...	1.8418	...
96.68	78.92	...	1.8429	...
96.99	79.18	...	1.8431	...
97.66	79.72	...	1.8434 max.	...
98.65	80.53	...	1.8403	...
99.40	81.14	...	1.8388 min.	...
99.76	81.44	...	1.8418	...
100.00	81.63	0.0	1.8500	1.822
...	83.46	10.0	1.888	1.858
...	85.30	20.0	1.920	1.887
...	87.14	30.0	1.957	1.920
...	88.97	40.0	1.979	1.945
...	90.81	50.0	2.009	1.964 max.
...	92.65	60.0	2.020 max.	1.959
...	94.48	70.0	2.018	1.942
...	96.32	80.0	2.008	1.890
...	98.16	90.0	1.990	1.864
...	100.00	100.0	1.984	1.814

(Knietsch, B. 1901, **34.** 4102.)

Sp. gr. of fuming H_2SO_4 at 35°.

Total SO_3 %	Free SO_3%	Sp. gr.	Total SO_3 %	Free SO_3%	Sp. gr.
81.63	0	1.8[illegible]6	91.18	52	1.9749
81.99	2	1.8270	91.55	54	1.9760
82.36	4	1.8360	91.91	56	1.9772
82.73	6	1.8425	92.28	58	1.9754
83.09	8	1.8498	92.65	60	1.9738
83.46	10	1.8565	93.02	62	1.9709
83.82	12	1.8627	93.38	64	1.9672
84.20	14	1.8692	93.75	66	1.9636
84.56	16	1.8756	94.11	68	1.9600
84.92	18	1.8830	94.48	70	1.9564
85.30	20	1.8919	94.85	72	1.9502
85.66	22	1.9020	95.21	74	1.9442
86.03	24	1.9092	95.58	76	1.9379
86.40	26	1.9158	95.95	78	1.9315
86.76	28	1.9220	96.32	80	1.9251
87.14	30	1.9280	96.69	82	1.9183
87.50	32	1.9338	97.05	84	1.9115
87.87	34	1.9405	97.42	86	1.9046
88.24	36	1.9474	97.78	88	1.8980
88.60	38	1.9534	98.16	90	1.8888
88.97	40	1.9584	98.53	92	1.8800
89.33	42	1.9612	98.90	94	1.8712
89.70	44	1.9643	99.26	96	1.8605
90.07	46	1.9672	99.63	98	1.8488
90.44	48	1.9702	100.00	100	1.8370
90.81	50	1.9733	...		...

(Knietsch, B. 1901, **34.** 4101.)

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.

Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4
1.000	0.00	1.028	4.12	1.056	8.19
1.001	0.15	1.029	4.26	1.057	8.33
1.002	0.31	1.030	4.41	1.058	8.47
1.003	0.46	1.031	4.56	1.059	8.62
1.004	0.60	1.032	4.70	1.060	8.76
1.005	0.73	1.033	4.85	1.061	8.90
1.006	0.87	1.034	5.00	1.062	9.04
1.007	1.01	1.035	5.14	1.063	9.18
1.008	1.15	1.036	5.29	1.064	9.33
1.009	1.30	1.037	5.44	1.065	9.47
1.010	1.45	1.038	5.58	1.066	9.61
1.011	1.60	1.039	5.73	1.067	9.75
1.012	1.75	1.040	5.88	1.068	9.89
1.013	1.89	1.041	6.03	1.069	10.04
1.014	2.04	1.042	6.17	1.070	10.18
1.015	2.19	1.043	6.32	1.071	10.31
1.016	2.34	1.044	6.46	1.072	10.45
1.017	2.49	1.045	6.60	1.073	10.59
1.018	2.64	1.046	6.75	1.074	10.73
1.019	2.79	1.047	6.89	1.075	10.87
1.020	2.93	1.048	7.04	1.076	11.00
1.021	3.08	1.049	7.18	1.077	11.14
1.022	3.23	1.050	7.32	1.078	11.28
1.023	3.38	1.051	7.47	1.079	11.42
1.024	3.53	1.052	7.61	1.080	11.56
1.025	3.67	1.053	7.76	1.081	11.69
1.026	3.82	1.054	7.90	1.082	11.83
1.027	3.97	1.055	8.04	1.083	11.97

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.—*Continued.*

Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4
1.084	12.11	1.145	20.25	1.206	27.95
1.085	12.24	1.146	20.38	1.207	28.08
1.086	12.38	1.147	20.51	1.208	28.20
1.087	12.52	1.148	20.64	1.209	28.32
1.088	12.66	1.149	20.77	1.210	28.45
1.089	12.79	1.150	20.90	1.211	28.57
1.090	12.93	1.151	21.03	1.212	28.69
1.091	13.07	1.152	21.16	1.213	28.82
1.092	13.20	1.153	21.28	1.214	28.94
1.093	13.34	1.154	21.41	1.215	29.06
1.094	13.48	1.155	21.54	1.216	29.18
1.095	13.61	1.156	21.67	1.217	29.31
1.096	13.75	1.157	21.80	1.218	29.43
1.097	13.89	1.158	21.93	1.219	29.55
1.098	14.02	1.159	22.05	1.220	29.69
1.099	14.16	1.160	22.18	1.221	29.80
1.100	14.29	1.161	22.31	1.222	29.92
1.101	14.43	1.162	22.44	1.223	30.04
1.102	14.56	1.163	22.56	1.224	30.17
1.103	14.70	1.164	22.69	1.225	30.29
1.104	14.83	1.165	22.82	1.226	30.41
1.105	14.97	1.166	22.94	1.227	30.53
1.106	15.10	1.167	23.07	1.228	30.65
1.107	15.24	1.168	23.20	1.229	30.78
1.108	15.37	1.169	23.32	1.230	30.90
1.109	15.51	1.170	23.45	1.231	31.02
1.110	15.64	1.171	23.57	1.232	31.14
1.111	15.78	1.172	23.71	1.233	31.26
1.112	15.91	1.173	23.83	1.234	31.38
1.113	16.05	1.174	23.96	1.235	31.50
1.114	16.18	1.175	24.08	1.236	31.62
1.115	16.31	1.176	24.21	1.237	31.75
1.116	16.45	1.177	24.34	1.238	31.87
1.117	16.58	1.178	24.46	1.239	31.99
1.118	16.71	1.179	24.59	1.240	32.11
1.119	16.84	1.180	24.71	1.241	32.23
1.120	16.98	1.181	24.84	1.242	32.35
1.121	17.11	1.182	24.97	1.243	32.47
1.122	17.24	1.183	25.09	1.244	32.59
1.123	17.37	1.184	25.22	.245	32.71
1.124	17.51	1.185	25.34	1.246	32.83
1.125	17.64	1.186	25.47	1.247	32.95
1.126	17.77	1.187	25.59	1.248	33.07
1.127	17.90	1.188	25.72	1.249	33.19
1.128	18.03	1.189	25.84	1.250	33.31
1.129	18.16	1.190	25.97	1.251	33.43
1.130	18.30	1.191	26.09	1.252	33.55
1.131	18.43	1.192	26.22	1.253	33.67
1.132	18.56	1.193	26.34	1.254	33.79
1.133	18.69	1.194	26.47	1.255	33.91
1.134	18.82	1.195	26.59	1.256	34.02
1.135	18.95	1.196	26.71	1.257	34.14
1.136	19.08	1.197	26.84	1.258	34.26
1.137	19.22	1.198	26.96	1.259	34.38
1.138	19.34	1.199	27.09	1.260	34.50
1.139	19.47	1.200	27.21	1.261	34.62
1.140	19.60	1.201	27.33	1.262	34.74
1.141	19.73	1.202	27.46	1.263	34.86
1.142	19.86	1.203	27.58	1.264	34.98
1.143	19.99	1.204	27.71	1.265	35.09
1.144	20.12	1.205	27.83	1.266	35.21

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.—*Continued.*

Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4
1.267	35.33	1.328	42.35	1.389	48.92
1.268	35.45	1.329	42.46	1.390	49.02
1.269	35.57	1.330	42.57	1.391	49.13
1.270	35.68	1.331	42.68	1.392	49.23
1.271	35.80	1.332	42.79	1.393	49.34
1.272	35.92	1.333	42.90	1.394	49.44
1.273	36.04	1.334	43.01	1.395	49.54
1.274	36.15	1.335	43.12	1.396	49.65
1.275	36.27	1.336	43.23	1.397	49.75
1.276	36.39	1.337	43.35	1.398	49.86
1.277	36.51	1.338	43.46	1.399	49.96
1.278	36.62	1.339	43.57	1.400	50.06
1.279	36.70	1.340	43.68	1.401	50.16
1.280	36.86	1.341	43.79	1.402	50.26
1.281	36.97	1.342	43.90	1.403	50.37
1.282	37.09	1.343	44.01	1.404	50.47
1.283	37.21	1.344	44.12	1.405	50.57
1.284	37.32	1.345	44.23	1.406	50.67
1.285	37.44	1.346	44.34	1.407	50.77
1.286	37.56	1.347	44.45	1.408	50.88
1.287	37.68	1.348	44.56	1.409	50.98
1.288	37.79	1.349	44.67	1.410	51.08
1.289	37.91	1.350	44.77	1.411	51.18
1.290	38.03	1.351	44.88	1.412	51.28
1.291	38.14	1.352	44.99	1.413	51.38
1.292	38.26	1.353	45.10	1.414	51.48
1.293	38.37	1.354	45.21	1.415	51.58
1.294	38.49	1.355	45.32	1.416	51.68
1.295	38.60	1.356	45.43	1.417	51.78
1.296	38.72	1.357	45.53	1.418	51.89
1.297	38.83	1.358	45.64	1.419	51.99
1.298	38.95	1.359	45.75	1.420	52.09
1.399	39.06	1.360	45.86	1.421	52.19
1.300	39.18	1.361	45.97	1.422	52.29
1.301	39.29	1.362	46.07	1.423	52.39
1.302	39.41	1.363	46.18	1.424	52.49
1.303	39.52	1.364	46.29	1.425	52.59
1.304	39.64	1.365	46.39	1.426	52.69
1.305	39.75	1.366	46.50	1.427	52.79
1.306	39.86	1.367	46.61	1.428	52.89
1.307	39.98	1.368	46.71	1.429	52.98
1.308	40.09	1.369	46.82	1.430	53.08
1.309	40.20	1.370	46.92	1.431	53.18
1.310	40.32	1.371	47.03	1.432	53.28
1.311	40.43	1.372	47.14	1.433	53.38
1.312	40.54	1.373	47.24	1.434	53.48
1.313	40.66	1.374	47.35	1.435	53.58
1.314	40.77	1.375	47.45	1.436	53.68
1.315	40.88	1.376	47.56	1.437	53.78
1.316	40.99	1.377	47.67	1.438	53.88
1.317	41.11	1.378	47.77	1.439	53.97
1.318	41.22	1.379	47.88	1.440	54.07
1.319	41.33	1.380	47.98	1.441	54.17
1.320	41.45	1.381	48.09	1.442	54.27
1.321	41.56	1.382	48.10	1.443	54.36
1.322	41.67	1.383	48.30	1.444	54.46
1.323	41.79	1.384	48.40	1.445	54.56
1.324	41.90	1.385	48.50	1.446	54.65
1.325	42.01	1.386	48.61	1.447	54.75
1.326	42.12	1.387	48.71	1.448	54.85
1.327	42.23	1.388	48.82	1.449	54.94

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.—*Continued.*

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.—*Continued.*

Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4
1.450	55.04	1.511	60.78	1.572	66.23	1.633	71.48	1.694	76.65	1.755	82.01
1.451	55.14	1.512	60.87	1.573	66.31	1.634	71.57	1.695	76.74	1.756	82.11
1.452	55.24	1.513	60.96	1.574	66.40	1.635	71.65	1.696	76.82	1.757	82.21
1.453	55.33	1.514	61.05	1.575	66.49	1.636	71.74	1.697	76.91	1.758	82.31
1.454	55.43	1.515	61.14	1.576	66.57	1.637	71.82	1.698	76.99	1.759	82.41
1.455	55.53	1.516	61.24	1.577	66.66	1.638	71.91	1.699	77.08	1.760	82.51
1.456	55.62	1.517	61.33	1.578	66.75	1.639	71.99	1.700	77.17	1.761	82.61
1.457	55.72	1.518	61.42	1.579	66.83	1.640	72.07	1.701	77.25	1.762	82.71
1.458	55.82	1.519	61.51	1.580	66.92	1.641	72.16	1.702	77.34	1.763	82.80
1.459	55.91	1.520	61.60	1.581	67.01	1.642	72.25	1.703	77.42	1.764	82.90
1.460	56.01	1.521	61.69	1.582	67.10	1.643	72.33	1.704	77.51	1.765	83.00
1.461	56.11	1.522	61.78	1.583	67.18	1.644	72.42	1.705	77.60	1.766	83.10
[illegible]	56.20	1.523	61.87	1.584	67.27	1.645	72.50	1.706	77.68	1.767	83.20
[illegible]	56.30	1.524	61.96	1.585	67.36	1.646	72.59	1.707	77.77	1.768	83.29
[illegible]	56.39	1.525	62.05	1.586	67.44	1.647	72.67	1.708	77.85	1.769	83.39
[illegible]	56.49	1.526	62.14	1.587	67.53	1.648	72.76	1.709	77.94	1.770	83.49
[illegible]	56.59	1.527	62.23	1.588	67.62	1.649	72.84	1.710	78.03	1.771	83.59
1.467	56.68	1.528	62.32	1.589	67.70	1.650	72.93	1.711	78.11	1.772	83.69
1.468	56.78	1.529	62.41	1.590	67.79	1.651	73.01	1.712	78.20	1.773	83.78
1.469	56.87	1.530	62.50	1.591	67.88	1.652	73.10	1.713	78.28	1.774	83.88
1.470	56.97	1.531	62.59	1.592	67.97	1.653	73.18	1.714	78.37	1.775	83.98
1.471	57.06	1.532	62.68	1.593	68.05	1.654	73.27	1.715	78.46	1.776	84.08
1.472	57.16	1.533	62.77	1.594	68.14	1.655	73.35	1.716	78.54	1.777	84.18
1.473	57.25	1.534	62.86	1.595	68.23	1.656	73.43	1.717	78.63	1.778	84.29
1.474	57.35	1.535	62.95	1.596	68.31	1.657	73.52	1.718	78.72	1.779	84.39
1.475	57.44	1.536	63.04	1.597	68.40	1.658	73.52	1.719	78.80	1.780	84.50
1.476	57.54	1.537	63.13	1.598	68.49	1.659	73.69	1.720	78.89	1.781	84.60
1.477	57.63	1.538	63.22	1.599	68.57	1.660	73.77	1.721	78.97	1.782	84.71
1.478	57.73	1.539	63.31	1.600	68.66	1.661	73.86	1.722	79.06	1.783	84.81
1.479	57.82	1.540	63.40	1.601	68.74	1.662	73.94	1.723	79.15	1.784	84.92
1.480	57.92	1.541	63.49	1.602	68.83	1.663	74.02	1.724	79.23	1.785	85.03
1.481	58.01	1.542	63.58	1.603	68.92	1.664	74.11	1.725	79.32	1.786	85.14
1.482	58.10	1.543	63.67	1.604	69.00	1.665	74.19	1.726	79.41	1.787	85.25
1.483	58.20	1.544	63.76	1.605	69.09	1.666	74.27	1.727	79.49	1.788	85.36
1.484	58.29	1.545	63.85	1.606	69.17	1.667	74.36	1.728	79.58	1.789	85.47
1.485	58.38	1.546	63.94	1.607	69.26	1.668	74.44	1.729	79.67	1.790	85.60
1.486	58.48	1.547	64.03	1.608	69.35	1.669	74.53	1.730	79.75	1.791	85.72
1.487	58.57	1.548	64.12	1.609	69.43	1.670	74.61	1.731	79.84	1.792	85.84
1.488	58.66	1.549	64.20	1.610	69.52	1.671	74.69	1.732	79.93	1.793	85.96
1.489	58.75	1.550	64.29	1.611	69.60	1.672	74.78	1.733	80.02	1.794	86.08
1.490	58.85	1.551	64.38	1.612	69.69	1.673	74.86	1.734	80.11	1.795	86.20
1.491	58.94	1.552	64.47	1.613	69.78	1.674	74.95	1.735	80.20	1.796	86.32
1.492	59.03	1.553	64.55	1.614	69.86	1.675	75.03	1.736	80.29	1.797	86.45
1.493	59.12	1.554	64.64	1.615	69.95	1.676	75.12	1.737	80.38	1.798	86.58
1.494	59.22	1.555	64.73	1.616	70.03	1.677	75.20	1.738	80.47	1.799	86.71
1.495	59.31	1.556	64.82	1.617	70.12	1.678	75.29	1.739	80.56	1.800	86.84
1.496	59.41	1.557	64.91	1.618	70.20	1.679	75.37	1.740	80.65	1.801	86.97
1.497	59.50	1.558	65.00	1.619	70.29	1.680	75.46	1.741	80.74	1.802	87.10
1.498	59.59	1.559	65.08	1.620	70.38	1.681	75.54	1.742	80.84	1.803	87.23
1.499	59.68	1.560	65.17	1.621	70.46	1.682	75.63	1.743	80.92	1.804	87.36
1.500	59.78	1.561	65.26	1.622	70.55	1.683	75.71	1.744	81.01	1.805	87.50
1.501	59.87	1.562	65.35	1.623	70.63	1.684	75.80	1.745	81.10	1.806	87.64
1.502	59.96	1.563	65.44	1.624	70.72	1.685	75.88	1.746	81.19	1.807	87.78
1.503	60.05	1.564	65.52	1.625	70.80	1.686	75.97	1.747	81.28	1.808	87.92
1.504	60.14	1.565	65.61	1.626	70.89	1.687	76.05	1.748	81.37	1.809	88.06
1.505	60.23	1.566	65.70	1.627	70.97	1.688	76.14	1.749	81.46	1.810	88.20
1.506	60.33	1.567	65.79	1.628	71.06	1.689	76.22	1.750	81.55	1.811	88.34
1.507	60.42	1.568	65.88	1.629	71.14	1.690	76.31	1.751	81.64	1.812	88.49
1.508	60.51	1.569	65.96	1.630	71.23	1.691	76.39	1.752	81.73	1.813	88.64
1.509	60.60	1.570	66.05	1.631	71.31	1.692	76.48	1.753	81.82	1.814	88.79
1.510	60.69	1.571	66.14	1.632	71.40	1.693	76.56	1.754	81.92	1.815	88.95

Continued on page 917.

Sp. gr. of H_2SO_4+Aq at t°. Sp. gr. of H_2O at 15° = 1.

% H_2SO_4	0°	10°	15°	20°	25°	30°	40°	50°	60°
0	1.00074	1.00060	1.00000	0.99910	0.99794	0.99654	0.99311	0.98895	0.98418
1	1.00833	1.00773	1.00698	1.00594	1.00465	1.00312	0.99950	0.99522	0.99034
2	1.01563	1.01466	1.01381	1.01266	1.01126	1.00963	1.00585	1.00143	0.99644
3	1.02281	1.02153	1.02055	1.01928	1.01777	1.01607	1.01216	1.00761	1.00252
4	1.03001	1.02841	1.02728	1.02590	1.02428	1.02251	1.01848	1.01383	1.00865
5	1.03728	1.03533	1.03406	1.03258	1.03086	1.02902	1.02487	1.02013	1.01484
6	1.04461	1.04232	1.04092	1.03934	1.03756	1.03565	1.03138	1.02653	1.02114
7	1.05199	1.04939	1.04786	1.04618	1.04434	1.04235	1.03796	1.03302	1.02752
8	1.05942	1.05652	1.05486	1.05308	1.05116	1.04910	1.04458	1.03952	1.03393
9	1.06689	1.06370	1.06192	1.06002	1.05799	1.05585	1.05119	1.04605	1.04041
10	1.07439	1.07093	1.06903	1.06702	1.06490	1.06267	1.05787	1.05264	1.04696
11	1.08194	1.07821	1.07619	1.07408	1.07186	1.06955	1.06462	1.05930	1.05357
12	1.08954	1.08555	1.08342	1.08120	1.07890	1.07650	1.07145	1.06604	1.06027
13	1.09718	1.09294	1.09071	1.08839	1.08600	1.08352	1.07834	1.07284	1.06703
14	1.10488	1.10040	1.09805	1.09564	1.09316	1.09061	1.08530	1.07971	1.07385
15	1.11261	1.10790	1.10546	1.10295	1.10039	1.09776	1.09233	1.08666	1.08075
16	1.12040	1.11547	1.11292	1.11033	1.10768	1.10498	1.09944	1.09368	1.08772
17	1.12823	1.12309	1.12045	1.11777	1.11505	1.11228	1.10661	1.10077	1.09476
18	1.13610	1.13076	1.12803	1.12526	1.12246	1.11963	1.11385	1.10792	1.10186
19	1.14402	1.13848	1.13566	1.13282	1.12995	1.12704	1.12115	1.11514	1.10902
20	1.15199	1.14625	1.14335	1.14043	1.13748	1.13451	1.12851	1.12242	1.11625
21	1.15998	1.15407	1.15109	1.14809	1.14508	1.14205	1.13594	1.12977	1.12353
22	1.16803	1.16194	1.15888	1.15581	1.15273	1.14964	1.14343	1.13718	1.13089
23	1.17611	1.16986	1.16673	1.16359	1.16045	1.15731	1.15100	1.14467	1.13832
24	1.18424	1.17784	1.17464	1.17143	1.16823	1.16503	1.15862	1.15221	1.14579
25	1.19240	1.18586	1.18260	1.17933	1.17607	1.17282	1.16631	1.15982	1.15335
26	1.20061	1.19393	1.19060	1.18728	1.18396	1.18066	1.17406	1.16749	1.16096
27	1.20885	1.20204	1.19865	1.19527	1.19190	1.18854	1.18186	1.17522	1.16862
28	1.21710	1.21019	1.20675	1.20332	1.19990	1.19650	1.18973	1.18302	1.17635
29	1.22539	1.21838	1.21489	1.21142	1.20796	1.20452	1.19767	1.19087	1.18414
30	1.23370	1.22661	1.22308	1.21957	1.21607	1.21259	1.20566	1.19879	1.19198
31	1.24204	1.23487	1.23131	1.22776	1.22423	1.22071	1.21371	1.20677	1.19989
32	1.25038	1.24316	1.23957	1.23600	1.23244	1.22887	1.22179	1.21476	1.20779
33	1.25878	1.25151	1.24789	1.24429	1.24069	1.23712	1.22999	1.22292	1.21589
34	1.26723	1.25990	1.25626	1.25263	1.24901	1.24540	1.23822	1.23109	1.22400
35	1.27571	1.26834	1.26468	1.26102	1.25738	1.25375	1.24652	1.23933	1.23219
36	1.28424	1.27683	1.27314	1.26947	1.26580	1.26214	1.25487	1.24763	1.24045
37	1.29283	1.28538	1.28167	1.27797	1.27429	1.27061	1.26329	1.25601	1.24878
38	1.30149	1.29400	1.29027	1.28655	1.28284	1.27915	1.27179	1.26448	1.25721
39	1.31022	1.30268	1.29894	1.29520	1.29148	1.28776	1.28038	1.27304	1.26575
40	1.31901	1.31144	1.30767	1.30392	1.30018	1.29646	1.28905	1.28169	1.27440
41	1.32788	1.32027	1.31648	1.31271	1.30896	1.30522	1.29779	1.29042	1.28311
42	1.33683	1.32917	1.32537	1.32158	1.31782	1.31407	1.30662	1.29924	1.29193
43	1.34587	1.33817	1.33435	1.33054	1.32676	1.32300	1.31553	1.30813	1.30081
44	1.35501	1.34727	1.34342	1.33960	1.33580	1.33202	1.32452	1.31710	1.30976
45	1.36425	1.35647	1.35261	1.34877	1.34496	1.34116	1.33363	1.32618	1.31881
46	1.37361	1.36579	1.36191	1.35805	1.35422	1.35040	1.34284	1.33365	1.32797
47	1.38308	1.37522	1.37132	1.36744	1.36359	1.35975	1.35215	1.34464	1.33721
48	1.39267	1.38476	1.38084	1.37694	1.37306	1.36921	1.36157	1.35401	1.34655
49	1.40238	1.39441	1.39047	1.38654	1.38264	1.37877	1.37108	1.36349	1.35600
50	1.41219	1.40418	1.40021	1.39627	1.39235	1.38845	1.38073	1.37310	1.36556
51	1.42214	1.41407	1.41007	1.40610	1.40215	1.39823	1.39047	1.38280	1.37524
52	1.43220	1.42408	1.42005	1.41605	1.41208	1.40814	1.40033	1.39262	1.38502

Sp. gr. of H_2SO_4+Aq. at t°. Sp. gr. of H_2O at 15° = 1 *Continued*

% H_2SO_4	0°	10°	15°	20°	25°	30°	40°	50°	60°
53	1.44239	1.43420	1.43014	1.42611	1.42211	1.41814	1.41028	1.40254	1.39490
54	1.45269	1.44443	1.44034	1.43628	1.43225	1.42825	1.42034	1.41255	1.40488
55	1.46311	1.45477	1.45065	1.44656	1.44250	1.43847	1.43051	1.42268	1.41497
56	1.47364	1.46523	1.46107	1.45695	1.45285	1.44880	1.44078	1.43290	1.42515
57	1.48427	1.47578	1.47159	1.46743	1.46331	1.45922	1.45115	1.44322	1.43542
58	1.49499	1.48643	1.48221	1.47802	1.47387	1.46975	1.46162	1.45364	1.44579
59	1.50583	1.49719	1.49292	1.48870	1.48452	1.48037	1.47218	1.46415	1.45626
60	1.51676	1.50804	1.50374	1.49949	1.49527	1.49109	1.48285	1.47476	1.46683
61	1.52778	1.51899	1.51465	1.51036	1.50611	1.50190	1.49360	1.48546	1.47748
62	1.53889	1.53002	1.52564	1.52132	1.51703	1.51278	1.50442	1.49622	1.48819
63	1.55008	1.54113	1.53672	1.53236	1.52804	1.52376	1.51533	1.50708	1.49900
64	1.56135	1.55233	1.54788	1.54348	1.53913	1.53481	1.52632	1.51801	1.50988
65	1.57270	1.56360	1.55912	1.55469	1.55030	1.54595	1.53740	1.52903	1.52084
66	1.58414	1.57496	1.57044	1.56597	1.56154	1.55716	1.54854	1.54011	1.53187
67	1.59565	1.58640	1.58184	1.57733	1.57287	1.56846	1.55978	1.55128	1.54298
68	1.60724	1.59792	1.59332	1.58878	1.58427	1.57981	1.57104	1.56246	1.55408
69	1.61892	1.60951	1.60488	1.60030	1.59577	1.59129	1.58247	1.57384	1.56541
70	1.63068	1.62118	1.61651	1.61189	1.60732	1.60280	1.59391	1.58521	1.57672
71	1.64251	1.63293	1.62821	1.62355	1.61894	1.61437	1.60540	1.59663	1.58806
72	1.65439	1.64473	1.63997	1.63527	1.63062	1.62601	1.61696	1.60811	1.59946
73	1.66633	1.65658	1.65178	1.64704	1.64234	1.63769	1.62855	1.61961	1.61087
74	1.67831	1.66847	1.66362	1.65883	1.65408	1.64939	1.64015	1.63111	1.62227
75	1.69030	1.68037	1.67547	1.67063	1.66584	1.66109	1.65175	1.64260	1.63366
76	1.70228	1.69225	1.68731	1.68242	1.67757	1.67278	1.66332	1.65405	1.64498
77	1.71424	1.70411	1.69911	1.69416	1.68926	1.68439	1.67481	1.66540	1.65617
78	1.72615	1.71589	1.71083	1.70582	1.70085	1.69591	1.68616	1.67658	1.66717
79	1.73798	1.72758	1.72243	1.71735	1.71231	1.70731	1.69741	1.68767	1.67809
80	1.74970	1.73909	1.73386	1.72868	1.72356	1.71847	1.70842	1.69854	1.68881
81	1.76120	1.75038	1.74504	1.73979	1.73458	1.72942	1.71921	1.70916	1.69930
82	1.77244	1.76140	1.75595	1.75057	1.74524	1.73998	1.72962	1.71945	1.70950
83	1.78312	1.77193	1.76642	1.76097	1.75557	1.75022	1.73972	1.72943	1.71937
84	1.79316	1.78191	1.77636	1.77087	1.76543	1.76006	1.74943	1.73902	1.72883
85	1.80250	1.79123	1.78567	1.78016	1.77470	1.76929	1.75863	1.74816	1.73789
86	1.81108	1.79982	1.79428	1.78878	1.78331	1.77789	1.76721	1.75674	1.74642
87	1.81887	1.80767	1.80214	1.79666	1.79123	1.78584	1.77519	1.76473	1.75445
88	1.82589	1.81476	1.80926	1.80381	1.79839	1.79302	1.78242	1.77199	1.76176
89	1.83216	1.82111	1.81564	1.81022	1.80484	1.79950	1.78895	1.77856	1.76834
90	1.83771	1.82677	1.82135	1.81597	1.81063	1.80532	1.79483	1.78448	1.77429
91	1.84263	1.83179	1.82642	1.82109	1.81580	1.81054	1.80013	1.78985	1.77972
92	1.84691	1.83619	1.83088	1.82561	1.82037	1.81516	1.80487	1.79471	1.78470
93	1.85059	1.83997	1.83471	1.82950	1.82432	1.81918	1.80902	1.79900	1.78914
94	1.85363	1.84311	1.83790	1.83275	1.82763	1.82255	1.81253	1.80266	1.79296
95	1.85598	1.84555	1.84040	1.83526	1.83022	1.82520	1.81528	1.80553	1.79595
96	1.85765	1.84729	1.84217	1.83709	1.83207	1.82708	1.81724	1.80758	1.79809
97	1.85854	1.84816	1.84305	1.83798	1.83297	1.82800	1.81822	1.80863	1.79924
98	1.85836	1.84789	1.84275	1.83766	1.83264	1.82767	1.81792	1.80840	1.79912
99	1.85671	1.84612	1.84093	1.83581	1.83076	1.82578	1.81604	1.80658	1.79741
100	(1.85330)	(1.84255)	(1.83729)	(1.83213)	(1.82705)	(1.82205)	(1.81231)	(1.80288)	(1.79381)

Auszug aus Band 5 der wissenschaftlichen Abhandlungen der Normaleichungskommission Berlin 1904, P. 257. Springer's publication.

(Domke, Z. anorg. 1905, **43**. 176.)

Sp. gr. of H_2SO_4+Aq at 15°/15° in air.—*Continued from page 915.*

Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4	Sp. gr.	% H_2SO_4
1.816	89.11	1.828	91.30	1.840	94.57
1.817	89.27	1.829	91.52	1.841	94.96
1.818	89.44	1.830	91.74	1.842	95.40
1.819	89.61	1.831	91.98	1.843	96.02
1.820	89.79	1.832	92.22	1.844	96.93
1.821	89.97	1.833	92.46	1.844?	97.50
1.822	90.15	1.834	92.71	1.844	99.08
1.823	90.33	1.835	92.98	1.843	99.84
1.824	90.51	1.836	93.26	1.842	98.29
1.825	90.70	1.837	93.56	1.841	98.61
1.826	90.90	1.838	93.87	1.840	98.88
1.827	91.10	1.839	94.20	18.394	100.00

(Lunge, calculated by Marshall, J. Soc. Chem. Ind. 1902, **21.** 1509.

Sp. gr. at 20° of H_2SO_4+Aq containing M g. mols. H_2SO_4 per liter.

M.	0.01	0.025	0.05
Sp. gr.	1.000719	1.001907	1.003551
M.	0.075	0.10	0.25
Sp. gr.	1.005152	1.00677	1.01618
M.	0.50	0.75	1.0
Sp. gr.	1.03218	1.04760	1.06307
M.	1.5	2.0	
Sp. gr.	1.09345	1.12316	

(Jones and Pearce, Am. Ch. J. 1907, **38.** 733.)

Boiling-point of H_2SO_4+Aq.

% H_2SO_4	B.-pt.	% H_2SO_4	B.-pt.
5	101.0°	70	170.0°
10	102.0	72	174.5
15	105.5	74	180.5
20	105.0	76	189.0
25	106.5	78	199.0
30	108.0	80	207.0
35	110.0	82	218.5
40	114.0	84	227.0
45	118.5	86	238.5
50	124.0	88	251.5
53	128.5	90	262.5
56	133.0	91	268.0
60	141.5	92	274.5
62.5	147.0	93	281.5
65	153.5	94	288.5
67.5	161.0	95	295.0

(Lunge, B. **11.** 370.)

Freezing- and melting-points of H_2SO_4+Aq.

Sp. gr. at 15°	F.-pt.	M.-pt.
1.671	liq. at −20°	...
1.691	"	...
1.712	"	...
1.727	−7.5	−7.5
1.732	−8.5	−8.5
1.749	−0.2	+4.5
1.767	+1.6	+6.5
1.790	+4.5	+8.0
1.807	−9.0	−6.0
1.822	liq. at −20°	...
1.842	"	...

(Lunge, B. **15.** 2644.)

Effect of impurities on sp. gr. of H_2SO_4+Aq.

The figures show the increase in sp. gr. of H_2SO_4+Aq caused by adding 0.1% of an impurity to acid of different strengths

Salt	100 %	98 %	94 %	80 %	70 %
Na_2SO_4	0.0011	0.0010	0.0007	0.0008	0.0007
$CaSO_4$	0.0012	0.0011	0.0009	0.0007	0.0006
$Al_2(SO_4)_3$	insol.	insol.	insol.	0.0012?	0.0011
$Fe_2(SO_4)_3$	"	"	0.0006?	0.0008	0.0007
$PbSO_4$	0.0017	0.0014	0.0015	insol.	insol.
$MgSO_4$	0.0011	0.0010	0.0012	0.0009	0.0009
As_2O_3	..	0.0013	..	0.0010	...
$HSNO_5$	0.00029	0.00027	...	0.00023	..

(Marshall, J. Soc. Chem. Ind. 1902, **21.** 1508.)

Sp. gr. of mixtures of H_2SO_4 (96.5%) and HNO_3 (94%) at 18°/18° in air.

% HNO_3 in mixture	Sp. gr.	% HNO_3 in mixture	Sp. gr.
0.00	1.8437	22.51	1.8215
0.57	1.8456	25.56	1.8112
1.05	1.8476	27.29	1.8053
4.67	1.8586	32.53	1.7863
7.17	1.8618	37.03	1.7700
7.37	1.8620	39.49	1.7601
7.75	1.8619	57.78	1.6879
9.10	1.8605	72.89	1.6227
11.33	1.8557	90.76	1.5408
12.71	1.8520	98.19	1.5080
16.52	1.8414	100.00	1.5009

(Marshall, J. Soc. Chem. Ind. 1902, **21.** 1508.)

Miscible with alcohol, with evolution of heat and formation of ethylsulphuric acid.

+H_2O=H_4SO_5, also called tetrahydroxyl sulphuric acid. (Marignac, A. ch. (3) **39.** 184.)

Mpt. 8.35°. (Pickering.)

+$2H_2O$=H_6SO_6, also called perhydroxyl sulphuric acid.

Mpt. −38.9°. (Biron, J. Russ. Phys. Chem. Soc. 1899, **31.** 517.)

+$3H_2O$. (Pickering, Chem. Soc. 1890, **57.** 331.)

$+4H_2O$. Mpt. $-75°$. (Pickering, Chem. Soc. 1890, **57.** 331.)

Sp. gr. and fr. pt. of hydrates of H_2SO_4.

Hydrate	% H_2SO_4	Sp. gr. of the liquid	Fr.-pt.
H_2SO_4 (pure)	100	1.842	+10.5
$H_2SO_4+H_2O$	84.48	1.777	+ 3.5
$H_2SO_4+2H_2O$	73.08	1.650	−70.0
$H_2SO_4+4H_2O$	57.65	1.476	−40.0
$H_2SO_4+6H_2O$	47.57	1.376	−50.0
$H_2SO_4+8H_2O$	40.50	1.311	−65.0
$H_2SO_4+10H_2O$	35.25	1.268	−88.0
$H_2SO_4+11H_2O$	33.11	1.249	−75.0
$H_2SO_4+12H_2O$	31.21	1.233	−55.0
$H_2SO_4+13H_2O$	29.52	1.219	−45.0
$H_2SO_4+14H_2O$	28.00	1.207	−40.0
$H_2SO_4+15H_2O$	26.63	1.196	−34.0
$H_2SO_4+16H_2O$	25.39	1.187	−25.6
$H_2SO_4+18H_2O$	23.22	1.170	−19.0
$H_2SO_4+20H_2O$	21.40	1.157	−17.0
$H_2SO_4+25H_2O$	17.88	1.129	− 8.5
$H_2SO_4+50H_2O$	9.82	1.067	− 3.5
$H_2SO_4+75H_2O$	6.77	1.045	0.0
$H_2SO_4+100H_2O$	5.16	1.032	+ 2.5
$H_2SO_4+300H_2O$	1.78	1.007	+ 4.5
$H_2SO_4+1000H_2O$	0.54	1.001	+ 0.5

(Pictet, C. R. 1894, **119.** 645.)

Sulphuric acid, anhydrous, SO_3.
See **Sulphur** ***tri*oxide.**

***Di*sulphuric (*Pyro*sulphuric) acid,** $H_2S_2O_7$.

Very deliquescent. Miscible with H_2O. Sol. in fuming H_2SO_4. Miscible in liquid SO_2. (Schultz-Sellack.)

$H_2S_2O_7$, $2H_2SO_4$. Fumes on air. (Jacquelain, A. ch. (3) **30.** 343.)

***Tetra*sulphuric acid,** $H_2S_4O_{13}$.

Fumes on air. (Weber, Pogg. **159.** 313.)

Sulphates.

Most sulphates are easily sol. in H_2O; but Ag_2SO_4, Hg_2SO_4, and $CaSO_4$ are only sl. sol., while $BaSO_4$, $SrSO_4$, and $PbSO_4$ are nearly insol. therein. All sulphates are sol. in conc. H_2SO_4. Basic sulphates are insol. in H_2O. Most sulphates are insol. in alcohol.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 823.)

Aluminum sulphate, basic, $2Al_2O_3,SO_3+5H_2O$.

Slowly sol. in 10 mols. $HC_2H_3O_2$. (Schlumberger, Bull. Soc. 1895, (3) **13.** 41.)

$+7H_2O$. Easily sol. in 8 mols. dil. $HCl+Aq$. or in 10 mols. 10% acetic acid in 24 hours. (Schlumberger.)

$+10H_2O$. Insol. in H_2O; easily sol. in cold dil. mineral acids, and $HC_2H_3O_2+Aq$. (Crum, A. **89.** 174.)

Min. *Felsöbanyite.*

$+15H_2O$. Min. *Paraluminite.*

$8Al_2O_3$, $5SO_3+25H_2O$. Insol. in H_2O; sol. in dil. acids. (Löwe, J. pr. **79.** 428.)

$5Al_2O_3$, $3SO_3+20H_2O$. Easily sol. in acids. (Debray, Bull. Soc. (2) **7.** 9.)

$3Al_2O_3$, $2SO_3+9H_2O$. Nearly insol. in conc. H_2SO_4. (Bayer, Dingl. **263.** 211.)

$+20H_2O$. Ppt.

$4Al_2O_3$, $3SO_3+36H_2O$. Insol. in H_2O. Easily sol. in dil. mineral acids, and hot $HC_2H_3O_2+Aq$. (Debray, Bull. Soc. (2) **7.** 1.)

Al_2O_3, $SO_3 + 6H_2O = (AlO)_2SO_4 + H_2O$. Insol. in H_2O or $HC_2H_3O_2+Aq$. Sl. sol. in hot HCl, easily sol. in warm $KOH+Aq$. (Böttinger, A. **244.** 225.)

$+9H_2O$. (Athanasesco, C. R. **103.** 27.)

Min. *Aluminite.*

$[Al_2(OH)_5]SO_4+2H_2O$.

Sol. in $HCl+Aq$. in the cold with decomp. Very unstable. (Schlumberger, Bull. Soc. 1895, (3) **13.** 60.)

$3Al_2O_3$, $4SO_3+9H_2O$. (Athanasesco, C. R. **103.** 271.)

$+30H_2O$. Sol. in 144 pts. cold, and 30.8 pts. boiling H_2O. Easily sol. in HCl, and HNO_3+Aq. (Rammelsberg, Pogg. **43.** 583.)

$2Al_2O_2$, $3SO_3$. Decomp. by H_2O into $3Al_2O_3$, SO_3 and $Al_2(SO_4)_3$. (Maus.)

Al_2O_3, $2SO_3 = Al_2O(SO_4)_2$.

Min. *Alumaine.*

$+H_2O$. Sol. in small quantity of H_2O, but decomp. by a large quantity into $(AlO)_2SO_4$ and $Al_2(SO_4)_3$. (Maus, Pogg. **11.** 80.)

$+12H_2O$. Easily sol. in hot or cold H_2O. Sat. solution contains 45% salt at 15°, which crystallises unchanged on evaporating. (Marguerite, C. R. **90.** 354.)

Above basic compounds are mixtures. (Pickering, C. N. **45.** 121, 133, 146.)

Aluminum sulphate, $Al_2(SO_4)_3$.

100 pts. H_2O dissolve (*a*) pts. $Al_2(SO_4)_3$, and (*b*) pts. $Al_2(SO_4)_3+18H_2O$ at:

	0°	10°	20°	30°	40°	50°
a	31.3	33.5	36.15	40.36	45.73	52.13
b	86.85	95.8	107.35	127.6	167.6	201.4

	60°	70°	80°	90°	100°
a	59.09	66.23	73.14	80.83	98.11
b	262.6	348.2	467.3	678.8	1132.

(Poggiale, A. ch. (3) **8.** 467.)

See also $+18H_2O$.

Sp. gr. of $Al_2(SO_4)_3+Aq$.

% $Al_2(SO_4)_3$	Sp. gr. at 15°	25°	35°	45°
5	1.0569	1.0503	1.045	1.0356
10	1.1071	1.1022	1.096	1.085
15	1.1574	1.1522	1.146	1.1346
20	1.2074	1.2004	1.192	1.1801
25	1.2572	1.2487	1.2407	1.2295

(Reuss, B. **17.** 2888.)

Sp. gr. of $Al_2(SO_4)_3$+Aq at 15° containing:

10	20	30% $Al_2(SO_4)_3+18H_2O$,
1.0535	1.1105	1.1710
40	50% $Al_2(SO_4)_3+18H_2O$.	
1.2355	1.3050	

Sp. gr. of sat. solution = 1.34.
(Gerlach, Z. anal. **28.** 493.)

Sp. gr. of $Al_2(SO_4)_3$+Aq. at 25°.

Strength of $Al_2(SO_4)_3$+Aq	Sp. gr.
1 normal	1.0550
1/2 "	1.0278
1/4 "	1.0138
1/8 "	1.0068

(Wagner, Z. phys. Ch. 1890, **5.** 35.)

100 pts. of a mixture of 1 vol. H_2SO_4+2 vols. H_2O dissolve only 6.45 pts. $Al_2(SO_4)_3$. (Baud, C. R. 1903, **137.** 494.)

$Al_2(SO_4)_3$ is completely pptd. from $Al_2(SO_4)_3$+Aq by an excess of glacial $HC_2H_3O_2$. (Persoz, A. ch. (2) **63.** 444.)

Solubility of $Al_2(SO_4)_3+(NH_4)_2Al_2(SO_4)_4$. *See under* $(NH_4)_2Al_2(SO_4)_4$.

Solubility of $Al_2(SO_4)_3+K_2Al_2(SO_4)_4$. *See under* $K_2Al_2(SO_4)_4$.

Solubility in $Fe_2(SO_4)_3$+Aq at 25°.

100 g. of the solution contain	
g. $Al_2(SO_4)_3$	g. $Fe_2(SO_4)_3$
27.82	0
26.01	6.064
24.21	9.819
21.64	13.02
15.22	23.28
*10.70	31.91
10.23	31.90

*Solution sat. with respect to both salts.
(Wirth and Bakke, Z. anorg. 1914, **87.** 48.)

See also under $Fe_2(SO_4)_3$.

Solubility of $Al_2(SO_4)_3+Li_2SO_4$ at 30°.

Solution % Li_2SO_4	Solution % $Al_2(SO_4)_3$	Residue % Li_2SO_4	Residue % $Al_2(SO_4)_3$	Solid phase
25.1	0	...	...	Li_2SO_4, H_2O
21.93	5.34	...	...	"
16.10	14.89	63.70	4.02	"
13.63	20.76	14.72	31.17	$Li_2SO_4, H_2O+Al_2(SO_4)_3, 18H_2O$
13.24	21.71	61.24	7.22	$Li_2SO_4, 4H_2O$
11.73	22.08	6.92	33.54	$Al_2(SO_4)_3, 18H_2O$
6.75	24.34	3.77	37.06	"
3.44	26.12	...	...	"
0.00	28.0	...	...	"

(Schreinemakers and de Waal, Ch. Weekbl. 1906, **3.** 539.)

100 g. of sat. solution of $Al_2(SO_4)_3$ in glycol contain 14.4 g. $Al_2(SO_4)_3$. (de Coninck, Bull. Ac. Roy. Belg. **1905.** 359.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone (Naumann, B. 1904, **37.** 4328.)

$+6H_2O$. Very slowly sol. in cold, completely sol. in hot H_2O.

$+8H_2O$. (Margueritte-Delarcharbonny, C. R. **112.** 229.)

$+10H_2O$. Deliquescent. (v. Hauer, W. A. B. **13.** 449.)

$+16H_2O$. Sol. in conc. H_2SO_4. (Baud, C. R. 1903, **137.** 494.)

$+17H_2O$. (Gawalowski, C. C. **1885.** 721.)

$+18H_2O$. Permanent. (Berzelius.)

100 g. of the aqueous solution contain 27.82 g. $Al_2(SO_4)_3$ at 25°. (Wirth, Z. anorg. 1913, **79.** 361.)

Solubility of $Al_2(SO_4)_3+18H_2O$ in H_2SO_4+Aq at 25°

H_2SO_4+Aq % H_2SO_4	100 g. of the solution contain g. $Al_2(SO_4)_3$
0	27.82
5.23	29.21
9.90	26.21
18.70	20.44
25.50	15.40
40.70	5.07
52.25	1.216
63.70	1.243
73.64	2.915

(Wirth, Z. anorg. 1913, **79.** 361.)

Hydrous salt is scarcely sol. in alcohol. (Berzelius.)

Min. *Alunogen.*

$+27H_2O$. Efflorescent. (Margueritte-Delarcharbonny, C. R. **99.** 800.)

Aluminum sulphate, acid, Al_2O_3, $4SO_3+4H_2O$.

Extremely slowly sol. in cold, more rapidly in hot H_2O. (Baud, C. R. 1903, **137.** 493.)

Al_2O_3, $6SO_3+10H_2O$. Sol. in H_2O; solution soon decomp. into $Al_2(SO_4)_3+H_2SO_4$. (Silberberger, M. 1904, **25.** 221.)

Aluminum ammonium sulphate (Ammonia alum), $(NH_4)_2Al_2(SO_4)_4+24H_2O$.

100 pts. H_2O dissolve 2.9 pts. anhydrous salt at 0°; 207.7 pts. anhydrous salt at 110.6°. (Mulder.)

100 pts. H_2O dissolve 8.74 pts. anhydrous salt at 17.5.° (Pohl, W. A. B. **6.** 597.)

100 pts. H_2O at t° dissolve pts. $(NH_4)_2Al_2(SO_4)_4$.

t°	Pts. $(NH_4)_2Al_2(SO_4)_4$	Pts. $(NH_4)_2Al_2(SO_4)_4+24H_2O$
0	2.10	3.90
10	4.99	9.52
20	7.74	15.13
30	10.94	22.01
40	14.88	30.92
50	20.09	44.11
60	26.70	66.65
70	35.11	90.67
80	45.66	134.47
90	58.68	209.31
100	74.53	357.48

(Poggiale, A. ch. (3) **8.** 467.)

According to Locke (Am. Ch. J. 1901, **26.** 174), Poggiale's tables for NH_4 and K alums are evidently transposed, and the above data are applied by Poggiale to K alum.

1 l. H_2O dissolves 91.9 g. anhydrous, or 191.9 g. hydrated salt, or 0.387 mols. anhydrous salt at 25°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Solubility in H_2O at t°.

t°	G. $(NH_4)_2Al_2(SO_4)_4$ per 100 g. H_2O	G. $(NH_4)_2Al_2(SO_4)_4+24H_2O$ per 100 g. H_2O	G. mol. $(NH_4)_2Al_2(SO_4)_4$ per 100 g. H_2O
0	2.10	3.90	0.0044
5	3.50	6.91	0.0074
10	4.99	9.52	0.0105
15	6.25	12.66	0.0132
20	7.74	15.13	0.0163
25	9.19	19.19	0.0194
30	10.94	22.01	0.0231
40	14.88	30.92	0.0314
50	20.10	44.10	0.0424
60	26.70	66.65	0.0569
95	109.7	00	0.2312

(Mulder, Poggiale, Locke; Marino, Gazz. ch. it. 1905, **35.** II, 351; Berkeley, Trans. Roy. Soc. 1904, **203.** A, 214, calc. by Seidell, Solubilities.)

B.-pt. of sat. solution is 110.6°.

M.-pt. of $(NH_4)_2Al_2(SO_4)_4+24H_2O=92°$. (Tilden, Chem. Soc. **45.** 409.); $=95°$. (Locke, *l. c.*)

Sp. gr. of aqueous solution at 15° containing:

3%	6%	9%	
1.0423	1.0141	1.0282	hydrous salt.

(Gerlach, Z. anal. **28.** 495.)

Solubility of NH_4 alum in presence of $(NH_4)_2SO_4$ and $Al_2(SO_4)_3$.

Mixture used	100 g. sat. solution contains	
	g. $(NH_4)_2SO_4$	g. $Al_2(SO_4)_3$
Sat. NH_4 alum at 18.5°	1.42	3.69
20 cc. above solution+6 g. cryst. $Al_2(SO_4)_3$	0.45	16.09
20 cc. above solution+4g. $(NH_4)_2SO_4$	20.81	0.29

(Rüdorff, 1885, B. **18.** 1160.)

Insol. in alcohol. (Mulder.)

Solubility of $Al(NH_4)(SO_4)_2+12H_2O$ in a mixture of 93.3 g. H_2O and 23.33 g. glycerine $=6.15$ g. (Dunlop, Pharm. J. 1910, **85.** 6.)

Solubility in 93.3 g. H_2O+23.3 g. glycerine +3.9 g. phenol=5.59 g. $Al(NH_4)(SO_4)_2+12H_2O$. (Dunlop.)

Min. *Tschermigite.*

Aluminum ammonium chromium sulphate, $Al_2(SO_4)_3$, $(NH_4)_2SO_4$, $Cr_2(SO_4)_3+48H_2O$.

Sol. in H_2O; decomp. by boiling. (Vohl, A. **94.** 71.)

Aluminum cæsium sulphate, $Al_2Cs_2(SO_4)_4+24H_2O$.

100 pts. H_2O at 17° dissolve 0.619 pt. cæsium alum. (Redtenbacher, J. pr. **94.** 442.)

Solubility in 100 pts. H_2O at t° (calculated for salt dried at 130°).

t°	Pts. alum	t°	Pts. alum	t°	Pts. alum
0	0.19	25	0.49	65	2.38
10	0.29	35	0.69	80	5.29
17	0.38	50	1.235	..	...

(Setterberg, A. **211.** 104.)

Solubility in H_2O.

t°	Pts. anhydrous salt per litre	G. mols. anhydrous salt per litre
25	4.7	0.013
30	5.89	0.0167
35	7.29	0.0207
40	9.00	0.0256

(Locke, Am. Ch. J. 1901, **26.** 180.)

Solubility of $Al_2Cs_2(SO_4)_4$ in H_2O at t°.
(G. $Al_2Cs_2(SO_4)_4+24H_2O$ in 100 g. solution.)

t°	% salt	t°	% salt
0	0.21	75	4.12
15	0.35	80	5.21
30	0.60	90	9.50
45	1.04	100.4	18.60
60	1.96		

(Berkeley, Trans. Roy. Soc. 1904, **203.** A, 214.)

Solubility in 100 g. H_2O at t°.

t°	G. $AlCs(SO_4)_2$	t°	G. $AlCs(SO_4)_2$	t°	G. $AlCs(SO_4)_2$	t°	G. $AlCs(SO_4)_2$
0	0.19	26	0.50	52	1.45	78	5.15
1	0.20	27	0.51	53	1.51	79	5.40
2	0.21	28	0.52	54	1.58	80	5.78
3	0.22	29	0.55	55	1.65	81	6.05
4	0.23	30	0.57	56	1.71	82	6.4
5	0.24	31	0.59	57	1.77	83	6.7
6	0.25	32	0.60	58	1.86	84	7.0
7	0.26	33	0.62	59	1.92	85	7.4
8	0.27	34	0.65	60	2.06	86	7.7
9	0.28	35	0.69	61	2.14	87	8.0
10	0.29	36	0.72	62	2.25	88	8.3
11	0.30	37	0.75	63	2.37	89	8.6
12	0.31	38	0.77	64	2.50	90	8.8
13	0.32	39	0.80	65	2.65	91	9.0
14	0.34	40	0.85	66	2.78	92	9.2
15	0.35	41	0.87	67	2.96	93	9.5
16	0.36	42	0.91	68	3.13	94	9.9
17	0.38	43	0.96	69	3.34	95	10.1
18	0.39	44	1.01	70	3.50	96	10.4
19	0.40	45	1.06	71	3.67	97	10.8
20	0.41	46	1.10	72	3.85	98	11.1
21	0.42	47	1.17	73	4.07	99	11.5
22	0.43	48	1.21	74	4.30	100	12.0
23	0.45	49	1.27	75	4.50	...	...
24	0.47	50	1.30	76	4.72	...	...
25	0.49	51	1.39	77	4.95	...	...

Values from 0–7° obtained by interpolation using Setterberg's values for 0° (A. 1882, **211.** 100).

From 80–100° they were calculated by extrapolation.

(Hart and Huselton, J. Am. Chem. Soc. 1914, **36.** 2084.)

Melts in crystal H_2O at 106° (Tilden, Chem. Soc. **45.** 409); at 120.5° (Erdmann); at 122° (Locke.)

Aluminum calcium sulphate, basic, Al_2O_3, $6CaO$, $3SO_3+32H_2O$.

Min. *Ettringite.* Mostly sol. in H_2O; sol. in HCl+Aq.

Aluminum chromium sulphate, $Al_2Cr_2(SO_4)_6$.

Insol. in H_2O.

$Al_2Cr_2(SO_4)_6, H_2SO_4$. Insol. in H_2O. (Étard C. R. **86.** 1400.)

Aluminum chromium potassium sulphate, $Al_2(SO_4)_3$, $Cr_2(SO_4)_3$, $2K_2SO_4+48H_2O$.

Sol. in H_2O, but decomp. on boiling. (Vohl.)

Aluminum copper sulphate, $2Al_2O_3$, $9CuO$, $3SO_3+21H_2O$.

Min. *Cyanotrichite.* (Percy, Phil. Mag. (3) **36.** 103.)

Aluminum hydroxylamine sulphate, $Al_2(SO_4)_3$, $(NH_2OH)_2SO_4+24H_2O$.

Sol. in H_2O. (Meyeringh, B. **10.** 1946.)

Aluminum iron (ferrous) sulphate, $Al_2(SO_4)_3$, $FeSO_4+24H_2O$.

Sol. in H_2O. (Klauer, A. **14.** 261.)

Min. *Halotrichite.*

$Al_2(SO_4)_3$, $2FeSO_4+27H_2O$. Sol. in H_2O. (Berthier.)

Al_2O_3, $2SO_3$, $6FeSO_4$. Easily sol. in H_2O. (Phillips.)

$Al_2(SO_4)_3$ $2FeSO_4$, H_2SO_4. Insol. in H_2O. (Étard, C. R. **87.** 602.)

Aluminum iron (ferric) sulphate, $Al_2(SO_4)_3$, $Fe_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Al_2(SO_4)_3$, $Fe_2(SO_4)_3$, H_2SO_4. As above (Étard.)

See $Al_2(SO_4)_3+Fe_2(SO_4)_3$, under $Al_2(SO_4)_3$ and $Fe_2(SO_4)_3$.

Aluminum ferrous potassium sulphate, $Al_2(SO_4)_3$, $12FeSO_4$, $2K_2SO_4+24H_2O$.

Permanent. Sl. sol. in H_2O. (Dufrenoy.)

Aluminum lead sulphate, $Al_2Pb_2(SO_4)_5+20H_2O$.

Permanent; insol. in H_2O. (G. H. Bailey J. Chem. Soc. Ind. **6.** 415.)

Aluminum lithium sulphate, $Li_2Al_2(SO_4)_4+24H_2O$.

Sol. in 24 pts. cold, and 0.87 pt. hot H_2O. (Kralovansky, Schw. J. **54.** 349.)

Does not exist. (Rammelsberg, J. B. **1847-48.** 394; Arfvedson; Gmelin.)

Aluminum lithium potassium sulphate (?).

Sol. in H_2O, from which it crystallises on cooling. (Joss, J. pr. **1.** 142.)

Aluminum magnesium sulphate, $MgSO_4$, $Al_2(SO_4)_3+22H_2O$.

Min. *Pickeringite.*

$2MgSO_4$, $Al_2(SO_4)_3+22H_2O$. Min. *Picraluminite.*

$3MgSO_4$, $Al_2(SO_4)_3+36H_2O$. Very sol. in H_2O. (Klauer, A. **14.** 264.)

Aluminum magnesium manganous sulphate, $Al_2(SO_4)_3$, $MgSO_4$, $MnSO_4+25H_2O$.

As sol. in H_2O as K alum. (Kane.) Very sol. in H_2O. (Smith, Sill. Am. J. (2) **18.** 379.) Min. *Bosjemanite.*

Aluminum manganous sulphate, $Al_2(SO_4)_3$, $MnSO_4+25H_2O$.

Sol. in H_2O. (Berzelius.)
$+24H_2O$. Min. *Apjohnite.*

Aluminum manganic sulphate, $2Al_2(SO_4)_3$, $Mn_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

Aluminum nickel sulphate, $Al_2(SO_4)_3$, $2NiSO_4$, H_2SO_4.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Aluminum potassium sulphate, basic, $3(Al_2O_3, SO_3)$, $K_2SO_4+6H_2O=K_2SO_4$, $3Al_2(SO_4)(OH)_4$.

Min. *Alunite.* Insol. in H_2O. Insol. in conc. HCl+Aq.

Sol. in boiling H_2SO_4 of 1.845 sp. gr., but more easily in a mixture of 12 g. H_2SO_4 and 1.5 g. H_2O, and also in weaker acids, if heated to 210°. (Mitscherlich, J. pr. **81.** 108.)

$+9H_2O$. Min. *Löwigite.* Sl. sol. in boiling HCl+Aq. (Mitscherlich, J. pr. **83.** 455.) Nearly insol. in HCl or conc. HNO_3+Aq, but sol. in a mixture of 1 pt. H_2SO_4 and 1 pt. H_2O. (Debray, Bull. Soc. (2) **7.** 9.)

$Al_2O(SO_4)_2$, K_2SO_4. Sol. in H_2O, but decomp. by heating.

With varying composition. Precipitates. Insol. in H_2O. Very sl. sol. in cold, gradually in hot acids. (Bley, J. pr. **39.** 17.) Very difficultly sol. in warm conc. HCl+Aq, but easily sol. in KOH+Aq. (Naumann, B. **8.** 1630.)

Aluminum potassium sulphate (Potash alum), $KAl(SO_4)_2+12H_2O$ or $K_2Al_2(SO_4)_4=K_2SO_4$, $Al_2(SO_4)_3+24H_2O$.

Sol. in H_2O with absorption of heat.

When 100 pts. H_2O at 10.8° are mixed with 14 pts. alum, the temp. is lowered 1.4.° (Rüdorff, B. **2.** 68.)

Burnt alum is very slowly sol. in H_2O.

100 pts. H_2O at t° dissolve P pts. $K_2Al_2(SO_4)_4+24H_2O$.

t°	P	t°	P
12.5	7 6	50.0	46 7
21.25	10.4	62 5	230.0
25.0	22.0	75.0	920.0
37.5	44 1	87.5	1566.6

(Brandes, **1822.**)

Sol. in 18 pts. cold, and 1.6 pts. boiling H_2O (Fourcroy); in 14.12 pts. cold, and 0.75 pt. boiling H_2O (Bergmann); in 15 pts. cold, and 0.75 pt. boiling H_2O (Dumas); in 11.7 pts. H_2O at 18.75° (Abl).

100 pts. H_2O dissolve 14.79 pts. alum at 15.56°, and 133.33 pts. at 100°. (Ure's Dict.)

$K_2Al_2(SO_4)_4$+Aq sat. at 15° contains 10.939 pts. alum in every 100 pts. H_2O. (Michel and Krafft.)

$K_2Al_2(SO_4)_4$+Aq sat. in cold contains 5.2% alum (Fourcroy), 6.7% (Boerhave).

100 pts. H_2O dissolve (*a*) pts. anhydrous alum, and (*b*) pts. crystallised at t°.

	0°	10°	20°	30°	40°	50°
a	2.62	4.50	6.57	9.05	12.35	15.9
b	5.22	9.16	13.66	19.29	27.3	36.5

	60°	70°	80°	90°	100°
a	21.1	26.95	35.2	50.3	70.83
b	51.3	71.97	103.1	187.8	421.9

(Poggiale, A. ch. (3) **8.** 467.)

According to Locke (Am. Ch. J. 1901, **26.** 174), Poggiale's tables for NH_4 and K alums are evidently transposed, and the above date are applied by Poggiale to NH_4 alum.

100 pts. H_2O dissolve $K_2Al_2(SO_4)_4+24H_2O$ corresponding to pts. anhydrous $K_2Al_2(SO_4)_4$.

Temp.	Pts. $K_2Al_2(SO_4)_4$	Temp.	Pts. $K_2Al_2(SO_4)_4$
0	3.0	60	25
5	3.5	70	40
10	4.0	80	71
15	5.0	90	109
20	5.9	92.5	119.5
30	7.9	100	154
40	11.7	110	200
50	17.0	111 9	210 6

(Mulder, Scheik. Verhandel. **1864.** 90.)

100 pts. H_2O at 17° dissolve 13.5 pts. $K_2Al_2(SO_4)_4+24H_2O$, or 7.36 pts. $K_2Al_2(SO_4)_4$. (Redtenbacher, J. pr. **94.** 442.)

Forms supersaturated solutions very easily. Supersat. solutions are brought to crystallisation by addition of a crystal of alum or an isomorphous substance, as chrome or iron alum. Other substances as NaCl, etc. have no action. (Thomson, Chem. Soc. **35.** 199.)

1 l. H_2O dissolves 72.3 g. anhydrous, or 138.4 g. hydrated salt, or 0.28 g. mol. of anhydrous salt at 25.° (Locke, Am. Ch. J. 1901, **26.** 175.)

Solubility in H_2O at t°.
(g. alum in 1000 g. H_2O.)

t°	g. alum	t°	g. alum
0	57.0	75	1280.9
5	76.3	76	1412.1
10	84.9	77	1517.9
15	103.6	78	1680.1
20	120.3	79	1775.2
25	131.3	80	1950.0
30	184.9	82	2273.5
36	204.3	84	2661.5
40	250.0	84.6	2816.0
45	290.2	85.1	3166.6
50	367.8	85.3	3337.2
55	457.7	85.6	3372.2
60	585.4	86	3997.8
65	708.4	87	4825.4
70	943.8	88	6639.6

(Marino, Gazz. ch. it. 1905, **35.** (2) 351.)

Solubility in H_2O at t°.

t°	g. $K_2Al_2(SO_4)_4$ per 100 g. H_2O	g. $K_2Al_2(SO_4)_4+24H_2O$ per 100 g. H_2O	g. mol. $K_2Al_2(SO_4)_4$ per 100 g. H_2O
0	3.0	5.65	0.0058
5	3.5	6.62	0.0068
10	4.0	7.60	0.0077
15	5.0	9.59	0.0097
20	5.9	11.40	0.0114
25	7.23	14.14	0.0140
30	8.39	16.58	0.0162
40	11.70	23.83	0.0227
50	17.00	30.40	0.0329
60	24.75	57.35	0.0479
70	40.00	110.5	0.0774
80	71.0	321.3	0.01374
90	109.0	2,275.0	0.2110
92.5	119.0	∞	0.2318

(Mulder, Poggiale, Locke; Marino, Gazz. ch. it. 1905, **35.** (2) 351; and Berkeley, Proc. Roy. Soc. 1904, **203.** A, 214, calc. by Seidell, Solubilities, 1st Ed.)

M.-pt. of $K_2Al_2(SO_4)_4+24H_2O=84.5°$ (Tilden, Chem. Soc. **45.** 409.); $=92.5°$ (Erdmann); $=91°$(Locke).

Sp. gr. of sat. $K_2Al_2(SO_4)_4$+Aq at 8° = 1.045 (Anthon); at 15° = 1.0488 (Michel and Krafft); at 15° = 1.0456 (Stolba).

Sp. gr. of $K_2Al_2(SO_4)_4$+Aq at 15° containing 5% $K_2Al_2(SO_4)_4$ = 1.0477. (Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $K_2Al_2(SO_4)_4$+Aq at 15°. a = pts. $K_2Al_2(SO_4)_4+24H_2O$ in 100 pts. solution; b = pts. $K_2Al_2(SO_4)_4$ in 100 pts. solution; c = pts. $K_2Al_2(SO_4)_4$ for 100 pts. H_2O.

a	b	c	Sp. gr.
4	2.1792	2.2277	1.0210
8	4.3584	4.5570	1.0420
12	6.5376	6.9950	1.0641
13	7.083	7.622	1.0690

(Gerlach, Z. anal. **27.** 280.)

Saturated solution boils at 111.9°, and contains 210.6 pts. $K_2Al_2(SO_4)_4+24H_2O$ to 100 pts. H_2O. (Mulder.)

100 pts. H_2O contain 52 pts. $K_2Al_2(SO_4)_4$, and boils at 104.5°. (Griffiths.) Crust forms at 106.3°, when the solution contains 114.2 pts. $K_2Al_2(SO_4)_4$ to 100 pts. H_2O. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $K_2Al_2(SO_4)_4$+Aq containing pts. $K_2Al_2(SO_4)_4$ to 100 pts. H_2O.

B.-pt.	Pts. $K_2Al_2(SO_4)_4$	B.-pt.	Pts. $K_2Al_2(SO_4)_4$
100.5°	17.0	104.0°	83.9
101.0	30.2	104.5	90.7
101.5	41.8	105.0	97.6
102.0	51.6	105.5	103.9
102.5	60.4	106.0	110.5
103.0	68.7	106.5	116.9
103.5	76.7	106.7	120.55

(Gerlach, Z. anal. **26.** 435.)

$K_2Al_2(SO_4)_4+Al_2(SO_4)_3$.

$K_2Al_2(SO_4)_4$ is nearly insol. in sat. $Al_2(SO_4)_3$+Aq. (Crum, A. **89.** 156.)

Solubility in $Al_2(SO_4)_3$+Aq. Solid Phase = K alum + $Al_2(SO_4)_3$.

t°	g. $Al_2(SO_4)_3+18H_2O$ in 1000 g. H_2O	g. K_2SO_4 in 1000 g. H_2O
0	234.73	23.45
20	824.25	30.85
35	911.02	35.29
50	1,243.21	59.55
65	1,598.00	119.43
77	1,872.11	183.80

(Marino, Gazz. ch. it. 1905, **35.** (2) 351.)

Solubility is decreased by presence of Na alum. (Venable, C. N. 1879, **40.** 198.)

Nearly completed pptd. from sat. aq. solution by addition or Fe or Cr alum. (v. Hauer, J. B. **1866.** 59.)

$K_2Al_2(SO_4)_4+MgSO_4$.

$K_2Al_2(SO_4)_4$+Aq sat. at 10°, and then sat. with $MgSO_4$ at 9°, contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous)	4.0	2.7	...
$MgSO_4$	...	31.2	31.1
		33.9	

(Mulder.)

$K_2Al_2(SO_4)_4+K_2SO_4$.

$K_2Al_2(SO_4)_4$+Aq at 10°, and then sat. with K_2SO_4 at same temp., contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous)	4.0	0.86	...
K_2SO_4	...	9.16	9.7
		10.20	

(Mulder.)

Solubility in K_2SO_4+Aq. Solid phase= K alum+K_2SO_4.

t°	g. $Al_2(SO_4)_3+18H_2O$ in 1000 g. H_2O	g. K_2SO_4 in 1000 g. H_2O	t°	g. $Al_2(SO_4)_3+18H_2O$ in 1000 g. H_2O	g. K_2SO_4 in 1000 g. H_2O
0.	5.06	75.83	40	73.88	163.10
0.5	8.658	75.18	50	126.00	195.40
5.	16.07	85.78	60	249.70	238.80
10	18.52	96.50	70	529.01	323.74
15	20.56	109.30	80	1,044.04	517.27
30	39.60	147.80	..	...	...

(Marino, *l. c.*)

$K_2Al_2(SO_4)_4+Na_2SO_4$.

$K_2Al_2(SO_4)_4$+Aq sat. at 10°, and then sat. with Na_2SO at 9°, contains for 100 pts. H_2O—

	At 10°		At 9°
Alum (anhydrous) .	4.0	4 1	. .
Na_2SO_4	. .	8.8	8.4
		12.9	

(Mulder.)

Solubility of $K_2Al_2(SO_4)_4+Tl_2Al_2(SO_4)_4$ in H_2O at 25°.

G. $K_2Al_2(SO_4)_4$ per l.	G. $Tl_2Al_2(SO_4)_4$ per l.	Solid phase Mol. % $K_2Al_2(SO_4)_4$	Sp. gr.
69.90	0.00	100	1.0591
74.56	0.48	99.61	1.0601
67.90	1.72	98.48	1.0598
65.30	4.52	95.45	1.0603
64.95	9.60	91.73	1.0605
53.23	18.44	82.54	1.0609
45.32	24.60	75.12	1.0609
38.02	32.48	65.73	1.0611
34.54	35.59	61.36	1.0611
28.35	42.99	51.93	1.0623
10.94	66.12	21.34	1.0654
0.00	75.46	0.00	1.0674

(Foch, Z. Kryst. Min. 1897, **28.** 397.)

Insol. in alcohol of 0.905 sp. gr. or less. (Anthon, J. pr. **14.** 125.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Solubility in H_2O is increased by glycerine. (Dunlop, Pharm. J, 1910, **31.** 6.)

Min. *Kalinite.*

+$8H_2O$. Stable in dry air. (Marino, *l. c.*)

+$14H_2O$. Converted into ord. alum in air. (Marino.)

Aluminum rubidium sulphate, $Al_2Rb_2(SO_4)_4$ +$24H_2O$.

100 pts. H_2O dissolve 2.27 pts. at 17°; very sol. in hot H_2O. (Redtenbacher, J. pr. **94.** 442.)

Solubility in 100 pts. H_2O at t° (calculated for salt dried at 130°).

t°	Pts. alum	t°	Pts. alum	t°	Pts. alum
0	0.71	25	1.85	65	9.63
10	1.09	35	2.67	80	21.60
17	1.42	50	4.98	..	

(Setterberg, A. **211.** 104)

Solubility in H_2O.

t°	Pts. per litre	G. mols. anhydrous salt per litre
25	18.1	0.059
30	21.9	0.072
35	26.6	0.087
40	32.2	0 106

(Locke, Am. Ch. J. 1901, **26.** 180.

Melts in crystal H_2O at 99° (Tilden, Chem. Soc. **45.** 409); at 105° (Erdmann); at 109° (Locke.)

Aluminum silver sulphate, $Al_2Ag_2(SO_4)_4$+ $24H_2O$.

Decomp. by H_2O. (Church and Northcote, C. N. **9.** 155.)

Aluminum sodium sulphate, $Al_2Na_2(SO_4)_4$+ $24H_2O$.

Very sl. efflorescent.

Sol. in 2.14 pts. H_2O at 13°, or 100 pts. H_2O dissolve 46.7 pts. soda alum. Sol. in 1 pt. boiling H_2O. (Zellner, Schw. J. **36.** 183.)

100 pts. H_2O dissolve 110 pts. at 15.5°, and form a liquid of 1.296 sp. gr. (Ure.)

100 pts. H_2O dissolve 51 pts. soda alum at 16°. (Augé, C. R. **110.** 1139.)

100 pts. H_2O dissolve 110 pts. soda alum at 0°. (Tilden, Chem. Soc. **45.** 409.)

100 g. H_2O dissolve at:

10°	15°	20°	25°	30°
36.7	38.7	40.9	43.1	45.8 g. anhydrous salt.

(Smith, J. Am. Chem. Soc. 1909, **31.** 247.)

M.-pt. of $Na_2Al_2(SO_4)_4+24H_2O$ =61°. (Tilden, Chem. Soc. **45.** 409.); =63.° (Locke, Am. Ch. J. 1901, **26.** 183.)

Insol. in absolute alcohol. (Zellner.)

Min. *Mendozite.*

Aluminum thallous sulphate, $TlAl(SO_4)_2$.

0.177 g. mols. of anyhydrous salt are sol. in 1 l. H_2O at 25°; or 1 l. H_2O dissolves 75 g. of the anhydrous, or 117.8 g. of the hydrated salt at 25°. (Locke, Am. Ch. J 1901, 26. 175.)

Solubility in H_2O at t°.

t°	G. $Al_2Tl_2(SO_4)_4$ in 100 g. H_2O	G. $Al_2Tl_2(SO_4)_4+24H_2O$ in 100 g. H_2O
0	3.15	4.84
5	3.80	5.86
10	4.60	7.12
20	6.40	10.00
25	7.60	11.95
30	9.38	14.89
40	14.40	23.57
50	22.50	38.41
60	35.36	65.19

(Seidell, Solubilities, 1st Ed., p. 15.)

$3Al_2(SO_4)_3$, $Tl_2SO_4+96H_2O$. Sol. in H_2O. (Lamy.)

Aluminum zinc sulphate, $Al_2(SO_4)_3$, $ZnSO_4+24H_2O$.

Sol. in H_2O. (Kane.)

Aluminum sulphate chromium chloride, $Al(OH_2)_6(SO_4)_2CrCl_2(OH_2)_4+2H_2O$.

(Werner, B. 1906, **39.** 337.)

Aluminum sulphate sodium fluoride.

Decomp. by H_2O. (Weber, Dingl. **263.** 112.)

Ammonium sulphate, $(NH_4)_2SO_4$.

Sol. in H_2O with absorption of heat.

75 pts. $(NH_4)_2SO_4$ mixed with 100 pts. H_2O lower the temperature from 13.2° to 6.8°, that is, 6.4.° (Rüdorff, B. **2.** 68.)

Sol. in 1.31 pts. H_2O at 19°. (Schiff, A **109.** 326.)
Sol. in 2 pts. H_2O at 18.75°. (Abl.)
Sol. in 2 pts. H_2O at 15.6°, and in 1 pt. boiling H_2O. (Fourcroy.)
100 pts. H_2O at 62.6° dissolve 78 pts. $(NH_4)_2SO_4$. (Wenzel.)
100 pts. H_2O at 15° dissolve 66.739 pts. $(NH_4)_2SO_4$. (Michel and Krafft.)

Sol. in 1.3 pts. cold H_2O. (Vogel, N. Rep. Pharm. **10.** 9.)

Sol. in 1.37 pts. cold H_2O at 10°. (Mulder, J. B. **1866.** 67.)

Sol. in 1.34 pts. H_2O at 16–17°. (v. Hauer, W. A. B. **53, 2.** 221.)

100 pts. H_2O dissolve at:

0° 10° 20° 30°
71.00 73.65 76.30 78.95 pts. $(NH_4)_2SO_4$,
40° 50° 60° 70°
81.60 84.25 86.90 89.55 pts. $(NH_4)_2SO_4$,
80° 90° 100°
92.20 94.85 97.50 pts. $(NH_4)_2SO_4$.

(Alluard, C. R. **59.** 500.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$	t°	Pts. $(NH_4)_2SO_4$
0	70.6	37	80.1	74	93.1
1	70.9	38	80.4	75	93.4
2	71.1	39	80.7	76	93.8
3	71.4	40	81.0	77	94.2
4	71.6	41	81.3	78	94.5
5	71.8	42	81.7	79	94.9
6	72.1	43	82.0	80	95.3
7	72.3	44	82.3	81	96.6
8	72.5	45	82.7	82	96.0
9	72.8	46	83.0	83	96.4
10	73.0	47	83.3	84	96.8
11	73.2	48	83.7	85	97.2
12	73.5	49	84.0	86	97.6
13	73.7	50	84.4	87	98.0
14	74.0	51	84.7	88	98.4
15	74.2	52	85.1	89	98.8
16	74.4	53	85.5	90	99.2
17	74.7	54	85.8	91	99.6
18	74.9	55	86.2	92	100.0
19	75.1	56	86.6	93	100.4
20	75.4	57	86.9	94	100.8
21	75.7	58	87.3	95	101.2
22	75.9	59	87.7	96	101.6
23	76.2	60	88.0	97	102.1
24	76.4	61	88.4	98	102.5
25	76.7	62	88.7	99	102.9
26	76.9	63	89.1	100	103.3
27	77.2	64	89.5	101	103.8
28	77.5	65	89.9	102	104.2
29	77.8	66	90.2	103	104.6
30	78.0	67	90.6	104	105.1
31	78.3	68	90.9	105	105.5
32	78.6	69	91.3	106	106.0
33	78.9	70	91.6	107	106.5
34	79.2	71	92.0	108	107.0
35	79.5	72	92.4	108.9	107.5
36	79.8	73	92.7	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 60.)

100 g. $(NH_4)_2SO_4$+Aq contain 41.4 g. $(NH_4)_2SO_4$ at 0°. (de Waal, Dissert. **1910**); 44.27 g. at 30°. (Schreinemakers, Z. phys. Ch. **71.** 110); 47.81 g. at 70°. (de Waal.)

$(NH_4)_2SO_4$+Aq sat. at 15° has sp. gr. 1.248. (Michel and Krafft, A. ch. (3) **41.** 471.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
1	1.0057	18	1.1035	35	1.2004
2	1.0115	19	1.1092	36	1.2060
3	1.0172	20	1.1149	37	1.2116
4	1.0230	21	1.1207	38	1.2172
5	1.0287	22	1.1265	39	1.2228
6	1.0345	23	1.1323	40	1.2284
7	1.0403	24	1.1381	41	1.2343
8	1.0460	25	1.1439	42	1.2402
9	1.0518	26	1.1496	43	1.2462
10	1.0575	27	1.1554	44	1.2522
11	1.0632	28	1.1612	45	1.2583
12	1.0690	29	1.1670	46	1.2644
13	1.0747	30	1.1724	47	1.2705
14	1.0805	31	1.1780	48	1.2766
15	1.0862	32	1.1836	49	1.2828
16	1.0920	33	1.1892	50	1.2890
17	1.0977	34	1.1948	..	...

(Schiff, calculated by Gerlach, Z. anal. **8.** 280.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
5	1.0292	20	1.1160	31	1.1787
10	1.0581	30	1.1730		

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 15°.

% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.	% $(NH_4)_2SO_4$	Sp. gr.
3	1.0181	10	1.0600	30	1.1773
6	1.0359	20	1.1190	40	1.2352

(Gerlach, Z. anal. **28.** 493.)

Sp. gr. of sat. solution = 1.248. (Gerlach.)

Sp. gr. of $(NH_4)_2SO_4$+Aq.

½$(NH_4)_2SO_4$ g. mol. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.5514	1.000347
1.1251	1.000704
2.3114	1.001436
4.5840	1.002823
10.0893	1.006093
20.0138	1.012023
40.5236	1.024117
56.8536	1.033690

(Dijken, Z. phys. Ch. 1897, **24.** 107.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 20°.

Normality of $(NH_4)_2SO_4$+Aq	% $(NH_4)_2SO_4$	Sp. gr.
3.75	40.28	1.2289
2.964	32.99	1.1858
1.978	23.01	1.1319
0.876	10.88	1.0626
0.492	6.275	1.0352

(Forchheimer, Z. phys. Ch. 1900, **34.** 22.)

Sp. gr. of $(NH_4)_2SO_4$+Aq at 20°.

Solution	Sp. gr.	weight of 10 ccm. of the solution	% $(NH_4)_2SO_4$
sat.	1.248	12.5062 g.	53.2
3/4 "	1.196	11.9034 "	39.9
1/2 "	1.139	11.3377 "	26.6
1/4 "	1.077	10.7232 "	13.3
1/8 "	1.039	...	6.65

(Wiener, Z. phys. Chem. 1911, **71.** 120.)

B.-pt. of sat. solution: crust formed at 106.2°, solution containing 88.2 pts. $(NH_4)_2SO_4$ to 100 pts. H_2O; highest temp. observed, 108.2°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $(NH_4)_2SO_4$+Aq containing pts. $(NH_4)_2SO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $(NH_4)_2SO_4$	B.-pt.	Pts. $(NH_4)_2SO_4$
100.5°	7.8	105.0°	71.8
101.0	15.4	105.5	78.7
101.5	22.8	106.0	85.5
102.0	30.1	106.5	92.3
102.5	37.2	107.0	99.1
103.0	44.2	107.5	105.9
103.5	51.1	108.0	112.6
104.0	58.0	108.2	115.3
104.5	64.9	...	...

(Gerlach, Z. anal. **26.** 431.)

Sol. with decomp. in HCl+Aq.

Solubility in H_2SO_4+Aq at 25°.

100 g. of the solution contain		Solid phase
Mol. H_2SO_4	Mol. $(NH_4)_2SO_4$	
0.00	2.28	
0.24	3.25	
0.47	3.19	$(NH_4)_2SO_4$
0.97	3.15	
1.19	3.15	
1.43	3.22	
1.72	3.18	
2.20	3.02	
2.60	2.97	
2.71	3.00	$(NH_4)_3H(SO_4)_2$
2.82	3.03	
2.96	3.10	
3.20	3.19	
3.32	3.25	
3.47	3.32	
3.54	3.20	
3.76	2.84	$(NH_4)HSO_4$
4.22	2.26	
5.09	1.44	

(D'Ans, Z. anorg. 1909, **65.** 229.)

Solubility in H_2SO_4+Aq at 30°.

Composition of the solution			Solid phase
% by wt. H_2SO_4	% by wt. $(NH_4)_2SO_4$	% by wt. H_2O	
10.63	43.59	45.79	$(NH_4)_2SO_4$
10.70	43.25	46.05	"
13.18	44.10	42.72	$(NH_4)_2SO_4$+ $3(NH_4)_2SO_4$, H_2SO_4
16.67	42.06	41.27	$3(NH_4)_2SO_4$, H_2SO_4
25.82	41.15	33.03	"
27.33	41.16	31.51	"
32.32	44.63	22.26	"
33.12	45.50	21.83	"
33.84	45.52	20.64	$(NH_4)HSO_4$
33.96	45.31	20.73	"
38.51	35.37	26.12	"
42.12	30.10	27.78	"
45.80	24.88	29.32	"
45.77	24.30	29.93	"
56.55	16.98	26.37	"
62.43	20.41	17.16	"
62.46	24.40	13.14	"
63.12	24.20	12.68	"
62.57	27.67	9.76	"
62.83	29.75	8.42	"
62.56	30.26	7.28	"
62.67	31.86	5.47	"
62.59	33.70	3.71	"
61.63	36.75	1.72	"
62.23	36.95	0.82	"

(Van Dorp, Z. phys. Ch. 1910, **73.** 285.)

Solubility of $(NH_4)_2SO_4$ in H_2SO_4+Aq at 25°.

In 1000 g. of the solution		Solid phase
Mol. SO_3	Mol. $(NH_4)_2SO_4$	
4.29	2.17	
4.57	1.83	$(NH_4)HSO_4$
4.85	1.60	
5.25	1.36	
5.66	1.22	
6.16	1.26	
6.47	1.55	$(NH_4)HSO_4$
6.51	1.95	
6.50	2.37	
6.43	2.50	$(NH_4)HSO_4+(NH_4)H_3(SO_4)_2$
7.28	1.64	
7.99	1.38	$(NH_4)H_3(SO_4)_2$
(7.60)	(1.74)	
(8.00)	(1.42)	
9.02	0.96	
9.21	0.832	$(NH_4)HS_2O_7$
9.60	0.977	
9.68	1.00	
9.67	1.26	$(NH_4)HS_2O_7$+?
10.43	0.894	

(D'Ans, Z. anorg. 1913, **80.** 241.)

Very easily sol., even in conc. NH_4OH+Aq. (Girard, Bull. Soc. (2) **43.** 522.)

Solubility of $(NH_4)_2SO_4$ in NH_4OH+Aq at 25°.

In 1000 g. of the solution	
Mol. $(NH_4)_2SO_4$	Mol. $(NH_3)_2$
3.28	0
2.60	1.02
2.13	1.95
1.59	3.44
1.16	5.35
0.78	7.13
0	9.47

(D'Ans and Schreiner, Z. anorg. 1910, **67.** 438.)

100 pts. H_2O dissolve 46.5 pts. $(NH_4)_2SO_4$ and 26.8 pts. NH_4Cl at 21.5°.

Solubility of $(NH_4)_2SO_4$ in NH_4Cl+Aq at 30°.

% NH_4Cl	% $(NH_4)_2SO_4$	Solid phase
0	44	$(NH_4)_2SO_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(NH_4)_2SO_4+NH_4Cl$
17.93	25.81	"
19.07	23.22	NH_4Cl
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Arch. Néer. Sc. 1910, (2) **15.** 92.)

See also under NH_4Cl.

$(NH_4)_2SO_4+CuSO_4$.

Solubility of $(NH_4)_2SO_4+CuSO_4$ in H_2O at 16°.

Solution	% $CuSO_4$	% $(NH_4)_2SO_4$
Both salts in excess	8.55	7.12
15 cc. sat. sol.+3 g. $(NH_4)_2SO_4$	1.77	18.16
15 cc. sat. sol.+3 g. $CuSO,5H_2O$	15.85	5.65

(Rüdorff, B. **6.** 482.)

Solubility of $(NH_4)_2SO_4+CuSO_4$ in H_2O at 30°.

% $(NH_4)_2SO_4$	% $CuSO_4$	Solid phase
0	20.32	$CuSO_4.5H_2O$
2.45	20.19	"
5.79	20.53	$CuSO_4, 5H_2O+CuSO_4, (NH_4)_2SO_4.6H_2O$
6.98	16.77	$CuSO_4, (NH_4)_2SO_4.6H_2O$
8.19	13.65	"
9.33	11.03	"
17.53	4.05	"
29.27	1.57	"
38.32	0.77	"
43.29	0.49	$CuSO_4, (NH_4)_2SO_4.6H_2O+(NH_4)_2SO_4$
44	0	$(NH_4)_2SO_4$

(Schreinemakers, Arch. Néer. Sc. 1910, **15.** 12.)

See also under $CuSO_4$.

$(NH_4)_2SO_4+FeSO_4$.

Solubility of $(NH_4)_2SO_4+FeSO_4$ in H_2O+Aq at 30°.

Compositon of the solution		Solid phase
% by wt. $FeSO_4$	% by wt. $(NH_4)_2SO_4$	
24.90	0	$FeSO_4, 7H_2O$
25.24	5.24	"
25.22	5.93	$FeSO_4, 7H_2O+FeSO_4, (NH_4)_2SO_4, 6H_2O$
25.26	5.89	"
23.59	6.44	$FeSO_4, (NH_4)_2SO_4, 6H_2O$
17.64	8.90	"
13.13	11.45	"
7.95	16.29	"
5.70	19.64	"
1.72	34.24	"
0.79	43.86	$FeSO_4, (NH_4)_2SO_4, 6H_2O+(NH_4)_2SO_4$
0.79	43.90	"
0	44.27	$(NH_4)_2SO_4$

(Schreinemakers, Z. phys. Ch. 1910, **71.** 111.)

$(NH_4)_2SO_4+Li_2SO_4$.

Solubility of $(NH_4)_2SO_4+Li_2SO_4$.

Temp. =30°.

% $(NH_4)_2SO_4$	% Li_2SO_4	Solid phase
44.1	0	$(NH_4)_2SO_4$
40.8	3	"
39.5	6.6	$(NH_4)_2SO_4+NH_4LiSO_4$
30	10	NH_4LiSO_4
21.6	15	"
15	20	"
12.5	21.9	$NH_4LiSO_4+Li_2SO_4, H_2O$
8.9	23	Li_2SO_4, H_2O
0	25.1	"

Temp. =50°.

% $(NH_4)_2SO_4$	% Li_2SO_4	Solid phase
45.7	1	$(NH_4)_2SO_4$
43.05	5.86	$(NH_4)_2SO_4+NH_4LiSO_4$
19.65	16.35	NH_4LiSO_4
13.90	21.20	"
13.97	21.23	$NH_4LiSO_4+Li_2SO_4, H_2O$
11.45	21.75	Li_2SO_4, H_2O
9.63	22.79	"
8.58	23.09	"
7.56	23.86	"
0	24.3	"

(Schreinemakers and Cocheret, Chem. Weekbl. 1905, **2.** 771.)

$(NH_4)_2SO_4+MnSO_4$.

Solubility of $(NH_4)_2SO_4+MnSO_4$ in H_2O.
G. per 100 g. sat. solution.

Temp. =30°.

$MnSO_4$	$(NH_4)_2SO_4$	Solid phase
39.3	0	$MnSO_4, 5H_2O$
38.49	3.64	$MnSO_4, 5H_2O+MnSO_4, (NH_4)_2SO_4, 6H_2O$
33.44	4.91	"
22.06	9.65	"
9.02	20.36	"
2.91	37.42	"
1.75	42.58	$MnSO_4, (NH_4)_2SO_4, 6H_2O+(NH_4)_2SO_4$
1.77	43.24	$(NH_4)_2SO_4$
0	43.4	"

Temp. =50°.

$MnSO_4$	$(NH_4)_2SO_4$	Solid phase
36.26	0	$MnSO_4, H_2O$
35.35	2.95	$MnSO_4, H_2O+2MnSO_4, (NH_4)_2SO_4$
30.57	5.14	$2MnSO_4, (NH_4)_2SO_4$
16.86	17.62	"
6.92	35.98	"
6.29	39.71	"
5.70	43.24	$2MnSO_4, (NH_4)_2SO_4+(NH_4)_2SO_4$
3.49	44.02	$(NH_4)_2SO_4$
0	45.7	"

(Schreinemakers, Chem. Weekbl. 1909, **6.** 131.)

$(NH_4)_2SO_4+K_2SO_4$.

100 pts. $(NH_4)_2SO_4+K_2SO_4+Aq$ sat. at 16.17° contain 38.41 pts. of the two salts, of which 5.45 pts. are K_2SO_4, and 32.96 pts. $(NH_4)_2SO_4$. (v. Hauer, J. pr. **28.** 137.)

100 pts. H_2O dissolve 50.6 pts. $(NH_4)_2SO_4$ and 7.2 pts. K_2SO_4 at 11° (Mulder, J. B. **1866.** 67.)

$(NH_4)_2SO_4$ and K_2SO_4 replace each other in solution, so that by adding one of these salts to a seemingly saturated solution of the other, it is dissolved with pptn. of the other salt. (Rüdorff, B. **6.** 485.)

Solubility of $(NH_4)_2SO_4+K_2SO_4$ at 19.1°.

Solution	% K_2SO_4	% $(NH_4)_2SO_4$
Both salts in excess	39.3	37.97
15 cc. sat. sol.+4 g. K_2SO_4	4.94	33.26
15 cc. sat. sol.+4 g. $(NH_4)_2SO_4$	2.05	40.80

(Rüdorff, B. **6.** 482.)

Solubility of $(NH_4)_2SO_4+K_2SO_4$ in H_2O at 25°.

g. K_2SO_4 per l.	g. $(NH_4)_2SO_4$ per l.	g. K_2SO_4 per l.	g. $(NH_4)_2SO_4$ per l.
127.9	0.0	59.28	355.0
135.7	115.7	40.27	482.7
84.2	281.1	0.0	542.3

Results are also given for 14°, 15°, 16°, 30°, 46° and 47°.

(Fock, Z. Kryst. Min. 1897, **28.** 365.)

$(NH_4)_2SO_4+Th(SO_4)_2$.

Solubility of $(NH_4)_2SO_4+Th(SO_4)_2$ at 16°.

Pts. per 100 pts. H_2O.

$(NH_4)_2SO_4$	$Th(SO_4)_2$	Solid phase
2.13	3.361	$Th(SO_4)_2.9H_2O$
4.80	5.269	"
10.02	8.947	"
16.56	13.330	$Th(SO_4)_2, 9H_2O+Th(SO_4)_2, (NH_4)_2SO_4.4H_2O$
28.00	10.359	$Th(SO_4)_2.(NH_4)_2SO_4.4H_2O$
35.20	9.821	" $+Th(SO_4)_2, 2(NH_4)_2SO_4.2H_2O$
45.14	6.592	$Th(SO_4)_2, 2(NH_4)_2SO_4.2H_2O$
49.05	5.750	"
52.88	4.583	$Th(SO_4)_2, 3(NH_4)_2SO_4.3H_2O$
69.74	1.653	"

(Barre, A. ch. 1911, (8) **24.** 239.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 826.)

Insol. in absolute alcohol. Sol. in 500 pts alcohol of 0.872 sp. gr., and in 62.5 pts. of 0.905 sp. gr. (Anthon, J. pr. **14.** 125.)

Sol. in 217.4 pts. of 66.8% alcohol (sp. gr. = 0.88) at 24.3°. (Pohl, J. pr. **56.** 219.)

Tolerably sol. in alcohol, the sp. gr. of which is greater than 0.860. Insol. in alcohol of sp. gr. less than 0.850.

Solubility in dil. alcohol.

When $(NH_4)_2SO_4$ is dissolved in dil. alcohol, two layers are formed, the compositions of which are as follows:

Sp. gr.	*Lower layer* 100 ccm. contain in g. alcohol	water	salt
1.2240	...	71.43	74.16
1.1775	8.85	68.26	59.54
1.1661	10.62	67.70	56.56
1.1655	11.29	67.34	56.30
1.1735	11.42	66.54	59.20

Sp. gr.	*Upper layer* 100 ccm. containing. alcohol	water	salt
0.9530	41.37	48.47	5.45
0.9512	44.20	45.95	4.97
0.9440	44.27	45.61	4.51
0.9098	52.64	36.78	1.56
0.8750	62.61	24.60	0.30
0.8549	67.04	18.36	0.09
0.8308	77.55	5.53	0.00

(Bodländer, Z. phys. Ch. **7.** 3, 8.)

Solubility in ethyl alcohol+Aq.

Temp.	g. H_2O	g. alcohol	g. salt
Upper layer			
16.6°	52.80	40.21	6.99
33.0°	47.99	46.75	5.26
41.8°	47.34	47.67	4.99
55.7°	45.90	49.47	4.63
Lower layer			
16.6°	60.33	10.19	29.48
33.0°	61.02	9.80	29.18
41.8°	61.16	9.74	29.10
55.7°	61.59	9.46	28.95

(Traube, Z. phys. Ch. 1887, **1.** 509.)

Solubility of $(NH_4)_2SO_4$ in alcohol at 30°.

Two liquid layers are formed between alcohol concentrations of 5.8 and 62°.

Composition of layers.

Upper layer			Lower layer		
% $(NH_4)_2SO_4$	% alcohol	% H_2O	% $(NH_4)_2SO_4$	% alcohol	% H_2O
2.2	56.6	41.2	37.1	5.8	57.1
2.6	54.5	42.9	35.7	6.3	58
3.4	52.3	44.3	33.8	7.4	58.8
13.2	31.8	55	21.7	18.4	59.9
17	25	58	17	25	58

At concentration of 62% alcohol, the liquid is homogeneous and contains 1.3% $(NH_4)_2SO_4$.

(Wibaut, Chem. Weekbl. 1909, **6.** 401.)

Solubility of $(NH_4)_2SO_4$ in alcohol at 60°.

% $(NH_4)_2SO_4$	% alcohol	% H_2O
43.02	2.32	54.66
41.1	4.1	54.8
...	..	...
1.2	64.5	34.3
0.2	75.5	24.3

Between 4.1° and 64.5°, two liquid layers are formed.

Composition of layers.

Upper layer			Lower layer		
% $(NH_4)_2SO_4$	% alcohol	% H_2O	% $(NH_4)_2SO_4$	% alcohol	% H_2O
1.2	64.5	34.3	41.1	4.1	54.8
1.6	60	38.4	36.8	6	57.2
3.8	50	46.2	30.8	9	60.2
7.4	40	52.6	26.6	12	61.4
10	34.4	55.6	23.6	15	61.4

(Schreinemakers, Z. phys. Ch. 1907, **59.** 641.)

Solubility in alcohol+Aq at 0°.

% $(NH_4)_2SO_4$	% alcohol	% H_2O
41.4	0	58.6
30.0	9.41	60.59
...	...	...
...	...	...
...	...	...
0.14	73.03	26.83

Two layers are formed between alcohol concentrations of 9.41 and 73.03%.

(de Waal, Dissert. **1910.**)

Solubility in propyl alcohol+Aq at 20°.

% propyl alcohol	% $(NH_4)_2SO_4$
20	6.7
30	4.8
40	3.2
50	2.0
60	1.0
70	0.4

(Linebarger, Am. Ch. J. 1892, **14.** 380.)

100 g. 95% formic acid dissolve 25.4 g. $(NH_4)_2SO_4$ at 16.5°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329).

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Ammonium hydrogen sulphate, NH_4HSO_4.

Sl. deliquescent. Sol. in 1 pt. cold H_2O. (Link.)

Very sl. sol. in alcohol. (Gerhardt, A. ch. (3) **20.** 255.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II, 1014.)

$(NH_4)_3H(SO_4)_2$. Not deliquescent. Sol. in H_2O. (Mitscherlich, Pogg. **39.** 198.)

$(NH_4)_2SO_4$, $3H_2SO_4$.) D'Ans and Schreiner, Z. anorg. 1913, **80.** 241.)

Ammonium *pyro*sulphate, $(NH_4)_2S_2O_7$.

Decomp. by H_2O. (Schulze.)

$NH_4HS_2O_7$. (D'Ans and Schreiner, Z. anorg. 1913, **80.** 241.)

Ammonium *octo*sulphate, $(NH_4)_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Ammonium antimony sulphate, $(NH_4)_2SO_4$, $Sb_2(SO_4)_3$.

Behaves toward H_2O and abs. alcohol as a mixture of the components. (Metzl, Z. anorg. 1905, **48.** 152.)

Decomp. very slowly by H_2O. (Gutmann, Arch. Pharm. 1898, **236.** 479.)

Ammonium bismuth sulphate, $NH_4Bi(SO_4)_2$ $+4H_2O$.

Easily sol. in HCl, and HNO_3+Aq; less sol. in conc. H_2SO_4, and hot dil. acids. Slowly decomp. by cold $HC_2H_3O_2$, and dil. H_2SO_4+Aq. (Lüddecke, A. **140.** 277.)

Ammonium cadmium sulphate, $(NH_4)_2SO_4$, $CdSO_4+6H_2O$.

Can be recrystallised from a little H_2O. (v. Hauer.)

1 l. H_2O dissolves 723 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

$3(NH_4)_2SO_4$, $CdSO_4+10H_2O$. (André, C. R. **104.** 987.)

Ammonium calcium sulphate, $(NH_4)_2Ca(SO_4)_2+H_2O$.

Decomp. by H_2O. (Fassbender, B. **11.** 1968.)

Sol. in $(NH_4)_2SO_4$+Aq. (Rose, Pogg. **110.** 292.)

This double salt is stable between 0° and 100° in solutions containing an excess of $(NH_4)_2SO_4$. It is not formed if the solution contains less than 35% $(NH_4)_2SO_4$. (Barre, C. R. 1909, **148.** 1605.)

$(SO_4)_3Ca_2(NH_4)_2$. Decomp. by H_2O. (D'Ans, B. 1907, **40.** 192.)

This double salt is formed in the presence of an excess of $CaSO_4$ and at temp. above 80°. (Barre, C. R. 1909, **148.** 1605.)

$Ca_5(NH_4)_2(SO_4)_6+H_2O$. Decomp. by H_2O. (D'Ans, B. 1907, **40.** 192.)

Ammonium calcium cupric sulphate, $Ca_2Cu(NH_4)_2(SO_4)_4+2H_2O$.

Very stable. (D'Ans, B. 1908, **41.** 1778.)

Ammonium calcium potassium sulphate, $NH_4CaK(SO_4)_2+H_2O$.

Decomp. by cold H_2O. (Fassbender, B. **11.** 1968.)

Ammonium cerous sulphate, $(NH_4)_2Ce_2(SO_4)_4+8H_2O$.

More sol. in cold than in hot H_2O. (Czudnowicz).

100 g. H_2O dissolve at:

22.3°	22.35°	35.1°	45.2°	
5.331	5.328	5.184	4.993	g. anhydrous salt,
45°	55.3°	55.2°		
2.994	2.240	2.187	g. anhydrous salt,	
75.4°	85.2°			
1.482	1.184	g. anhydrous salt.		

(Wolff, Z. anorg. 1905, **45.** 102.)

$5(NH_4)_2SO_4$, $Ce_2(SO_4)_3$. (Barre, C. R. 1910, **151.** 873.)

Ammonium ceric sulphate, $3(NH_4)_2SO_4$, $Ce(SO_4)_2+4H_2O$.

Slightly efflorescent. Easily sol. in H_2O. (Mendelejeff, A. **168.** 50.)

$3(NH_4)_2SO_4$, $2Ce(SO_4)_2+3H_2O$. Sl. sol. in H_2O. (Mendelejeff.)

Ammonium chromous sulphate, $NH_4Cr(SO_4)_2$.

0.407 g. mol. anhydrous salt is sol. in 1 l. H_2O at 25°. (Locke, Am. Ch. J. 1901, **26.** 175.)

$+6H_2O$. 100 ccm. of sat. aqueous solution contain 55 g. of the salt at 20°. Insol. in alcohol. (Laurent, C. R. 1911, **131.** 112.)

Ammonium chromic sulphate, $(NH_4)_2SO_4$, $Cr_2(SO_4)_3$.

Not attacked by boiling H_2O or conc. HCl +Aq. Very slowly attacked by boiling KOH +Aq (sp. gr. = 1.3). Insol. in $CrCl_2$+Aq or $SnCl_2$+Aq. (Klobb, Bull. Soc. (3) **9.** 664.)

$+5H_2O$. Is ammonium chromosulphate, which see.

$+24H_2O$. **Chrome Alum.**

Violet modification. Efflorescent. Sol. in cold H_2O, but solution is decomp. on heating with formation of green modification. The dil. solution of green modification is gradually converted into violet modification by standing. Alcohol ppts. it from aqueous solution. (Schrötter, Pogg. **53.** 526.)

100 cc. H_2O dissolve 10.78 g. anhydrous, or 21.21 g. hydrated salt at 25°. Melts in crystal H_2O at 45°. (Locke, Am. Ch. J. **1901. 26.** 174.)

Solubility in H_2O.

Saturation is very slowly reached owing to transition between violet and green modifications. If time of saturation is taken at 2½ hours, 100 g. of the solution contain at:

0°	30°	40°	
3.77	10.6	15.5 g.	$(NH_4)_2Cr_2(SO_4)_4$.

This is assumed to be the solubility of the violet modification.

In 300 hours, 15.96 g. salt are dissolved at 30°, and 24.64 g. in 250 hours at 40°. (Koppel, B. 1906, **39.** 3741.)

Calc. from electrical conductivity measurements, a solution containing 3.8 g. of the sulphate in 100 g. contains 48% of the green compound at 40° and 61% at 55°. With solutions of 6–7 times the above concentration equilibrium is reached at 40° with 30–40% green alum. (Koppel.)

Sp. gr. of aqueous solution of violet modification at 15°, containing:

4	8	12%	$(NH_4)_2Cr_2(SO_4)_4+24H_2O$.
1.020	1.0405	1.0610	

Sat. solution at 15° has sp. gr. = 1.070. (Gerlach.)

Green modification. Sol. in H_2O and alcohol. When in aqueous solution, it gradually changes to violet modification.

Sp. gr. of aqueous solution of green modification at 15°, containing:

10	20	30%	$(NH_4)_2Cr_2(SO_4)_4+24H_2O$,
1.044	1.091	1.142	
40	50	60%	$(NH_4)_2Cr_2(SO_4)_4+24H_2O$,
1.197	1.255	1.317	
70	80	90%	$(NH_4)_2Cr_2(SO_4)_4+24H_2O$.
1.384	1.456	1.532	

(Gerlach, Z. anal. **28.** 498.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$3(NH_4)_2SO_4$, $Cr_2(SO_4)_3$. Only sl. attacked by boiling H_2O. Not attacked by boiling conc. $(NH_4)_2SO_4$+Aq. (Klobb, Bull. Soc. (3) **9.** 663.)

Ammonium cobaltous sulphate, $(NH_4)_2Co(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve at:

0°	10°	18°	23°	35°	
8.9	11.6	15.2	17.1	19.6	pts. anhydrous salt,
40°	45°	50°	60°	75°	
22.3	25	28.7	34.5	43.3	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 pts. saturated solution contain at:

20°	40°	60°	80°	
14.9	20.8	25.6	33	pts. anhydrous salt.

(v. Hauer, J. pr. **74.** 433.)

1 l. H_2O dissolves 147.2 g. anhydrous salt at 25°. Tobler's results are inaccurate. (Locke, Am. Ch. J. 1902, **27.** 459.)
Pptd. from aqueous solution by alcohol.

Ammonium cobaltic sulphate, $(NH_4)_2Co_2(SO_4)_4+24H_2O$.

Sol. in H_2O with decomp. (Marshall, Chem. Soc. 59. 760.)

Ammonium cobaltous cupric sulphate, $2(NH_4)_2SO_4$, $CoSO_4$, $CuSO_4+12H_2O$.

Quite easily sol. in hot H_2O, but on long boiling a basic salt is pptd. (Vohl, A. **94.** 58.)

Ammonium cobaltous ferrous sulphate, $2(NH_4)_2SO_4$, $CoSO_4$, $FeSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cobaltous magnesium sulphate, $2(NH_4)SO_4$, $CoSO_4$, $MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cobaltous manganous sulphate, $2(NH_4)SO_4$, $CoSO_4$, $MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cobaltous nickel sulphate, $2(NH_4)SO_4$, $CoSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cobaltous zinc sulphate, $2(NH_4)_2SO_4$, $CoSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cupric sulphate, $(NH_4)_2SC_4$, $CuSO_4+6H_2O$.

Efflorescent in warm air.

Sol. in 1.5 pts. boiling H_2O, and separates almost wholly on cooling. (Vogel, J. pr. **2.** 194
Sol. in 1.55 pts. H_2O at 18 75°. (Abl.)

100 pts. H_2O at 19° dissolve 26.6 pts., and sat. solution has sp. gr. = 1.1337. (Schiff, A. **109.** 426.

100 g. sat. solution at 30° contain 30.36 g. anhydrous salt. (Schreinemakers, Arch. Néer. Sci. 1910, (2) **15.** 92.)

Solubility of $(NH_4)_2Cu(SO_4)_2$, $6H_2O+(NH_4)_2Ni(SO_4)_2$, $6H_2O$ in H_2O at 13–14°.
Mols. per 100 mols. H_2O.

Cu salt	Ni salt	% Cu salt in solid phase
0	0.521	0
0.1476	0.295	10.29
0.2664	0.2089	30.59
0.4165	0.1449	52.23
0.4785	0.1202	78.80
1.0350	0	100

(Fock, Z. Kryst. Min. 1897, **28.** 365.)

Solubility of $(NH_4)_2Cu(SO_4)_2$, $6H_2O+K_2Cu(SO_4)_2$, $6H_2O$ in H_2O at 13–14°.
Mols. per 100 mols. H_2O.

K salt	NH_4 salt	% K salt in solid phase
0	1.035	0
0.897	0.8618	5.06
0.2269	0.6490	16.76
0.2570	0.5887	30.40
0.2946	0.5096	36.63
0.3339	0.3319	50.15
0.4560	0.1961	69.93
0.4374	0	100.

(Fock.)

Solubility of $(NH_4)_2Cu(SO_4)_2$, $6H_2O+(NH_4)_2Zn(SO_4)$, $6H_2O$ in H_2O at 13–14°.
Mols. per 100 mols. H_2O.

Cu salt	Zn salt	% Cu salt in solid phase
0.0422	0.8069	2.39
0.0666	0.5638	4.52
0.1218	0.5115	9.03
0.2130	0.4924	14.67
0.3216	0.4022	22.62
1.035	0	100.

(Fock.)

$(NH_4)_2SO_4$, $2CuSO_4$. Very sol. in H_2O (Klobb, C. R. 115. 230.)

Ammonium cupric ferrous sulphate.

Sol. in H_2O without decomposition. (Vohl, A. **94.** 61.)

Ammonium cupric magnesium sulphate, $2(NH_4)_2SO_4$, $CuSO_4$, $MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cupric magnesium potassium sulphate, $(NH_4)_2SO_4$, $CuSO_4$, $MgSO_4$, $K_2SO_4+12H_2O$.

Sol. in H_2O. (Schiff.)
$2(NH_4)_2SO_4$, $CuSO_4$, $2MgSO_4$, $K_2SO_4+18H_2O$. Sol. in H_2O. (Schiff.)

Ammonium cupric manganous sulphate, $2(NH_4)_2SO_4, CuSO_4, MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium cupric nickel sulphate, $2(NH_4)_2SO_4, CuSO_4, NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium cupric potassium sulphate, $NH_4KSO_4, CuSO_4+6H_2O$.

Sol. in H_2O. (Schiff.)

Ammonium cupric zinc sulphate, $2(NH_4)_2SO_4, CuSO_4, ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium cupric sulphate ammonia, $(NH_4)_2SO_4, CuO, 2NH_3$.

Sol. in 1.5 pts. cold H_2O, but decomp. on exposure to air or dilution. Insol. in alcohol. (Kühn.)

Ammonium didymium sulphate, $(NH_4)_2SO_4, Di_2(SO_4)_3+8H_2O$.

Sol. in 18 pts. H_2O, and less easily in $(NH_4)_2SO_4$+Aq. (Marignac.)

Moderately sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 362.)

Ammonium erbium sulphate, $(NH_4)_2SO_4, Er_2(SO_4)_3+8H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium gallium sulphate, $(NH_4)_2Ga_2(SO_4)_4+24H_2O$.

Sol. in cold water and dilute alcohol. Conc. solution clouds up on boiling, but clears on cooling. Dil. solution separates out a basic salt, insol. in hot or cold H_2O. (Boisbaudran.)

Ammonium glucinum sulphate, $(NH_4)_2SO_4, GlSO_4+2H_2O$.

Sol. in H_2O. (Atterberg.)

Ammonium indium sulphate, $(NH_4)_2In_2(SO_4)_4+24H_2O$.

100 pts. H_2O dissolve 200 pts. salt at 16°, and 400 pts. at 30°.

Insol. in alcohol.

Melts in crystal H_2O at 36°. (Rössler, J. pr. (2) **7.** 14.)

$+8H_2O$. (Rössler.)

Ammonium iridium sulphate, $(NH_4)_2SO_4, Ir_2(SO_4)_3+24H_2O$.

Easily sol. in H_2O. (Marino, Z. anorg. 1904, **42.** 221.)

Ammonium iron (ferrous) sulphate, $(NH_4)_2Fe(SO_4)_2+6H_2O$.

Much less sol. in H_2O than $FeSO_4+7H_2O$. (Vogel, J. pr. 2. 192.)

100 pts. H_2O dissolve at:

0°	12°	20°	30°	36°	
12.2	17.5	21.6	28.1	31.8	pts. anhydrous salt,
45°	55°	60°	65°	75°	
36.2	40.3	44.6	49.8	56.7	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 pts. H_2O at 16.5° dissolve 35.9 pts. hydrous salt.

1 l. H_2O dissolves 351 pts. or 1.044 g. mol. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Sol. in H_2O without decomp. Aq. solution at 30° contains 13.13% $FeSO_4$ and 11.45% $(NH_4)_2SO_4$. (Schreinemakers, C. C. **1910,** I. 801.)

Sp. gr. of $(NH_4)_2FeSO_4$+Aq at 19°.
% = % $(NH_4)_2FeSO_4+6H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.006	11	1.066	21	1.130
2	1.013	12	1.073	22	1.136
3	1.018	13	1.080	23	1.143
4	1.024	14	1.085	24	1.150
5	1.030	15	1.092	25	1.156
6	1.036	16	1.097	26	1.164
7	1.042	17	1.104	27	1.171
8	1.047	18	1.110	28	1.179
9	1.054	19	1.116	29	1.185
10	1.060	20	1.124	30	1.193

(Schiff calculated by Gerlach, Z. anal. **8.** 280.)

Insol. in acetone.

Ammonium ferric sulphate, basic.

Extremely difficultly sol. in HCl+Aq. Not decomp. by KOH+Aq. (Berzelius.)

$5(NH_4)_2O, 3Fe_2O_3, 12SO_3+18H_2O$ or $2(NH_4)_2O, Fe_2O_3, 4SO_3+4H_2O$. Sol. in 2.4 pts. cold H_2O. (Maus, Pogg. **11.** 79.)

Ammonium iron (ferric) sulphate, $(NH_4)_2SO_4, Fe_2(SO_4)_3$.

Attacked slowly by cold H_2O. (Lachaud and Lepierre.)

Nearly insol. in H_2O. (Weinland, Z. anorg. 1913, **84.** 363.)

$+24H_2O$. *Iron alum.* Sol. in 3 pts. H_2O at 15°. (Forchhammer, Ann. Phil. **5.** 406.)

100 cc. H_2O dissolve 44.15 g. anhydrous, or 124.40 g. hydrated salt at 25°, or 1.659 g. mols. anhydrous salt are sol. in 1 l. H_2O at 25°. (Locke, Am. Ch. J. 1901, **26.** 174.)

Sp. gr. of aqueous solution at 15° containing:

5	10	15% $(NH_4)_2Fe_2(SO_4)_4+24H_2O$,
1.023	1.047	1.071
20	25	30% $(NH_4)_2Fe_2(SO_4)_4+24H_2O$,
1.096	1.122	1.148
35	40% $(NH_4)_2Fe_2(SO_4)_4+24H_2O$.	
1.175	1.203	

40% solution is sat. at 15°. (Gerlach, Z. anal. **28.** 496.)

Melts in crystal H_2O at 40°. (Locke.)

$3(NH_4)_2SO_4$, $Fe_2(SO_4)_3$. Insol. in cold H_2O. (Lachaud and Lepierre.)

Ammonium iron (ferroferric) sulphate, $4(NH_4)_2SO_4$, $FeSO_4$, $Fe_2(SO_4)_3+3H_2O$.

Sl. sol. in cold H_2O; decomp. into basic salt by hot H_2O; insol. in alcohol. (Lachaud and Lepierre, C. R. **114.** 916.)

Ammonium ferrous magnesium sulphate, $4(NH_4)_2SO_4$, $3FeSO_4$, $MgSO_4+24H_2O$.

Sol. in H_2O. (Schiff, A. **107.** 64.)

$2(NH_4)_2SO_4$, $FeSO_4$, $MgSO_4+12H_2O$. Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium ferrous manganous sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $MnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium ferrous nickel sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium ferrous zinc sulphate, $2(NH_4)_2SO_4$, $FeSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Bette, A. **14.** 286.)

Ammonium lanthanum sulphate, $(NH_4)_2SO_4$, $La_2(SO_4)_3+8H_2O$.

Sl. sol. in H_2O. (Marignac.)

Quite sol. in H_2O. (Cleve.)

$+2H_2O$. (Barre, C. R. 1910, **151.** 872.)

$5(NH_4)_2SO_4$, $2La_2(SO_4)_3$. Sl. sol. in $(NH_4)_2SO_4$+Aq of concentrations above 60%. (Barre, A. ch. 1911, (8) **24.** 246.)

$5(NH_4)_2SO_4$, $La_2(SO_4)_3$. (Barre.)

Ammonium lead sulphate, $(NH_4)_2SO_4$, $PbSO_4$.

Decomp. by H_2O into its constituents. (Wöhler and Litton, A. **43.** 126.)

Decomp. by H_2O. Only stable in contact with solutions containing:

13.86 pts. $(NH_4)_2SO_4$ per 100 pts. H_2O at 20°.

19.25 pts. $(NH_4)_2SO_4$ per 100 pts. H_2O at 50°.

24.31 pts. $(NH_4)_2SO_4$ per 100 pts. H_2O at 75°.

29.42 pts. $(NH_4)_2SO_4$ per 100 pts. H_2O at 100°.

(Barre, C. R. 1909, **149.** 294.)

Ammonium lithium sulphate, NH_4LiSO_4.

Solubility in H_2O = 35.25% at —10,° and 36.18% at 70°. (Schreinemakers, C. C. **1906,** I. 217.)

This is the only double salt which $(NH_4)_2SO_4$ forms with Li_2SO_4 below 100°. (Spielrein, C. R. 1913, **157.** 48.)

Ammonium magnesium sulphate, $(NH_4)_2Mg(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 15.9 pts. anhydrous double salt at 13°. (Mulder.)

100 pts. H_2O dissolve at:

0°	10°	15°	20°	30°	
9.0	14.2	15.7	17.9	19.1	pts. anhydrous salt,
45°	50°	55°	60°	75°	
25.6	30.0	31.9	36.1	45.3	pts. anhydrous salt.

(Tobler, A. **96.** 193.)

More sol. in H_2O than $(NH_4)_2SO_4$ or $MgSO_4$ (Graham.)

1 l. H_2O dissolves 199 pts. anhydrous salt at 25°. Tobler's results are inaccurate. (Locke, Am. Ch. J. 1902, **27.** 459.)

100 g. H_2O dissolve at:

34°	41° F.	
18.22	20.72 g.	$(NH_4)_2SO_4$, $MgSO_4$, $6H_2O$.
50°	59° F.	
22.48	24.08 g.	$(NH_4)_2SO_4$, $MgSO_4$, $6H_2O$,
60°	70° F.	
24.81	28.26 g.	$(NH_4)_2SO_4$, $MgSO_4$, $6H_2O$,
81° F.		
33.33 g.		$(NH_4)_2SO_4$, $MgSO_4$, $6H_2O$.

(Lothian, Pharm. J. 1910, (4) **30.** 546.)

Lothian's results for solubility in H_2O probably incorrect because of inaccuracy of experimental method. (Seidell, Pharm. J. 1911, (4) **33.** 846.)

Solubility of $(NH_4)_2Mg(SO_4)_2$ in H_2O at t°.

t°	g. anhydrous salt per 100 g.	
	solution	H_2O
0	10.58	11.83
10	12.75	14.61
20	15.23	17.96
25	16.45	19.69
30	17.84	21.71
40	20.51	25.86
50	23.18	30.17
60	26.02	35.17
80	32.58	48.32
100	39.66	65.72

(Porlezza, Att. Acc. Linc. 1914, (5) **23.** II, 509.)

Min. *Cerbolite.*

Ammonium magnesium nickel sulphate, $2(NH_4)_2SO_4$, $MgSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium magnesium potassium zinc sulphate, $2(NH_4)_2SO_4$, $3MgSO_4$, $3K_2SO_4$, $2ZnSO_4+30H_2O$.

Sol. in H_2O. (Schiff, A. **107.** 64.)

$(NH_4)_2SO_4$, $2MgSO_4$, $2K_2SO_4$, $ZnSO_4+18H_2O$. Sol. in H_2O. (Schiff.)

$(NH_4)_2SO_4$, $MgSO_4$, K_2SO_4, $ZnSO_4+12H_2O$ Sol. in H_2O. (Schiff.)

Ammonium magnesium zinc sulphate, $2(NH_4)_2SO_4$, $MgSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium manganous sulphate, $(NH_4)_2SO_4$, $MnSO_4+6H_2O$.

Deliquescent. Easily sol. in H_2O. (Jahn.)

1 l. H_2O dissolves 372 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

$(NH_4)_2SO_4$, $2MnSO_4$. Readily decomp. by H_2O. (Lepierre, C. R. 1895, **120.** 924.)

Ammonium manganic sulphate, $(NH_4)_2SO_4$, $Mn_2(SO_4)_3$.

Decomp. by H_2O. Insol. in ether, C_6H_6, and conc. H_2SO_4. Sol. in dil. H_2SO_4+Aq. (Lepierre, Bull. Soc. 1895, (3) **13** 596.)

$+24H_2O$. Decomp. by H_2O. (Mitscherlich.)

Ammonium manganous nickel sulphate, $2(NH_4)_2SO_4$, $MnSO_4$, $NiSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium manganous zinc sulphate, $2(NH_4)_2SO_4$, $MnSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Ammonium mercuric sulphate, $(NH_4)_2SO_4$, $3HgSO_4+2H_2O$.

(Hirzel, J. B. **1850.** 333.)

$(NH_4)_2SO_4$, $HgSO_4$. Difficultly sol. in H_2O. Easily sol. in NH_4OH+Aq.

Ammonium mercurous sulphate ammonia, $3Hg_2O$, $2(NH_4)HgSO_4$, $2NH_3$.

Insol. in hot or cold, dil. or conc. H_2SO_4 and HNO_3. Sol. in HCl. (Tarugi, Gazz. ch. it. 1903, **33.** (1) 131.)

Ammonium nickel sulphate, $(NH_4)_2SO_4$, $NiSO_4+6H_2O$.

Sol. in 4 pts. cold H_2O. (Link, **1796.**)

100 pts. H_2O dissolve at:

3.5°	10°	16°	20°	30°	
1.8	3.2	5.8	5.9	8.3	pts. anhydrous salt,
40°	50°	59°	68°	85°	
11.5	14.4	16.7	18.8	28.6	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 pts. sat. solution contain at 20°, 9.4; at 40°, 13.2; at 60°, 18.6; at 80°, 23.1 pts. anhydrous salt. (v. Hauer, J. pr. **74.** 433.)

1 l. H_2O dissolves 75.7 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Nearly insol. in a weak acid solution of $(NH_4)_2SO_4$. (Thompson, C. C. **1863.** 957.)

Ammonium nickel zinc sulphate, $2(NH_4)_2SO_4$, $NiSO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Ammonium nickel sulphate ammonia, $(NH_4)_2SO_4$, $NiSO_4$, $6NH_3+3H_2O$.

(André, C. R. **106.** 936.)

Ammonium platinic sulphate, $2(NH_4)_2SO_4$, $Pt_3(SO_4)_3+25H_2O$.

Sol. in H_2O. (Prost, Bull. Soc. (2) **46.** **156.**)

Ammonium potassium sulphate, $(NH_4)_2SO_4$, $K_2SO_4+4H_2O$.

Soluble in H_2O. 100 pts. H_2O at 16° dissolve 13.68 pts. salt. (Thomson, **1831.**)

Min. *Taylorite.*

Ammonium praseodymium sulphate, $(NH_4)_2SO_4$, $Pr_2(SO_4)_3+8H_2O$.

Sl. sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 359.)

Ammonium rhodium sulphate, $(NH_4)_2SO_4$, $Rh_2(SO_4)_3+24H_2O$.

Very sol. H_2O; melts in crystal H_2O at 102–103°. (Piccini, Z. anorg. 1901, **27.** 67.)

Ammonium samarium sulphate, $(NH_4)_2SO_4$, $Sm_2(SO_4)_3+8H_2O$.

Sl. sol. in H_2O. (Cleve, Bull. Soc. (2) **43.** 166.)

Ammonium scandium sulphate, $(NH_4)_2SO_4$, $Sc_2(SO_4)_3$.

Sol. in H_2O. (Cleve.)

Sol. in H_2O and in dil. $(NH_4)_2SO_4$+Aq. (R. J. Meyer, Z. anorg. 1914, **86.** 279.)

Ammonium sodium sulphate, $NH_4NaSO_4+2H_2O$.

100 pts. H_2O dissolve 46.6 pts. of cryst. salt at 15°, and the solution has a sp. gr. of 1.1749.

Sp. gr. of aqueous solution containing:

31.8	24.44	15.9%	$NH_4NaSO_4+2H_2O$,
1.1749	1.1380	1.0849	
12.72	6.36	%	$NH_4NaSO_4+2H_2O$.
1.0679	1.0337		

(Schiff, A. **114.** 68.)

Ammonium strontium sulphate.

Insol. in excess of $(NH_4)_2SO_4$+Aq. (Rose, Pogg. **110.** 296.)

$(NH_4)_2SO_4$, $SrSO_4$. This double salt is only stable in contact with nearly sat. solutions of $(NH_4)_2SO_4$. (Barre, C. R. 1909, **149.** 293.)

Ammonium tellurium sulphate, $(NH_4)HSO_4$, $2TeO_2$, SO_3+2H_2O.

As K salt. (Metzner, A. ch. 1898, (7) **15.** 203.)

Ammonium thallic sulphate, $NH_4Tl(SO_4)_2$.

(Marshall, C. C. **1902,** II. 1089.)

$+4H_2O$. Decomp. by H_2O. Easily sol. in dil. acids. (Fortini, Gazz. ch. it. **1905, 35.** (2) 450.)

Ammonium thorium sulphate, $2(NH_4)_2SO_4$, $Th(SO_4)_2$.

Easily sol. in H_2O and sat. $(NH_4)_2SO_4$+Aq. (Cleve.)

+$2H_2O$. (Barre.)

$(NH_4)_2SO_4$, $Th(SO_4)_2+4H_2O$. (Barre, A. ch. 1911, (8) **24.** 240.)

$3(NH_4)_2SO_4$, $Th(SO_4)_2+3H_2O$. (B.)

Ammonium titanium sulphate, $(NH_4)_2SO_4$, TiO, SO_4+H_2O.

Very sol. in H_2O with decomp.

Insol. in conc. H_2SO_4. (Rosenheim, Z. anorg. 1901, **26.** 252.)

$(NH_4)_2O$, $2TiO_2$, $2SO_3+3H_2O$. Slowly decomp. by H_2O. (Blondel, Bull. Soc. 1899, (3) **21.** 262.)

Ammonium titanium *sesqui***sulphate,** $(NH_4)_2SO_4$, $3Ti_2(SO_4)_3+18H_2O$.

Insol. in H_2O; sol. in HCl.

Insol. in H_2SO_4. Decomp. by boiling with conc. H_2SO_4. (Stähler, B. 1905, **38.** 2623.)

Ammonium uranous sulphate, $2(NH_4)_2SO_4$, $U(SO_4)_2$.

Easily sol. in H_2O. (Rammelsberg.)

Sol. in H_2O but solution rapidly decomp. (Kohlschütter, B. 1901, **34.** 3630.)

Ammonium uranyl sulphate, $(NH_4)_2SO_4$, $(UO_2)SO_4+2H_2O$.

Quite difficultly sol. in H_2O. (Arfvedson.)

Ammonium vanadous sulphate, $(NH_4)_2SO_4$, VSO_4+6H_2O.

Decomp. in the air.

Sol. in H_2O. (Piccini, Z. anorg. 1899, **19.** 205.)

Less sol. in H_2O than VSO_4+7H_2O. (Piccini and Marino, Z. anorg. 1902, **32.** 60.)

Ammonium vanadic sulphate, $(NH_4)_2SO_4$, $V_2(SO_4)_3+12H_2O$.

Insol. in H_2O.

Insol. in H_2SO_4. Decomp. by boiling with conc. H_2SO_4.

Sol. in HCl. (Stähler, B. 1905, **38.** 3980.)

+$24H_2O$. Very sol. in H_2O; decomp. in the air. (Piccini, Z. anorg. 1896, **11.** 108.)

100 pts. H_2O dissolve 39.76 pts. salt at 10°.

Sp. gr. of sat. solution at 4°/20° = 1.687. (Piccini, Z. anorg. 1897, **13.** 446.)

1 l. H_2O dissolves 31.69 g. anhydrous or 78.51 g. hydrated salt at 25°, or 1.210 g. mols. anhydrous salt are sol. in 1 l. H_2O at 25°.

Mpt. of crystals = 45°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Ammonium vanadyl sulphate, $(NH_4)_2SO_4$, $VOSO_4+3\frac{1}{2}H_2O$.

Easily sol. in H_2O and in a mixture of alcohol and conc. H_2SO_4, but cannot be recryst. therefrom. (Koppel and Behrendt, Z. anorg. 1903, **35.** 176.)

$(NH_4)_2SO_4$, $2VOSO_4+H_2O$. Deliquescent. Slowly but abundantly sol. in H_2O, but cannot be recryst. from it except by addition of H_2SO_4. (Koppel and Behrendt, Z. anorg. 1903, **35.** 172.)

Ammonium yttrium sulphate, $2(NH_4)_2SO_4$, $Y_2(SO_4)_3+9H_2O$.

Sol. in H_2O. (Cleve.)

Ammonium zinc sulphate, $(NH_4)_2SO_4$, $ZnSO_4$ +$6H_2O$.

100 pts. H_2O dissolve pts. $(NH_4)_2SO_4$, $ZnSO_4$ at:

0°	10°	13°	15°	20°	
7.3	8.8	10.0	12.5	12.6	pts. salt,
30°	45°	60°	75°	85°	
16.5	21.7	29.7	37.8	46.2	pts. salt.

(Tobler, A. **95.** 193.)

1 l. H_2O dissolves 140.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

+$7H_2O$. (André, C. R. **104.** 987.)

Ammonium zirconium sulphate.

Sol. in cold or hot H_2O or in acids. (Berzelius.)

Ammonium sulphate antimony fluoride, $(NH_4)_2SO_4$, $2SbF_3$.

Very sol. in H_2O. (Mayer, B. 1894, **27.** R. 922.)

Ammonium sulphate chromic chloride, $2(NH_4)_2SO_4$, $CrCl_3+6H_2O$.

Sol. in H_2O. (Weinland, B. 1907, **40.** 3768.)

Ammonium sulphate hydrogen peroxide, $(NH_4)_2SO_4$, H_2O_2.

Efflorescent in air.

Easily sol. in H_2O. (Willstätter, B. 1903, **36.** 1829.)

Antimony sulphate basic,, $7Sb_2O_3$, $2SO_3$+$3H_2O$.

Insol. in, and not decomp. by hot or cold H_2O. (Adie, Chem. Soc. **57.** 540.)

$5Sb_2O_3$, $2SO_3+7H_2O$. Insol. in H_2O. (Hensgen, R. t. c. **4.** 401.)

$2Sb_2O_3$, SO_3+xH_2O. Not decomp. by cold H_2O. (Adie.)

Sb_2O_3, $SO_3=(SbO)_2SO_4$. Decomp. by hot H_2O. (Peligot, J. B. **1847.** 426.)

+H_2O. As above. (Adie.)

Sb_2O_3, $2SO_3$, and +H_2O, and +$2H_2O$. Scarcely decomp. by cold, slowly by boiling H_2O. Slowly sol. in dil. HCl+Aq. (Adie.)

Antimony sulphate, $Sb_2(SO_4)_3$.

Very deliquescent. Combines with H_2O to a hard mass with evolution of heat; with more H_2O it becomes liquid, and by repeated treat-

ment with much boiling H_2O it is wholly decomp. into H_2SO_4 and Sb_2O_3. (Hensgen, R. t. c. **4.** 401.)

Antimony sulphate, acid, Sb_2O_3, $4SO_3$.

Decomp. by H_2O. (Adie.)

Sb_2O_3+8, or $9SO_3$. Decomp. by H_2O. (Adie.)

Antimony barium sulphate, $Sb_2(SO_4)_3$, $BaSO_4+6H_2O$.

As Ca comp. (Kühl, Z. anorg. 1907, **54.** 257.)

Antimony cæsium sulphate, $SbCs(SO_4)_2$.

Slowly decomp. by cold H_2O (Gutman, Arch. Pharm. 1908, **246.** 188.)

Antimony calcium sulphate, $Sb_2(SO_4)_3$, $CaSO_4+6H_2O$.

Decomp. by H_2O. (Kühl, Z. anorg. 1907, **54.** 257.)

Antimony lithium sulphate, $SbLi(SO_4)_2$.

Decomp. by H_2O. (Gutman, Arch. Pharm. 1908, **246.** 187.)

Antimony potassium sulphate, $KSb(SO_4)_2$.

Decomp. by H_2O. (Gutmann, Arch. Pharm. 1898, **236.** 478.)

Antimony rubidium sulphate, $SbRb(SO_4)_2$.

Slowly decomp. by cold H_2O. (Gutman.)

Antimony silver sulphate, $SbAg(SO_4)_2$.

Slowly decomp. by H_2O. (Kühl, Z. anorg. 1907, **54.** 258.)

Slowly decomp. by cold H_2O. (Gutman Arch. Pharm. 1908, **246.** 189.)

Antimony sodium sulphate, $NaSb(SO_4)_2$.

Easily decomp. by H_2O. (Gutmann, Arch. Pharm. 1898, **236.** 478.)

Antimony strontium sulphate, $Sb_2(SO_4)_3$, $SrSO_4+6H_2O$.

As Ca comp. (Kühl, Z. anorg. 1907, **54.** 257.)

Antimony thallium sulphate, $SbTl(SO_4)_2$.

Slowly decomp. by cold H_2O. Decomp. by conc. H_2SO_4. (Gutman, Arch. Pharm. 1908, **246.** 189.)

Arsenic sulphate.
See **Arsenic sulphur *tri*oxide.**

Barium sulphate, $BaSO_4$.

Sol. in 43,000 pts. H_2O (Kirwan); in 200,000 pts. H_2O (Margueritte, C. R. **38.** 308).

100 pts. H_2O dissolve 0.002 pt. $BaSO_4$. (Ure's Dict.)

$BaCl_2$+Aq containing 1 pt. BaO to 71,000 pts. H_2O, when treated with H_2SO_4, becomes turbid in ½ hour. (Harting, J. pr. 22. 52.)

$Ba(NO_3)_2$+Aq containing 1 pt. BaO to 25,000 pts. H_2O gives a distinct cloud with H_2SO_4 or Na_2SO_4+Aq; with 50,000–100,000 pts. H_2O a slight turbidity is produced: with 200,000–400,000 pts. H_2O the mixture becomes turbid in a few minutes; while with 800,000 pts. H_2O no action is visible. (Lassaigne, J Chim. Méd. 8. 526.)

Sol. in 800,000 pts. H_2O (Calvert); in 400,000 pts. cold or hot H_2O (Fresenius).

Calculated from the electrical conductivity of the solution, $BaSO_4$ is sol. in 429,700 pts. H_2O at 18.4°, and 320,000 pts. at 37.7°. (Holleman, Z. phys. Ch. **12.** 131.)

1 l. H_2O dissolves 1.72 mg. at 2°; 1.97 mg. at 10°; 2.29 mg. at 19.0°; 2.60 mg. at 26°; 2.91 mg. at 34°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

Calculated from the electrical conductivity of the solution, $BaSO_4$ is sol. in 425,000 pts. H_2O at 18.3°. Results of Fresenius and Hintz (Z. anal. 1896, **35.** 170) are incorrect. (Küster, Z. anorg. **1896,** 12. 267.)

Sat. aq. solution contains 2.29 mg. $BaSO_4$ per liter at 25° when particles of salt are not less than 1.8μ in diameter.

Sat. aq. solution contains 4.15 mg. $BaSO_4$ per liter at 25° when particles of salt are 0.1μ in diameter. (μ=0.0001 cm.) (Hulett, Z. phys. Ch. 1901, **37.** 398–9.)

In general the influence of the size of the grain on the solubility of the substance is negligible when the solubility exceeds 2%. The increase of normal solubility by using finely divided solids, amounts to 80% in the case of $BaSO_4$. (Hulett, Z. phys. Ch. 1904, **47.** 366.)

1 l. H_2O dissolves 2.3 mg. $BaSO_4$ at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

Calculated from electrical conductivity of $BaSO_4$+Aq.

0.0190 milli-equivalents are sol. in 1 liter H_2O at 18°; 0.0212 at 25°; 0.0288 at 50°; 0.0334 at 100°.

(Melcher, J. Am. Chem. Soc. 1910, **32.** 55.)

Not attacked by cold HCl or HNO_3+Aq after several hours, and only in traces after several days. On boiling, traces of $BaSO_4$ dissolve, and the liquid after cooling can be precipitated by $BaCl_2$ or H_2SO_4+Aq, but not by H_2O alone. (Rose, Pogg. **95.** 108.)

By washing $BaSO_4$ long enough with H_2O containing HCl or HNO_3 [$HC_2H_3O_2$ (Siegle)], the filtrate can be precipitated by H_2SO_4 or $BaCl_2$. (Piria, J. B. **1856.** 334.)

1000 pts. 3% HCl+Aq dissolve 0.06 pt. $BaSO_4$ in the cold, and still more on boiling.

230 ccm. HCl+Aq of 1.02 sp. gr. dissolve 0.048 g. $BaSO_4$ from 0.679 g. $BaSO_4$ when boiled ¼ hour.

168 ccm. HCl+Aq of 1.03 sp. gr. dissolve 0.0075 g. $BaSO_4$ from 0.577 g. $BaSO_4$ when boiled 5 minutes. (Siegle, J. pr. **69.** 142.)

Solubility of $BaSO_4$ in HCl+Aq.

No. cc. HCl+Aq containing 1 mg. equiv. HCl	Mg. $BaSO_4$ per 1 mg. equiv. of HCl	g. per 100 cc. solution	
		HCl	$BaSO_4$
2.0	0.133	1.82	0.0067
1.0	0.089	3.65	0.0089
0.5	0.056	7.29	0.0101
0.2	0.017	18.23	0.0086

(Banthisch, J. pr. 1884, **29.** 54.)

100,000 pts. H_2O dissolve 0.124 pt. $BaSO_4$; 1000 pts. HNO_3+Aq of 1.167 sp. gr. dissolve 2 pts. $BaSO_4$; 1000 pts. HNO_3+Aq of 1.032 sp. gr. dissolve 0.062 pt. $BaSO_4$. (Calvert, Chem. Gaz. **1856.** 55.)

When 0.4 g. $BaSO_4$ is heated ¼ hour with 150 ccm. HNO_3+Aq of 1.02 sp. gr., 0.165 g. is dissolved. (Siegle, J. pr. **69.** 142.)

Solubility of $BaSO_4$ in HNO_3+Aq.

No. cc. HNO_3+Aq containing 1 mg. equiv. HNO_3	Mg. $BaSO_4$ per 1 mg. equiv. of $BaSO_4$	G. per 100 cc. solution	
		HNO_3	$BaSO_4$
2.0	0.140	3.15	0.0070
1.0	0.107	6.31	0 0107
0.5	0.085	12.61	0.0170
0.2	0.048	31 52	0.0241

(Banthisch, J. pr. 1884, **29.** 54.)

Acetic acid has less solvent power than other acids. 80 ccm. $HC_2H_3O_2$+Aq of 1.02 sp. gr. boiled with 0.4 g. $BaSO_4$ ¼ hour dissolve 0.002 g. (Siegle, J. pr. **69.** 142.)

Sol. in boiling conc. H_2SO_4. (See $BaH_2(SO_4)_2$).

Sol. in fuming H_2SO_4. (See BaS_2O_7.)

Sol. in 2500 pts. boiling 40% HBr+Aq; in 6000 pts. boiling 40% HI+Aq. (Haslam, C. N. **53.** 87.)

Sol. in considerable amount in metaphosphoric acid+Aq. (Scheerer and Drechsel, J. pr. (2) **7.** 68.)

Not attacked by boiling conc. KOH+Aq if CO_2 is not present. (Rose, Pogg. **95.** 104.)

Very sl. decomp. by standing a long time with cold conc. alkali carbonates+Aq.

Decomp. by boiling Na_2CO_3 or K_2CO_3+Aq, not by $(NH_4)_2CO_3$+Aq. (See Storer's Dict. for analytical data.)

Very sl. sol. in NH_4Cl+Aq, 1 pt. dissolving in 230,000 pts. sat. NH_4Cl+Aq.

500 ccm. sat. NH_4NO_3+Aq with 50 ccm. sat. NH_4Cl+Aq dissolve 2 g. $BaSO_4$. 100 ccm. sat. NH_4NO_3+Aq with 100 ccm. sat. NH_4Cl+Aq dissolve only 0.08 g. $BaSO_4$, therefore above solubility is due to free chlorine. (Mittentzwey, J. pr. **75.** 214.)

$BaSO_4$ cannot be precipitated from solutions containing free Cl_2. (Erdmann, J. pr. **75.** 215.)

Pptn. is retarded sl. by tartaric and racemic acids. (Spiller.)

Na metaphosphate prevents pptn. of $BaSO_4$ but not ortho- or pyrophosphate. (Scheerer, J. pr. **75.** 114.)

Not precipitated in presence of alkali citrates. (Spiller.)

Much less sol. in NH_4Cl+Aq than in NH_4NO_3+Aq. Insol. in warm conc. $Na_2S_2O_3$+Aq. (Diehl, J. pr. **79.** 431.)

Not appreciably sol. in H_2O containing ammonium or sodium chloride. (Brett, Wittstein, Wackenroder.)

Not appreciably sol. in H_2O at 250°, or in H_2O containing Na_2S. (Senarmont.)

Solubility is increased by alkali nitrates, but not appreciably by NaCl, $KClO_3$, or $Ba(NO_3)_2$. (Fresenius, Z. anal. **9.** 52.)

Scarcely sol. in boiling conc. $(NH_4)_2SO_4$+Aq. (Fresenius.)

Solubility in H_2O increased by presence of $MgCl_2$ (Fresenius); cerium salts (Marignac).

Sol. in Fe_2Cl_6+Aq. (Lunge, Z. anal. **19.** 141.)

Solubility in various salts+Aq at 20–25°.

g. salt per l.	Mg. $BaSO_4$ dissolved per l. in		
	$FeCl_3$	$AlCl_3$	$MgCl_2$
1	58	33	30
2.5	72	43	30
5	115	60	33
10	123	94	33
25	150	116	50
50	160	170	50
100	170	175	50

(Fraps, Am. Ch. J. 1902, **27.** 290.)

Solubility in sat. solution of various salts+Aq.

Salt	G. $BaSO_4$ sol. in 1 l. of the solvent
$NaNO_3$	0.2940
NaCl	0.00783
NH_4Cl	0.00827

(Ehlert, Z. Elektrochem, 1912, **18.** 728.)

Conc. $CrCl_3$+Aq dissolves 40–120 times as much $BaSO_4$ as H_2O, when boiled therewith for 5 days; conc. $CrCl_3$+Aq acidified with HCl, 450 times as much in 10 days. (Kuster, Z. anorg. 1905, **43.** 348.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Sol. in H_2O_2+Aq. (Gawalowski, C. C. **1906,** II. 7.)

100 cc. 95% formic acid dissolve 0.01 g. $BaSO_4$ at 18.5°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); in ethyl acetate. (Naumann. B. 1904, **37.** 3601.)

Min. *Barite.*

Barium hydrogen sulphate, $BaH_2(SO_4)_2$.

100 pts. H_2SO_4 dissolve 2.22 pts. $BaSO_4$ (Lies-Bodart and Jacquemin, C. R. **46.** 1206); 5.69 pts. $BaSO_4$ (Struve, Z. anal. **9.** 34).

Boiling H_2SO_4 dissolves 10–12% freshly precipitated $BaSO_4$ without separating crystals on cooling. H_2SO_4 at 100° dissolves more than boiling H_2SO_4, and becomes cloudy if heated to boiling. (Schultz, Pogg. **133.** 146.)

1 g. $BaSO_4$ pptd. from $BaCl_2$ is sol. in 3153 g. 91% H_2SO_4; from $Ba(NO_3)_2$ is sol. in 1519 g. 91% H_2SO_4. (Varenne and Pauleau, C. R. **93.** 1016.)

100 pts. hot conc. H_2SO_4 dissolve approx. 6 pts. $BaSO_4$. (Rohland, Z. anorg. 1910, **66.** 206.)

10 ccm. of sat. $BaSO_4$+absolute H_2SO_4 contain approx. 2.851 g. $BaSO_4$. (Bergius, Z. phys. Ch. 1910, **72.** 355.)

Equilibrium in the system $BaSO_4+H_2SO_4+H_2O$ at 25°.

Composition of the solution		
% H_2SO_4	g. $BaSO_4$ per l.	Solid phase
73.83	0.030	$BaSO_4$
78.04	0.135	"
80.54	0.285	"
83.10	0.800	"
85.78	3.215	$BaSO_4$, $2H_2SO_4.H_2O$
88.08	12.200	"
93.17	49.665	$BaSO_4$, H_2SO_4

(Volkhonski, C. C. **1910,** I. 1954; C. A. **1911.** 617.)

Decomp. by H_2O, alcohol, or ether.

$+2H_2O$. (Schultz.)

$BaSO_4$, $2H_2SO_4+H_2O$. (Volkhonski.)

Barium *pyro*sulphate, BaS_2O_7.

100 pts. fuming H_2SO_4 dissolve 15.89 pts. $BaSO_4$. (Struve, Z. anal. **9.** 34.)

Very deliquescent.

Decomp. with H_2O with hissing. (Schultz-Sellack, B. **4.** 111.)

Barium calcium sulphate, $3BaSO_4$, $CaSO_4$.

Min. *Dreelite.*

Barium platinic sulphate (?).

Insol. in H_2O or boiling HCl or HNO_3+Aq. Sol. in hot conc. H_2SO_4 or aqua regia. (E. Davy.)

Barium tin (stannic) sulphate, $BaSO_4$, $Sn(SO_4)_2+3H_2O$.

Decomp. by H_2O. Insol. in HCl. (Weinland and Kühl, Z. anorg. 1907, **54.** 249.)

Barium titanium sulphate, $2BaSO_4$, $3Ti(SO_4)_2$.

Ppt. Decomp. by H_2O, giving titanic acid. (Weinland, Z. anorg. 1907, **54.** 255.)

Barium sulphate potassium chloride, $3BaSO_4$, KCl.

Ppt. (Silberberger, M. 1904, **25.** 233.)

Bismuth sulphate, basic, $(BiO)_2SO_4$.

Insol. in H_2O. Sol. in HNO_3 or H_2SO_4+Aq.

$+2H_2O$. (Heintz, Pogg. **63.** 55.)

$4Bi_2O_3$, $3SO_3+15H_2O$. Insol. in H_2O. (Leist.)

$(BiO)HSO_4+H_2O$. Insol. in H_2O. Sol. in dil. H_2SO_4+Aq.

$+2H_2O$. Decomp. by H_2O with separation of $(BiO)_2SO_4+2H_2O$. (Heintz.)

$3Bi_2O_3$, $2SO_3+2H_2O$. Insol. in H_2O. (Athanasesco, C. R. **103.** 271.)

$5Bi_2O_3$, $11SO_3+17H_2O$. This sulphate crystallizes out from sulphuric acid of any strength between H_2SO_4, $6H_2O$ and H_2SO_4, $12H_2O$. (Adie, Proc. Chem. Soc. 1899, **15.** 226.)

Bi_2O_3, $2SO_3$, $2\frac{1}{2}H_2O$ is in equilibrium at 50° with 5.4–51.4% H_2SO_4+Aq.

Bi_2O_3, SO_3 is in equilibrium at 50° with acid solutions weaker than 5.4% H_2SO_4. (Allan, Am. Ch. J. 1902, **27.** 287.)

Bismuth sulphate, $Bi_2(SO_4)_3$.

Very hygroscopic. Takes up H_2O with strong evolution of heat to form $2Bi_2(SO_4)_3+7H_2O$, which becomes $Bi_2(SO_4)_3+3H_2O$ at 100°. Decomp. by boiling H_2O into Bi_2O_3, SO_3+H_2O. (Hensgen, J. B. **1885.** 552.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Bismuth sulphate, acid, Bi_2O_3, $4SO_3$.

Bi_2O_3, $4SO_3$ is in equilibrium at 50° with 51.4–90% H_2SO_4+Aq. (Allan, Am. Ch. J. 1902, **27.** 287.)

$+H_2O$. Crystallizes out from sulphuric acid at temp. above 170°. (Adie, Proc. Chem. Soc. 1899, **15.** 226.)

$+3H_2O$. Crystallizes from sulphuric acid of any strength between H_2SO_4, H_2O and H_2SO_4, $2H_2O$. (Adie.)

+7, or $9H_2O=BiH(SO_4)_2+3H_2O$. Insol. in H_2O. Easily sol. in acids, especially HCl, and HNO_3+Aq. (Leist, A. **160.** 29.)

$+7H_2O$. Crystallizes out from sulphuric acid of any strength between H_2SO_4, $3H_2O$ and H_2SO_4, $5H_2O$.

$+10H_2O$. Crystallizes out from sulphuric acid at temp. below 170°. (Adie.)

Bismuth potassium sulphate, $Bi_2(SO_4)_3$, $3K_2SO_4$ (?).

Decomp. by H_2O; insol. in sat. K_2SO_4+Aq. (Heintz.)

$Bi_2(SO_4)_3$, $2K_2SO_4$.

$BiK(SO_4)_2=Bi_2(SO_4)_3$, K_2SO_4. Insol. in cold H_2O; decomp. by boiling. (Brigham, Am. Ch. J. **14.** 170.)

Bismuth sodium sulphate, $Bi_4Na_6(SO_4)_9$.
(Lüdecke, A. **140.** 277.)

Boron sulphate.
See **Borosulphuric acid.**

Bromomolybdenum sulphate.
See under **Bromomolybdenum compounds.**

Cadmium sulphate, basic, $2CdO, SO_3$, and $+H_2O$.

Difficultly sol. in H_2O. (Stromeyer.) Sl. sol. in hot H_2O. (Habermann, M. **5.** 432.)

$4CdO, SO_3$. (Pickering, Chem. Soc. 1907, **91.** 1987.)

Cadmium sulphate, $CdSO_4$.

Sat. $CdSO_4$+Aq contains at:

0°	10°	24°	30°	65°	
35.9	37.5	41.5	42.0	49.7% $CdSO_4$,	
86°	94°	130°	165°	188°	200°
43.5	91.6	27.7	14.7	7.1	2.3% $CdSO_4$.

$CdSO_4$ easily forms supersat. solutions. (Étard, A. ch. 1894, (7) **2.** 552.)

Solubility in H_2O.

t°	Per cent $CdSO_4$ in sat. solution	Solid phase
−18	43.35	Ice
−10	43.27	"
0	43.01	$CdSO_4$, $^8/_3H_2O$
+10	43.18	"
15	43.20	"
20	43.37	"
30	43.75	"
40	43.99	"
60	44.99	"
62	45.06	"
72	46.2	"
73.5	46.6	"
74.5	46.7	"
75	46.5	$CdSO_4$, H_2O
77	42.2	"
78.5	41.5	"
85	39.6	"
90	38.7	"
95	38.1	"
100	37.8	"

(Mylius and Funk, B. 1897, **30.** 825.)
See also under $CdSO_4+2^2/_3H_2O$, and $7H_2O$.

Sp. gr. at 0°/4° of $CdSO_4$+Aq containing 14.0 g. $CdSO_4$ in 1000 g. H_2O = 1.0122.
Sp. gr. at 12°/4° of $CdSO_4$+Aq containing 14.0 g. $CdSO_4$ in 100 g. H_2O = 1.0121.
Sp. gr. at 12°/4° of $CdSO_4$+Aq containing 57.2 g. $CdSO_4$ in 1000 g. H_2O = 1.0514.
Sp. gr. at 0°/4° of $CdSO_4$+Aq containing 183.1 g. $CdSO_4$ in 1000 g. H_2O = 1.1552.
Sp. gr. at 13°/4° of $CdSO_4$+Aq containing 183.1 g. $CdSO_4$ in 1000 g. H_2O = 1.1529.
(Fouqué, Ann. Observ. 1868, **9.** 172.)

Sp. gr. of $CdSO_4$+Aq at 18°.

% $CdSO_4$	1	5	10	15
Sp. gr.	1.0084	1.0486	1.1026	1.1607
% $CdSO_4$	20	25	30	35
Sp. gr.	1.2245	1.295	1.3725	1.4575
% $CdSO_4$	36			
Sp. gr.	1.4743			

(Grotrian, W. Ann. 1883, **18.** 193.)

Sp. gr. of $CdSO_4$+Aq at room temp. containing:

7.14	14.66	22.011% $CdSO_4$.
1.0681	1.1591	1.2681

(Wagner, W. Ann. 1883, **18.** 268.)

Sp. gr. of $CdSO_4$+Aq at 25°.

Concentration of $CdSO_4$ +Aq	Sp. gr.
1–normal	1.0973
$^1/_2$– "	1.0487
$^1/_4$– "	1.0244
$^1/_8$– "	1.0120

(Wagner, Z. phys. Ch. 1890, **5.** 36.)

Sp. gr. of $CdSO_4$+Aq.

% $CdSO_4$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0289	17.29	0.99908	0.99893
. .	23.65	0.99776	. . .
0.0498	18.00	. . .	0.99915
0.0999	18.00	. . .	0.99961
0.495	18.00	. . .	1.0034
0.981	18.00	. .	1.0084

(Wershofen, Z. phys. Ch. 1890, **5.** 494.)

Sp. gr. at 16°/4° of $CdSO_4$+Aq containing 29.4654% $CdSO_4$ = 1.36289; containing 21.3671% $CdSO_4$ = 1.24211. (Schönrock, Z. phys. Ch. 1893, **11.** 781.)

Sp. gr. of $CdSO_4$+Aq at 18°/4°.

% $CdSO_4$	25.121	18.172
Sp. gr.	1.297	1.200
% $CdSO_4$	9.952	5.639
Sp. gr.	1.101	1.055

(de Muynck, W. Ann. 1894, **53.** 561.)

$CdSO_4$+Aq containing 13.40% $CdSO_4$ has sp. gr. 20°/20° = 1.1429.
$CdSO_4$+Aq contaiing 16.79% $CdSO_4$ has sp. gr. 20°/20° = 1.1847.
(Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 282.)

Sp. gr. of $CdSO_4$ at 18.2°, when p = per cent strength of solution; d = observed density; w = volume conc in grams per cc. $\left(\frac{pd}{100} = w.\right)$

p	d	w
39.86	1.5639	0.6231
31.53	1.4080	0.4439
26.85	1.3310	0.3574
24.17	1.2901	0.3118
18.35	1.2084	0.2217
13.27	1.1437	0.1518
9.97	1.1045	0.1102
7.46	1.0764	0.0803
6.12	0.0619	0.0650
2.52	0.0242	0.0259
1.45	0.0132	0.0147
0.464	0.0033	0.0046

(Barnes, J. phys. Ch. 1898, **2.** 543.)

Sp. gr. of $CdSO_4$+Aq sat. at 25° and 1 atm. = 1.617. (Sinnige, Z. phys. Ch. 1909, **67.** 518.)

See also under $CdSO_4 + 2^2/_3H_2O$, and $+4H_2O$.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+H_2O$. *See* Mylius and Funk, under $CdSO_4$.

$+1^1/_3 H_2O$. (Worobieff, Bull. Soc. 1896, (3) **16.** 1754.)

$+2^2/_3H_2O$. 1 pt. H_2O dissolves 0.59 pt. anhydrous salt at 23°, and not much more on heating. Sat. solution boils at 102°. Precipitated by alcohol. (v. Hauer.)

100 g. H_2O dissolve g. $CdSO_4$ at t°.

t°	G. $CdSO_4$
0	75.52
5	75.65
7	65.73
9	75.85
11.5	75.94
13	76.04
15	76.11
16	76.16
17	76.13
18	76.14
19	76.18
25	76.79

(Kohnstamm and Cohen, W. Ann. 1898, **65.** 352.)

100 pts. H_2O dissolves at:

13.7° 14.98° 15.0° 16.0°
76.06 76.09 76.14 76.18 pts. anhydrous salt,

16.96° 18.0° 19.0° 25.0°
76.26 76.32 76.39 76.81 pts. anhydrous salt.

(Steinwehr, W. Ann. 1902, (4) **9.** 1050.)

100 g. H_2O dissolve 76.02 g. $CdSO_4$ at 25°. (Stortenbecker, Z. phys. Ch. 1900, **34.** 109.)

Solubility of $CdSO_4 + 2^2/_3H_2O$ at 25° and varying pressures.

Pressure in atmospheres	G. $CdSO_4$ in 100 g. H_2O
1	76.80
500	77.85
500	78.08
1000	78.77
1000	78.68
Det. by another method	
Pressure in atmospheres	G. $CdSO_4$ in100 g. H_2O
250	77.53
500	78.02
750	78.60
1000	78.96

(Cohen and Sinnige, Trans. Farad. Soc. 1910, **5.** 269.)

Sp. gr. at 21.6°/0° of $CdSO_4$+Aq containing 11.47% $CdSO_4 + ^8/_3H_2O$ = 1.0944. (Kanonnikoff, J. pr. 1885, (2) **31.** 346.)

100 g. H_2O dissolve 57.61 g. $CdSO_4$ + 10.63 g. $FeSO_4$ at 25°. (Stortenbecker, Z. phys. Ch. 1900, **34.** 109.)

$+4H_2O$. (Lescoeur, A. ch. 1895, (7) **4.** 222.)

Sp. gr. at 15° of $CdSO_4$+Aq containing 10 g. $CdSO_4 + 4H_2O$ in 100 c.c of solution = 1.0790; containing 20 g. $CdSO_4 + 4H_2O$ in 100 cc. of solution = 1.1522. (Traube, J. pr. 1885, (2) **31.** 207.)

Could not be obtained. (Mylius and Funk.)

$+7H_2O$.

Solubility in H_2O.

t°	% $CdSO_4$
−17	44.45
−16	44.5
−12	45.3
−10	46.1
− 7	47.5
− 5	48.5
− 4.5	48.7

(Mylius and Funk, B. 1897, **30.** 828.)

Cadmium cæsium sulphate, $CdSO_4, Cs_2SO_4 + 6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

1 l. H_2O dissolves 1399 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cadmium calcium potassium sulphate, $Ca_2CdK_2(SO_4)_4+2H_2O$.

(D'Ans, B. 1908, **41.** 1778.)

Cadmium cerium sulphate, $CdSO_4$, $Ce_2(SO_4)_3+6H_2O$.

Sol. in H_2O. (Wyrouboff.)

Cadmium hydrazine sulphate, $CdH_2(SO_4)_2$, $2N_2H_4$.

1 pt. is sol. in 202.5 pts. H_2O at 12°.

Not attacked by dil. acids. Easily sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 331.)

Cadmium magnesium sulphate, $CdSO_4$, $MgSO_4+14H_2O$.

Very efflorescent. Sol. in H_2O. (Schiff, A. **104.** 325.)

Cadmium potassium sulphate, K_2SO_4, $CdSO_4+1\frac{1}{2}H_2O$.

Sol. in H_2O. (v. Hauer, Pogg. **133.** 176.)

100 pts. H_2O dissolve 42.50 pts. anhydrous salt at 26°;

100 pts. H_2O dissolves 42.80 pts. anhydrous salt at 31°;

100 pts. H_2O dissolve 43.45 pts. anyhydrous salt at 40°;

100 pts. H_2O dissolve 44.90 pts. anyhydrous salt at 64°. (Wyrouboff, Bull. Soc. Min. 1901, **24.** 68.)

$+2H_2O$. 100 pts. H_2O dissolve 42.89 pts. anhydrous salt at 16°; 46.82 pts. at 31°; 47.40 pts. at 40°. (Wyrouboff.)

$+4H_2O$. Efflorescent. (Wyrouboff, Bull. Soc. Min. 1891, **14.** 235.)

$+6H_2O$. Very efflorescent, and easily decomp. (Schiff.)

Does not exist. (Wyrouboff.)

Cadmium rubidium sulphate, $CdSO_4$, $Rb_2SO_4+6H_2O$.

Efflorescent. Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 767 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cadmium sodium sulphate, $CdSO_4$, $Na_2SO_4+2H_2O$.

Sol. in H_2O. (v. Hauer.)

Solubility of $CdNa_2(SO_4)_2+2H_2O$ in 100 g. H_2O at t°.

t°	Grams $CdSO_4$	Grams Na_2SO_4
24	35.49	24.04
25	35.88	24.46
30	36.28	24.605
35	36.69	24.99
40	37.24	25.455

(Koppel, Z. phys. Ch. 1905, **52.** 413.)

Decomp. by H_2O below 20.5°.

Solubility of $CdNa_2(SO_4)_2$, $2H_2O+CdSO_4$, $^8/_3$ H_2O in 100 g. H_2O at t°.

t°	Grams $CdSO_4$	Grams Na_2SO_4	t°	Grams $CdSO_4$	Na_2SO_4 Grams	t°	Grams $CdSO_4$	Grams Na_2SO_4
0	73.54	8.85	15	73.765	9.435	30	73.915	11.10
5	73.38	8.675	20	73.81	9.455	35	75.01	12.32
10	72.765	9.55	25	73.71	10.48	40	75.385	13.75

(Koppel.)

Solubility of $CdNa_2(SO_4)_2$, $2H_2O+Na_2SO_4$, $10H_2O$ in 100 g. H_2O at t°.

t°	Grams $CdSO_4$	Grams Na_2SO_4
−14.8	72.68	8.32
0	66.325	11.625
5	61.78	12.97
10	55.34	14.785
12	51.615	15.95
15	46.60	17.99
19.8	36.13	22.16
20	36.25	23.52
24	27.82	29.17
25	25.59	31.06
30	14.62	44.145

(Koppel.)

Solubility of $CdNa_2(SO_4)_2$, $2H_2O+Na_2SO_4$ (anhydrous) in 100 g. H_2O at t°.

t°	Grams $CdSO_4$	Grams Na_2SO_4
35	13.26	47.06
40	16.25	46.27

(Koppel.)

Cadmium sulphate ammonia, $CdSO_4$, $6NH_3$.

Sol. in H_2O with separation of CdO. (Rose, Pogg. **20.** 152.)

$CdSO_4$, $4NH_3+4H_2O$. Decomp. by H_2O. (Malaguti and Sarzeau, A. ch. (3) **9.** 431.)

$+2H_2O$. Ppt. (André, C. R. **104.** 987.)

$+2\frac{1}{2}H_2O$. Sol. in H_2O with separation of basic sulphate. (Müller, A. **149.** 70.)

$CdSO_4$, $3NH_3$. (Isambert, C. R. 1870, **70.** 457.)

Cadmium sulphate cupric oxide, $CdSO_4$, $3CuO+xH_2O$.

(Recoura, C. R. 1901, **132.**1415.)

$2CdSO_4$, $3CuO+8H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 383.)

$+12H_2O$. (Mailhe.)

$6CdSO_4$, $20CuO+xH_2O$. (Recoura, C. R. 1901, **132.** 1415.)

Cadmium sulphate hydrazine, $CdSO_4$, $2N_2H_4$.

Easily sol. in NH_4OH+Aq but cannot be cryst. therefrom. (Franzen, Z. anorg. 1908, **60.** 282.)

Cadmium sulphate hydrogen chloride, $3CdSO_4, 4HCl+4H_2O$.

Very deliquescent. (Baskerville and Harris, J. Am. Chem. Soc. 1901, **23.** 896.)

$3CdSO_4, 8HCl$. Very deliquescent. (Baskerville and Harris.)

Cæsium sulphate, Cs_2SO_4.

Not deliquescent.

100 pts. H_2O dissolve 158.7 pts. Cs_2SO_4 at —2°.

100 cc. H_2O at 17-18° dissolve 163.5 g. Cs_2SO_4. (Tutton, Chem Soc. 1894, **65.** 632.)

Solubility in H_2O.

t°	G. Cs_2SO_4 per 100 g. Solution	G. Cs_2SO_4 per 100 g. H_2O	G. mols. Cs_2SO_4 per l	t°	G. Cs_2SO_4 per 100 g. Solution	G. Cs_2SO_4 per 100 g. H_2O	G. mols. Cs_2SO_4 per l
0	62.6	167.1	3.42	60	66.7	199.9	3.78
10	63.4	173.1	3.49	70	67.2	205.0	3.83
20	64.1	178.7	3.56	80	67.8	210.3	3.88
30	64.8	184.1	3.62	90	68.3	214.9	3.92
40	65.5	189.9	3.68	100	68.8	220.3	3.97
50	66.1	194.9	3.73	108.6	69.2	224.5	4.00

(Berkeley, Trans. Roy. Soc. 1901, **203.** A. 210.)

Solubility in Na_2SO_4+Aq.

Sat. solution contains 54.7% Cs_2SO_4+ 11.45% Na_2SO_4 at 25°. (Foote, J. Am. Chem. Soc. 1911, **33.** 467.)

Insol. in alcohol. (Bunsen.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); (Eidmann, C. C. **1899,** II. 1014.)

Solubility in glycol at ord. temp.=3.0–3.2%. (de Coninck, Belg. Acad. Bull. **1905.** 359.)

Cæsium hydrogen sulphate, $CsHSO_4$.

Sol. in H_2O.

Cæsium ***pyro*****sulphate,** $Cs_2S_2O_7$.

Decomp. by H_2O.

Cæsium ***octo*****sulphate,** $Cs_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Cæsium calcium sulphate, $Ca_2Cs_2(SO_4)_3$.

Very stable, (D'Ans, B. 1908, **41.** 1776.)

Cæsium chromium sulphate, $Cs_2Cr_2(SO_4)_4+24H_2O$.

Melts in crystal H_2O at 116°. (Locke.)

Solubility in H_2O.

Temp.	G. per litre	G. mols. anhydrous salt per l.
25°	5.7	0.015
30°	9.6	0.025
35°	12.06	0.032
40°	15.5	0.0405

(Locke, Am. Ch. J. 1901, **26.** 180.)

Cæsium cobaltous sulphate, $Cs_2SO_4, CoSO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

1 l. H_2O dissolves 418.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium cobaltic sulphate, $Cs_2Co_2(SO_4)_4+24H_2O$.

Melts in crystal H_2O at 116°. (Locke, Am. Ch. J. 1901, **26.** 1[illegible].)

Cæsium copper sulphate, $Cs_2SO_4, CuSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 460 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium gallium sulphate, $Cs_2Ga_2(SO_4)_4+24H_2O$.

(Soret, Arch. sc. phys. nat. 1888, (3) **20.** 531.)

Cæsium indium sulphate, $Cs_2In_2(SO_4)_4+24H_2O$.

75.7 g. anhydrous (117.39 hydrated) salt or 0.172 g. mols of anhydrous salt are sol. in 1 l. H_2O at 25°. (Locke, Am. Ch. J. 1901, **26.** 175.)

100 pts. H_2O dissolve 3.04 pts. at 16.5°. (Chabriè and Rengade, C. R. 1900, **131.** 1301.)

Cæsium iridium sulphate, $Cs_2SO_4, Ir_2(SO_4)_3+24H_2O$.

Mpt. 109–110.°

Very sl. sol. in cold. More easily sol. in hot H_2O. (Marino, Z. anorg. 1904, **42.** 218.)

Cæsium iron (ferrous) sulphate, $Cs_2SO_4, FeSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 1011 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium iron (ferric) sulphate, $Cs_2Fe_2(SO_4)_4+24H_2O$.

Melts in crystal H_2O at 71°. (Locke.)

Solubility in H_2O.

t°	G. per litre	G. mols. anhydrous salt per litre
25	17.1	0.045
30	25.2	0.066
35	37.5	0.099
40	60.4	0.156

(Locke, Am. Ch. J. 1901, **26.** 180.)

Cæsium lanthanum sulphate, Cs_2SO_4, $La_2(SO_4)_3+2H_2O$.

(Baskerville, J. Am. Chem. Soc. 1904, **26.** 67.)

$2Cs_2SO_4$, $3La_2(SO_4)_3$. (Baskerville.)

Cæsium magnesium sulphate, Cs_2SO_4, $MgSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 533 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium manganous sulphate, Cs_2SO_4, $MnSO_4+8H_2O$.

Sol. in H_2O. (Tutton.)

Sol. in H_2O and acids with decomp. (Piccini, Z. anorg. 1899, **20.** 14.)

1 l. H_2O dissolves 804 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 45.

Cæsium manganic sulphate, Cs_2SO_4, $Mn_2(SO_4)_3+24H_2O$.

Decomp. by H_2O and dil. acids with separation of MnO_2. Sol. in 1:3 H_2SO_4+Aq and in conc. HNO_3. Insol. in acetic acid. Sol. in oxalic acid+Aq. (Christensen, Z. anorg. 1901, **27.** 332.)

Cæsium neodymium sulphate, Cs_2SO_4, $Nd_2(SO_4)_3+3H_2O$.

(Baskerville, J. Am. Chem. Soc. 1904, **26.** 74.)

Cæsium nickel sulphate, Cs_2SO_4, $NiSO_4+6H_2O$.

Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 255.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium praseodymium sulphate, Cs_2SO_4, $Pr_2(SO_4)_3+2H_2O$.

(Baskerville, J. Am. Chem. Soc. 1904, **26.** 73.)

$+4H_2O$. (Baskerville.)

Cæsium rhodium sulphate, $Cs_2SO_4,Rh_2(SO_4)_3+24H_2O$.

Sl. sol. in cold, sol. in warm H_2O; mpt. 110–111.° (Piccini, Z. anorg. 1901, **27.** 64.)

Cæsium thallic sulphate, $CsTl(SO_4)_4+1\frac{1}{2}H_2O$.

Hygroscopic. (Locke, Am. Ch. J. 1902, **27.** 283.)

$+3H_2O$. Very sl. sol. in cold; easily sol. in hot H_2O. Can be recryst. from H_2SO_4+Aq. The recryst. salt is at once decomp. by H_2O or 95% alcohol. (Locke.)

Cæsium thorium sulphate, $Cs_2SO_4,Th(SO_4)_2+2H_2O$.

Sl. sol. in H_2O. (Manuelli, Gazz. ch. it. 1903, **32.** (2) 523.)

Cæsium titanium sulphate, $Cs_2SO_4,Ti_2(SO_4)_3+24H_2O$.

Deliquesces in the air and is decomp.

Sl. sol. in cold H_2O; decomp. by hot H_2O. (Piccini, Gazz. ch. it. 1895, **25.** 542.)

Sl. sol. in cold H_2O, more sol. in hot H_2O acidified with H_2SO_4.

Decomp. in neutral aq. solution. (Piccini, Z. anorg. 1898, **17.** 356.)

Cæsium uranyl sulphate, $Cs_2(UO_2)(SO_4)_2+2H_2O$.

As Na salt. (de Coninck, C. C. **1905,** I. 1306.)

Cæsium vanadium sulphate, $Cs_2V_2(SO_4)_4+24H_2O$.

7.71 g. anhydrous (13.1 g. hydrated) salt, or 0.0204 gr. mols. of the anhydrous salt are sol. in 1 l. H_2O at 25°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Sl. sol. in cold, easily sol. in hot H_2O. (Piccini, Z. anorg. 1896, **11.** 114.)

100 pts. H_2O dissolve 0.464 pts. of the salt at 10° and sp. gr. of the solution at 4°/20° = 2.033. More sol. in hot H_2O than in cold. (Piccini, Z. anorg. 1897, **13.** 446.)

Cæsium zinc sulphate, Cs_2SO_4, $ZnSO_4+6H_2O$.

Sol. in H_2O. (Bunsen and Kopp, Pogg. **113.** 337.)

1 l. H_2O dissolves 386.3 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cæsium zirconium sulphate, $Zr_2O_3,(CsSO_4)_2+11H_2O$.

Ppt. (Rosenheim, B. 1905, **38.** 815.)

Calcium sulphate, $CaSO_4$, **and** $+2H_2O$.

The older determinations of the solubility of $CaSO_4$ in H_2O have little, but historical, value, as the solutions were usually either non-saturated or supersaturated. They may be tabulated as follows.

A = pts. H_2O required for dissolving 1 pt. $CaSO_4$, and B for 1 pt. $CaSO_4+2H_2O$ at t°.

t°	A	B	Authority
Hot or cold	500	. .	Fourcroy
Cold	500	. . .	Bergmann
Boiling	450	. . .	"
All temp.	322	. . .	Lassaigne
(?)	438	. . .	Anthon
(?)	250–300	. . .	Dumas
Hot or cold	578.5	461.5	Bucholz
Cold	480	380	Giese
Hot	491	388	"
15–20°	492	388	Tipp
12.5°	503	397	Lecoq

100 pts. H_2O at t° dissolve pts. $CaSO_4$

t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$
0	0.205	35	0.254	70	0.241
5	0.219	40	0.252	80	0.239
12	0.233	50	0.251	90	0.231
20	0.241	60	0.248	100	0.217
30	0.249	.	. . .	. . .	. .

(Poggiale, A. ch. (3) **8.** 469.)

Poggiale worked with supersat. solutions. (Droeze, B. **10.** 330.)

H_2O dissolves $CaSO_4$ most abundantly at 35° (Poggiale); at 32-41° (Marignac).

1 pt. $CaSO_4+2H_2O$ dissolves at:

0°	18°	24°	32°	38°
in 415	385	378	371	368 pts. H_2O,
41°	53°	72°	86°	99°
in 370	375	391	417	451 pts. H_2O,

or (by calculation) 1 pt. anhydrous $CaSO_4$ dissolves at:

0°	18°	24°	32°	38°
in 525	488	479	470	466 pts. H_2O,
41°	53°	72°	86°	99°
in 468	474	495	528	571 pts. H_2O.

The above nonsat. solutions are obtained by using a large excess of $CaSO_4+2H_2O$. The undissolved part retains its water of crystallisation. $CaSO_4$, dehydrated at 130–140°, forms a supersaturated solution with H_2O in 10 minutes, containing 1 pt. $CaSO_4$ to 110 pts. H_2O, which soon deposits crystals. The undissolved part takes up its water of crystallisation. Ignited $CaSO_4$ dissolves very slowly in H_2O, so that in 24 hours the solution contains $^1/_{583}$ to $^1/_{598}$ anhydrous $CaSO_4$. By longer contact solution continues with formation of supersaturated solutions, which contain after 10–30 days $^1/_{372}$ to $^1/_{328}$ $CaSO_4$, but these become normal as the anhydrous $CaSO_4$ gradually takes up its water of crystallisation. The mineral anhydrite behaves similarly, water taking up $^1/_{582}$ $CaSO_4$ in 1 day, $^1/_{351}$ in 40 days, and $^1/_{457}$ in 8 months.

Supersaturated solutions are also obtained by evaporation of a saturated solution. By evaporation with heat, solutions are obtained containing $^1/_{306}$ $CaSO_4$, and in the cold with $^1/_{172}$ $CaSO_4$, in the solution over the separated $CaSO_4+2H_2O$. Neutralising dil. H_2SO_4+Aq with $CaCO_3$ gives a solution containing $^1/_{114}$ $CaSO_4$, which crystallises out partly in 24 hours, leaving $^1/_{313}$ $CaSO_4$ dissolved.

Supersaturated solutions containing $^1/_{110}$ to $^1/_{150}$ $CaSO_4$ deposit crystals rapidly; those under $^1/_{350}$ do not crystallise spontaneously. A solution containing $^1/_{288}$ shows crystals in 14 days, and contains $^1/_{312}$ in 1 month, $^1/_{414}$ in 2 months, $^1/_{446}$ in 3 months, in spite of repeated shaking.

Boiling diminishes the supersaturation without however removing it entirely. (Marignac, A. ch. (5) **1.** 274.)

1 pt. $CaSO_4+2H_2O$ is sol. in 443 pts. H_2O at 13.7°; in 447 pts. H_2O at 14.2°; in 421 pts. H_2O at 20.2°; in 419 pts. H_2O at 21.2°; and in 445 pts. H_2CO_3+Aq sat. at 18.7°. (Church, J. B. 1867. 192.)

Church's solutions were not sat. (Droeze, B. **10.** 330.)

1000 pts. H_2O dissolve 2.19 pts. $CaSO_4$+$2H_2O$ at 16.5°; 2.352 pts. $CaSO_4+2H_2O$ at 22°. (Cossa, Gazz. ch. it. **1873.** 135.)

Cossa's solutions were not saturated. (Droeze.)

$CaSO_4+2H_2O$ is sol. in 415 pts. H_2O at 0°; in 412 pts. H_2O at 5°; in 407 pts. H_2O at 10°; in 398 pts. H_2O at 15°; in 371 pts. H_2O at 20°; in 365 pts. H_2O at 25°; in 361 pts. H_2O at 30°; in 359 pts. H_2O at 35°. (Droeze, B. **10.** 330.)

Sol. in 500 pts. H_2O at 12.5°. (From Marignac's and his own results, de Boisbaudran, A. ch. (5) 3. 477.)

$CaSO_4$ is sol. in 564.5 pts. H_2O at 0.8°; 506.27 pts. at 14°; 472–3 pts. at 32.5–38.8°; 498.73 pts. at 64°; 533.92 pts. at 79.6°. (Raupenstrauch, M. **6.** 563.)

According to Goldammer (C. C. **1888.** 708) H_2O is fully saturated with $CaSO_4$ by shaking the finely-powdered substance 5 minutes therewith.

The following results were obtained. Figures denote pts. H_2O in which 1 pt. $CaSO_4$ was dissolved at t° (a) from pptd. $CaSO_4$ "ipse fact.," (b) from pptd. $CaSO_4$ "gehe," (c) from "glacies mariae pulv.," (d) from "glacies Mariae pulv.," containing less than $2H_2O$.

t°	a	b	c	t°	d
0	561.5	558	557.5	0	476.5
7.5	526	526	520	. . .	. . .
15	497.5	497.5	493	20	436
22.5	481	481.5	479	. . .	. . .
30	475	475	470	. . .	. . .
37.5	463	469	465.5	40	450
45	473.5	474.5	470.5	. . .	. . .
60	484	486.5	482	60	476
75	507.5	508	503	80	502.5
90	533.5	530	534	. . .	. . .
100	556	557	534.5	100	547

Burnt gypsum easily forms supersat. solutions containing nearly 1% CaSO. It forms supersat. solutions more readily at 0°, and that tendency decreases with increase of temp., hence figures in (d) which contained burnt gypsum. (Goldammer, C. C. **1888.** 708.)

Calculated from electrical conductivity of $CaSO_4$+Aq, 1 l. H_2O dissolves 2.07 g. $CaSO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

The anhydrous salt varies in solubility. Solubility depends (1) upon temp. and time of drying, (2) upon the relative amount of salt, (3) upon time of shaking. Possibly α and β modifications. (Potilizin, C. C. **1894,** II. 515.)

2.04 gr. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

At 15° and after 5 minutes shaking, the highest degree of supersaturation which can be obtained with pure sol. calcium sulphate = 9.47 g. of the anhydrous salt or 11.976 g. $CaSO_4+2H_2O$ in 1 l. of H_2O. (Cavazzi, C. C. **1905,** I. 1694.)

Solubility of $CaSO_4$ in 100 pts. H_2O at high temp.

t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$	t°	Pts. $CaSO_4$
140	0.078	175–185	0.027	250	0.016
165	0.056	240	0.018	...	

(Tilden and Shenstone, Phil. Trans. **1884.** 31.)

Pptn. of $CaSO_4$ which has been started by heating solution to 140–150° continues even after solution has cooled. (Storer.)

$CaSO_4$ is completely insol. in sea water or pure H_2O at temperatures between 140° and 150.° (Cousté.)

Solubility of $CaSO_4$ in sea water at temperatures over 100°. t° = temp.; P = pressure in atmospheres; % = per cent $CaSO_4$ in sat. solution.

t°	P	%	t°	P	%
103	1	0.500	118.5	1.50	0.226
103.8	1	0.477	121.2	1.5	0.183
105.15	1	0.432	124	2	0.140
108.6	1.25	0.395	127.9	2	0.097
111	1.25	0.355	130 °	2.5	0.060
113.2	1.25	0.310	133.3	2.5	0.023
115.8	1.50	0.267	...	...	...

(Cousté, Ann. Min. (5) **5.** 80.)

Solubility of $CaSO_4$ in H_2O at various pressures.

100 g. sat. $CaSO_4$+Aq at 1 atmos. pressure and 15° contain 0.206 g. $CaSO_4$; at 20 atmos. pressure and 15° contain 0.227 g. $CaSO_4$; at 1 atmos. pressure and 16.2° contain 0.213 g. $CaSO_4$. (Möller, Pogg. **117.** 386.)

Soluble anhydrite:

1 l. H_2O dissolves 22.8 milliequivalents at 100°.

1 l. H_2O dissolves 6.4 milliequivalents at 156.°

Anhydrite:

1 l. H_2O dissolves 9.2 milliequivalents at 100°.

1 l. H_2O dissolves 2.7 milliequivalents at 156°.

1 l. H_2O dissolves 0.7 milliequivalents at 218°.

(Melcher, J. Am. Chem. Soc. 1910, **32.** 63.)

See also under gypsum, p. 953.

Maximum solubility is at 37.5°. (Cameron, J. phys. Chem. 1901, **5.** 572.)

Sp. gr. of sat. $CaSO_4$+Aq at 15° = 1.0022. (Stolba, J. pr. **97.** 503.)

Sp. gr. of sat. $CaSO_4$+Aq. at 31° = 1.0031.

1 pt. $CaSO_4$ is sol. in 218 pts. H_2O containing CO_2. (Beyer, Arch. Pharm. (2) **150.** 193.)

Sl. sol. in cold HCl+Aq; completely sol. in boiling dil. HCl or HNO_3+Aq. (Rose, Pogg. **95.** 108.)

Solubility of $CaSO_4$ in HCl+Aq.

t°	% HCl	100 ccm. dissolve g. of $CaSO_4$	t°	% HCl	100 ccm. dissolve g. of $CaSO_4$
25	0.77	0.6405	25	6.12	1.6539
25	1.56	0.8821	101	0.77	1.1209
25	3.06	1.2639	102	3.06	3.1780
25	4.70	1.5342	103	6.12	4.6902

(Lunge, J. Soc. Chem. Ind. **4.** 31.)

Solubility in HNO_3+Aq at 25°.

g. HNO_3 per 100 cc.	g. $CaSO_4$ per 100 cc. solution	g. HNO_3 per 100 cc.	g. $CaSO_4$ per 100 cc. solution
0	0.208	6	1.48
1	0.56	8	1.70
2	0.82	10	1.84
3	1.02	12	1.98
4	1.20		

(Banthisch, J. pr. 1884, **29.** 52.)

For solubility in H_2SO_4 see $CaH_2(SO_4)_2$.

Solubility in H_3PO_4+Aq at 25°.

G. P_2O_5 per l.	G. $CaSO_4$ per l.	Sp. gr. 25°/25°
0.0	2.126	...
5.0	3.138	1.002
10.5	3.734	1.007
21.4	4.456	1.016
46.3	5.760	1.035
105.3	7.318	1.075
145.1	7.920	1.106
204.9	8.383	1.145
312.0	7.965	1.221
395.7	6.848	1.230
494.6	5.573	1.344

(Taber, J. phys. Chem. 1906, **10.** 628.)

Solubility in formic acid at 25°.

100 cc. of solution of acid containing 4%

dissolve 0.24 g. $CaSO_4$. (Banthisch, J. pr. 1884, **29.** 52.)

Solubility of $CaSO_4$ in chloracetic acid at 25°. 100 cc. of solution of acid containing 4% dissolve 0.22 g. $CaSO_4$; 10%, 0.27 g. (Banthisch, J. pr. 1884, **29.** 52.)

Solubility in H_2O is increased by presence of NH_4Cl (Vogel, J. pr. **1.** 196), ammonium succinate (Wittstein, Repert. **57.** 18), $(NH_4)_2SO_4$, $(NH_4)_2B_4O_7$ (Popp, A. Suppl. **8.** 11); also KNO_3 (Vogel, Jun.), Na_2SO_4 (Henry, J. Pharm. **12.** 31), NaCl (Trommsdorf, N. J. Pharm. **18, 1.** 234.)

Decomp. by alkali carbonates +Aq. (*See* Storer's Dict.)

1 g. $CaSO_4$ is sol. in 162 ccm. sat. KCl+Aq at 8°; in 147 ccm. sat. NaCl+Aq at 8.5°; in 93 ccm. sat. NH_4Cl+Aq at 12.5°; in 94 ccm. sat. KNO_3+Aq; in 92 ccm. sat. $NaNO_3$+Aq; in 320 ccm. sat. NH_4NO_3+Aq; in 54 ccm. $^2/_9$ sat. NH_4NO_3+Aq; in about 2000 ccm. sat. K_2SO_4+Aq. (Droeze.)

More sol. in Fe_2Cl_6, Cr_2Cl_6, $CuCl_2$, $ZnCl_2$+Aq than in H_2O, but not more sol. in $CaCl_2$+Aq. (Gladstone.)

NH_4Cl+Aq.

1 g. $CaSO_4$ is sol. in 92 ccm. sat. NH_4Cl+Aq at 13.5°; in 94 ccm. $^1/_2$ sat. NH_4Cl+Aq at 13.5–15.5°; in 200 ccm. $^1/_8$ sat. NH_4Cl+Aq at 13.5°; in 183 ccm. $^1/_8$ sat. NH_4Cl+Aq at 100°. (Fassbender, B. **9.** 1360.)

Solubility of $CaSO_4$ in 25% NH_4Cl+Aq.

t°	% $CaSO_4$	t°	% $CaSO_4$
8	1.030	60	1.333
9	1.023	80	1.026
25	1.096	120	1.000
39	1.126	..	...

(Tilden and Shenstone, Roy. Soc. Proc. **38.** 335.)

Solubility in NH_4Cl+Aq increases with percentage of NH_4Cl, but if solution contains more than 60 g. NH_4Cl per l. more CaO dissolves than SO_3. With 333 g. NH_4Cl per l., the solution contains 4.9 g. SO_3 and 4.4 g. CaO, while the SO_3 content requires only 3.4 g. CaO. (Ditte, C. R. 1898, **126.** 694.)

Solubility of $CaSO_4$ in NH_4Cl+Aq at 25°.

Grams NH_4Cl per liter	Grams $CaSO_4$ per liter
10.8	3.90
24.4	5.38
46.7	7.07
94.5	8.80
149.7	10.30
198.6	10.85
210.0	10.88
275.0	10.60
325.0	9.40
375.3 (saturated)	7.38

(Cameron and Brown, J. phys. Chem. 1905, **9.** 211.)

$CaCl_2$+Aq.

Solubility of $CaSO_4$ in $CaCl_2$+Aq at t°.

t°	% $CaCl_2$	100 ccm. dissolve g. of $CaSO_4$	t°	% $CaCl_2$	100 ccm. dissolve g. of $CaSO_4$
23	3.54	0.1225	25	16.91	0.0702
24	6.91	0.0963	101.0	3.54	0.1370
25	10.36	0.0886	102.5	10.36	0.1426
25	15.90	0.0734	103.5	16.91	0.1301

(Lunge, *l. c.*)

Solubility of $CaSO_4$ in H_2O containing various amts. of $CaCl_2$ at 20°. 100 pts. H_2O containing pts. $CaCl_2$ dissolve pts. $CaSO_4$.

Pts $CaCl_2$	Pts. $CaSO_4$	Pts. $CaCl_2$	Pts. $CaSO_4$
0.00	0.225	19.80	0.041
11.50	0.078	51.00	0.000
14.39	0.063	67.05	0.000

(Tilden and Shenstone.)

Solubility of $CaSO_4$ in $CaCl_2$+Aq at t°.

t°	% $CaCl_2$	% $CaSO_4$	t°	% $CaCl_2$	% $CaSO_4$
15	15.00	0.063	94	15.16	0.110
21	14.70	0.068	138	14.70	0.071
39	15.00	0.091	170	14.82	0.031
72	14.90	0.100	195	14.70	0.022

(Tilden and Shenstone, *l. c.*)

Solubility in $CaCl_2$+Aq at 25°.

g. per l. of solution		g. per l. of solution	
$CaCl_2$	$CaSO_4$	$CaCl_2$	$CaSO_4$
0.00	2.06	51.53	1.02
7.49	1.24	97.02	0.84
11.96	1.18	192.71	0.47
25.77	1.10	280.30	0.20
32.05	1.08	367.85	0.03

(Cameron and Seidell, J. phys. Ch. 1901, **5.** 643.)

1000 pts. of 1% $CaCl_2$+Aq. dissolve 1.1414 pts. $CaSO_4$; 40% $CaCl_2$, 0.2130 pts. $CaSO_4$. (Orloff, Chem. Soc. 1903, 84, (2) 211.)

Solubility in CaO_2H_2+Aq at 25°.

G. $CaSO_4$ per l.	G. CaO per l.	Solid phase
0.0	1.166	$Ca(OH)_2$
0.391	1.141	"
0.666	1.150	"
0.955	1.215	"
1.214	1.242	"
1.588	1.222	$Ca(OH)_2$ and $CaSO_4$, $2H_2O$
1.634	0.939	$CaSO_4$, $2H_2O$
1.722	0.611	"
1.853	0.349	"
1.918	0.176	"
2.030	0.062	"
2.126	0.0	"

(Cameron and Bell, J. Am. Chem. Soc. 1906, **28.** 1221.)

$MgCl_2$+Aq.
Sol. in 324 pts. $MgCl_2$+Aq (34.1% $MgCl_2$) at 19°. (Karsten.)
1 g. $CaSO_4$ is sol. in 146 ccm. $^1/_9$ sat. $MgCl_2$ +Aq at 13.5°. (Fassbender.)
1 l. $^1/_9$ sat. $MgCl_2$+Aq dissolves 6.83 g. $CaSO_4+2H_2O$ at 13.5°. (Droeze.)

Solubility of $CaSO_4$ in $MgCl_2$+Aq.

t°	% $MgCl_2$	% $CaSO_4$
9	19.7	0.765
39	11.1	2.744
80	9.99	1.038

(Tilden and Shenstone, *l. c.*)

Solubility in $MgCl_2$+Aq at 26°.

g. per l. of solution			g. per l. of solution		
$MgCl_2$	$CaSO_4$	H_2O	$MgCl_2$	$CaSO_4$	H_2O
0.0	2.08	997.9	121.38	8.62	972.2
8.50	4.26	996.5	206.98	6.57	949.9
19.18	5.69	994.5	337.0	2.77	908.7
46.64	7.59	989.1	441.0	1.39	878.6

(Cameron and Seidell, J. phys. Ch. 1901, **5.** 645.)

1 l. sat. $MgCl_2$+Aq at 25° containing 476.5 g. $MgCl_2$ dissolves 1.09 g. $CaSO_4$. (Cameron and Brown, J. phys. Ch. 1905, **9.** 214.)
NH_4NO_3+Aq.
1 g. $CaSO_4$ is sol. in 320 ccm. sat. NH_4NO_3 +Aq at 8–9°; in 54 ccm. $^2/_9$ sat. NH_4NO_3+ Aq at 13.5°; in 103 ccm. $^2/_{27}$ sat. NH_4NO_3+Aq at 13.5°. (Fassbender.)

Solubility of $CaSO_4$ in NH_4NO_3+Aq at 25°.

G. NH_4NO_3 per l.	G. $CaSO_4$ per l.
10	3.18
25	3.93
55	5.80
100	7.65
150	8.88
200	9.85
300	10.80
400	11.40
550	12.02
750	12.20
1000	11.81
1200	11.10
1400	10.02
saturated	7.55

(Cameron and Brown, J. phys. Chem. 1905, **9.** 213.)

$Ca(NO_3)_2$+Aq.
Solubility of $CaSO_4$ in $Ca(NO_3)_2$+Aq at 25°.

Weight of 1000 cc. of solution	G. $Ca(NO_3)_2$ per l.	G. $CaSO_4$ per l.
998.1	0	2.084
1013.8	25	1.238
1031.7	50	1.196
1067.3	100	1.134
1136.9	200	0.929
1203.5	300	0.759
1265.6	400	0.569
1328.1	500	0.403
1352.0	544	0.346

(Seidell and Smith, J. phys. Chem. 1904, **8.** 498.)

$Mg(NO_3)_2$+Aq.
Solubility of $CaSO_4$ in $Mg(NO_3)_2$+Aq at 25°.

Weight of 1000 cc. of solution grams	G. $Mg(NO_3)_2$ per l.	G. $CaSO_4$ per l.
998.1	0	2.084
1020.5	25	5.772
1039.8	50	7.884
1078.6	100	9.920
1149.8	200	13.340
1219.0	300	14.000
1282.1	400	14.683
1355.3	514	15.040

(Seidell and Smith, J. phys. Chem. 1904, **8.** 497.)

1 l. sat. $Mg(NO_3)_2$+Aq at 25° containing 615.1 g. $Mg(NO_3)_2$ dissolves 15.26 g. $CaSO_4$. (Cameron and Brown, J. phys. Ch. 1905, **9.** 214.)

KNO_3+Aq.

1 g. $CaSO_4$ is sol. in 94 ccm. sat. KNO_3+Aq at 13.5°; in 82 ccm. sat. KNO_3+Aq at 15.5°; in 68 ccm. nearly sat. KNO_3+Aq at 20°. (Fassbender.)

Solubility in KNO_3+Aq at 25°.

Wt. of 1000 ccm. of solution grams	G. KNO_3 per l.	G. $CaSO_4$ per l.
998.1	0.0	2.084
1008.1	12.5	3.284
1015.4	25.0	4.080
1032.1	50.0	5.255
1062.5	100.0	6.855
1092.4	150.0	7.907
1122.4	200.0	8.688
1153.9	260.0	a { 6.278 12.112

a Probably due to formation of double salt of calcium and potassium sulphates, $CaK_2(SO_4)_2+H_2O$.

(Seidell and Smith, J. phys. Chem. 1908, **8.** 496.)

$NaNO_3$+Aq.

1 g. $CaSO_4$ is sol. in 92 ccm. sat. $NaNO_3$+Aq at 8.5°; in 318 ccm. $^1/_8$ sat. $NaNO_3$+Aq at 13.5°. (Fassbender.)

100 ccm. sat. $NaNO_3$+Aq dissolve 1.086 g. $CaSO_4+2H_2O$; 100 ccm. $^1/_8$ sat. $NaNO_3$+Aq dissolve 0.314 g. $CaSO_4+2H_2O$. (Droeze, B. **10.** 338.)

Solubility in $NaNO_3$+Aq at 25°.

Wt. of 1000 ccm. of solution grams	G. $NaNO_3$ per l.	G. $CaSO_4$ per l.
998.1	0	2.084
1016.3	25	4.252
1034.0	50	5.500
1058.4	100	7.100
1133.6	200	8.790
1191.6	300	9.282
1363.9	600	7.886
1390.4	655	7.238

(Seidell and Smith, J. phys. Chem. 1904, **8.** 495.)

1 l. sat. $NaNO_3$+Aq at 25°, containing 668.4 g. $NaNO_3$, dissolves 5.52 g. $CaSO_4$. (Cameron and Brown, J. phys. Ch. 1905, **9.** 214.)

Solubility in KBr+Aq at 21°.

G. KBr per l.	G. $CaSO_4$ per l.	G. KBr per l.	G. $CaSO_4$ per l.
0	2.05	100	6.3
10	3.1	125	6.7
20	3.6	150	7.0
40	4.5	200	7.3
60	5.2	250	Double salt.
80	5.9		

(Ditte, A. ch. 1898, (7) **14.** 294.)

KCl+Aq.

1 g. $CaSO_4$ is sol. in 162 ccm. sat. KCl+Aq at 8°; in 295 ccm. $^1/_5$ sat. KCl+Aq at 9°.

Solubility in KCl+Aq at 21°.

g. per l.		g. per l.	
KCl	$CaSO_4$	KCl	$CaSO_4$
0	2.05	60	6.6
10	3.6	80	7.2
20	4.5	100	7.5
40	5.8	125	Double Salt

(Ditte, A. ch. 1898, (7) **14.** 294.

Solubility in KI+Aq at 21°.

G. KI per l.	G. $CaSO_4$ per l.	G. KI per l.	G. $CaSO_4$ per l.
0	2.05	100	5.1
10	2.8	125	5.45
20	3.2	150	5.8
40	3.9	200	5.95
60	4.5	250	6.00
80	4.85	300	Double salt.

(Ditte, *l. c.*)

NaCl+Aq.

Sol. in 122 pts. sat. NaCl+Aq. (Anthon.)

Insol. in sat. NaCl+Aq, but more sol. in dil. NaCl+Aq than in H_2O. Maximum solubility in NaCl+Aq is when the sp. gr. is 1.033.

1 g. $CaSO_4$ is sol. in 147 ccm. of sat. NaCl+Aq at 8.5°; in 150 ccm. of sat. NaCl+Aq at 13.5°; in 149 ccm. of $^1/_3$ sat. NaCl+Aq at 13.5°; in 244 ccm. of $^1/_5$ sat. NaCl+Aq at 13.5°. (Fassbender.)

100 ccm. sat. NaCl+Aq dissolve 0.6785 g. $CaSO_4+2H_2O$ at 8.5°; 0.6665 g. $CaSO_4+2H_2O$ at 13.5°. 100 ccm. $^1/_8$ sat. NaCl+Aq dissolve 0.671 g. $CaSO_4+2H_2O$ at 13.5°; $^1/_6$ sat. NaCl+Aq dissolve 0.4085 g. $CaSO_4+2H_2O$ at 13.5°. (Droeze.)

Solubility of $CaSO_4$ in NaCl+Aq at t°.

t°	% NaCl	% $CaSO_4$	t°	% NaCl	% $CaSO_4$
20	19.90	0.823	130	19.92	0.392
44	19.93	0.830	165	20.04	0.250
67	19.95	0.832	169	20.05	0.244
85	19.90	0.823	179	20.10	0.229
101	20.08	0.682	225	21.00	0.178

(Tilden and Shenstone, Roy. Soc. Proc. **38.** 331.)

Solubility of $CaSO_4$ in NaCl+Aq at t°.

t°	% NaCl	100 ccm. dissolve g. of $CaSO_4$	t°	% NaCl	100 ccm. dissolve g. of $CaSO_4$
21.5	3.53	0.5115	17.5	17.46	0.7369
19.5	7.35	0.6429	101.0	3.53	0.4891
21	11.12	0.7215	102.5	14.18	0.6248
18	14.18	0.7340	103	17.46	0.6299

(Lunge, J. Soc. Chem. Ind. **4.** 31.)

100 pts. H_2O containing pts. NaCl dissolve pts. $CaSO_4$ at 20°.

Pts. NaCl	Pts. $CaSO_4$	Pts. NaCl	Pts. $CaSO_4$	Pts. NaCl	Pts. $CaSO_4$
0.00	0.225	5.05	6.34	24.40	0.820
0.52	0.301	10.00	7.38	35.10	0.734
2.03	0.441	20.00	0.823	35.86	0.709
5.02	6.15	...	...	...	...

(Tilden and Shenstone.)

Solubility in NaCl+Aq at 26°.

g. per l.		wt. of 1 cc. solution	g. per l.		wt. of 1 cc. solution
NaCl	$CaSO_4$		NaCl	$CaSO_4$	
0.00	2.12	0.9998	176.50	7.12	1.1196
9.11	6.66	1.0644	228.76	6.79	1.1488
143.99	7.18	1.0981	264.17	6.50	1.1707
148.34	7.16	1.012	320.49	5.72	1.2034

(Cameron, J. phys. Ch. 1901, **5.** 556.)

Solubility in NaCl+Aq at 15°.

G. $CaSO_4$ per l.	G. NaCl per l.
2.3	0.6
2.5	1.1
3.1	5.1
3.7	10.6
4.8	31.1
5.6	51.4
7.4	139.9

(Cameron, J. phys. Ch. 1901, **5.** 559.)

Solubility in NaCl+Aq at 26°.

NaCl in 100 g. H_2O	$CaSO_4$ in 100 g. H_2O
0.0000	0.2126
9.4307	0.6886
15.2056	0.7581
15.6859	0.7575
18.8570	0.7605
25.0478	0.7439
29.3509	0.7219
36.5343	0.6515

(Cameron, J. phys. Ch. 1901, **5.** 564.)

Solubility in NaCl+Aq.

30°		52°		70°		82°	
G. NaCl per l.	G. $CaSO_4$ per l.	G. NaCl per l.	G. $CaSO_4$ per l.	G. NaCl per l.	G. $CaSO_4$ per l.	G. NaCl per l.	G. $CaSO_4$ per l.
0.5	2.5	0.5	2.3	0.5	2.2	0.0	2.07
10.3	3.6	1.1	2.4	10.0	3.4	1.0	2.18
30.3	5.0	5.0	2.9	29.6	4.9	5.0	2.65
47.3	6.1	10.1	3.5	48.8	5.8	10.1	3.30
73.4	6.9	29.6	5.0	132.7	7.4	29.5	4.68
126.9	7.3	48.3	5.8	195.0	7.6	48.8	5.54
192.4	7.7	75.7	6.6	...	...	74.9	6.23
...	...	131.6	7.1	...	...	128.7	7.00
...	...	195.9	7.4	...	...	195.1	7.15

(Cameron, J. phys. Ch. 1901, **5.** 562.)

1 l. sat. NaCl+Aq at 25° containing 318.3 g. NaCl dissolves 5.52 g. $CaSO_4$. (Cameron and Brown, J. phys. Ch. 1905, **9.** 214.)

Solubility in NaCl+Aq.

G. NaCl per l. of NaCl+Aq	G. anhydrous $CaSO_4$ dissolved per litre	
	at 14°	at 20°
0.0	1.70	2.10
2.925	2.32	2.70
5.850	2.79	3.15
11.70	3.41	3.75
14.62	3.68	4.00
29.25	4.40	4.70
58.50	5.72	6.00
87.75	6.58	6.85
102.3	6.90	7.15
117.0	7.10	7.30
131.6	7.20	7.30
146.2	7.10	7.13
160.8	7.00	7.05
175.6	6.80	6.80
204.7	6.30	6.30
234.0	5.90	5.90
263.2	5.50	5.52
292.6	5.30	5.30

(d'Anselme, Bull. Soc. 1903, (3) **29.** 373.)

Solubility in NaCl+Aq.

G. NaCl in 100 cc. solution	G. $CaSO_4+2H_2O$
0.00	0.200 g.
2.44 g.	0.635 g.
4.77 g.	0.826 g.
9.50 g.	1.056 g.
14.22 g.	1.193 g.
23.15 g.	1.275 g.
31.30 g.	1.583 g.

(Cloez, Bull. Soc. 1903, (3) **29.** 167.)

Solubility in NaCl+Aq at t°.

When a sat. solution of NaCl is shaken with a mixture of solid NaCl and $CaSO_4$+$2H_2O$, the calcium sulphate dissolved, calculated from the amount of CaO in solution, is always greater than that calculated from the sulphuric acid in solution. Similar results are obtained when solid calcium sulphate alone is shaken with a sat. solution of NaCl.

t°	In 100 g. of the solution		
	Cl	$CaSO_4$ calc. from CaO	$CaSO_4$ calc. from SO_3
0	15.253	0.4464	0.4334
10	15.920	0.4477	0.4426
25	15.967	0.4609	0.4542
40	16.123	0.4938	0.4730
50	16.270	0.5093	0.4832
60	16.324	0.5305	0.5047
62.5	16.361	..	0.5091
65	16.459	0.5435	0.3749
71	16.486	0.5578	0.3631
75	16.524	0.5603	0.3587
85	16.670	0.5399	0.3519
99	17.128	0.4066	0.3414

(Arth, Bull. Soc. 1906, (3) **35.** 780.)

Within a temp. range from 25°–80° $CaSO_4$ $CaSO_4$ forms no double salt in solutions of NaCl. At any concentration with respect to the latter maximum solubility occurs with 155 g. NaCl per l. and amounts to 7.3 g. $CaSO_4$ at 80°. (Cameron, J. phys. Chem. 1907, **11.** 496.)

See also under Gypsum, p. 653.

Solubility of $CaSO_4$ in NaCl+Aq in contact with solid $Ca(HCO_3)_2$.

G. $CaSO_4$ per l.	G. $Ca(HCO_3)_2$ per l.	G. NaCl per l.
1.9298	0.0603	0.000
2.7200	0.0724	3.628
3.4460	0.0885	11.490
5.1560	0.1006	39.620
6.4240	0.0603	79.520
5.2720	0.0563	121.900
4.7860	0.0482	193.800
4.4620	0.0402	267.600

(Cameron and Seidell, J. phys. Chem. 1901, **5.** 653.)

$(NH_4)_2SO_4$+Aq.

Sol. in 287 pts. $(NH_4)_2SO_4$+Aq (1:4). (Fresenius, Z. anal. 30. 593.)

1 g. $CaSO_4$ is sol. in 327 ccm. $(NH_4)_2SO_4$+Aq at 9°; in 369 ccm. $^1/_7$ sat. $(NH_4)_2SO_4$+Aq at 13.5°. (Fassbender.)

Solubility in sat. $(NH_4)_2SO_4$, or Na_2SO_4 is the same as in H_2O. (Droeze, B. 10. 330.)

Solubility in $(NH_4)_2SO_4$+Aq at 25°.

g. per l. solution		wt. of 100 cc. solution	g. per l.		wt. of 100 cc. solution
$(NH_4)_2SO_4$	$CaSO_4$		$(NH_4)_2SO_4$	$CaSO_4$	
0.00	0.208	99.91	6.575	0.144	100.36
0.129	0.204	99.91	13.15	0.146	100.82
0.258	0.199	99.92	26.30	0.162	101.76
0.821	0.181	99.95	84.9	0.233	105.34
1.643	0.166	99.99	169.8	0.333	110.32
3.287	0.154	100.10	339.6	0.450	119.15

(Sullivan, J. Am. Chem. Soc. 1905, **27.** 529.)

Solubility in $(NH_4)_2SO_4$+Aq at 50°.

Sp. gr.	g. $(NH_4)_2SO_4$ per l.	g. $CaSO_4$ per l.	Solid phase
..	0	2.168	$CaSO_4+2H_2O$
1.0026	15.65	1.609	
1.0113	30.67	1.750	
1.0440	91.6	2.542	
1.0819	160.4	3.402	
1.1108	221.6	4.068	
1.1385	280.6	4.690	
1.1653	340.6	5.084	
1.1972	415.6	5.336	
1.1964	416.5	5.354	$CaSO_4$, $(NH_4)_2SO_4$+$2H_2O$
1.2043	428.4	4.632	
1.2187	479.4	3.524	
1.2437	530.8	2.152	
1.2480	558.0	1.986	
1.2502	564.7	1.98	$(NH_4)_2SO_4$
1.2508	566.0	1.08	
1.2510	566.7	0	

(Bell and Taber, J. phys. Chem. 1906, **10.** 120.)

Solubility of $CaSO_4$ in $(NH_4)_2SO_4$+Aq at t°.

Excess of $(NH_4)_2SO_4$			Excess of $CaSO_4$		
t°	% $CaSO_4$	% $(NH_4)_2SO_4$	t°	% $CaSO_4$	% $(NH_4)_2SO_4$
6	0.1529	41.82	3	0.3782	36.62
40.5	0.1569	44.55	31	0.4070	35.50
58	0.1662	46.07	60	0.5083	34.97
78	0.1968	47.51	75	0.5898	34.86
100	0.2546	49.45	80	0.6108	34.88
			84	0.5725	32.40
			100	0.4895	25.97

(Barre, C. R. 1909, **148.** 1605.)

The solubility of $CaSO_4$ in H_2O is considerably increased by the presence of $(NH_4)_2SO_4$

but decreased by the presence of K_2SO_4. (Barre, C. R. 1909, **148.** 1606.)

$CuSO_4$+Aq.

Solubility in $CuSO_4$+Aq at 25°.

Sp. gr. of the solution 25°/25°	g. $CuSO_4$ per l.	g. $CaSO_4$ per l.
1.002	1.144	2.068
1.005	3.564	1.986
1.007	6.048	1.944
1.009	7.279	1.858
1.016	14.814	1.760
1.021	19.729	1.736
1.030	29.543	1.688
1.041	39.407	1.718
1.051	49.382	1.744
1.061	58.880	1.782
1.098	97.950	1.931
1.146	146.725	2.048
1.192	196.021	2.076
1.218	224.916	2.088

(Bell and Taber, J. phys. Ch. 1907, **11.** 637.)

$MgSO_4$+Aq.

Insol. in sat. $MgSO_4$+Aq.

1 g. $CaSO_4$ is sol. in 1162 ccm. $^1/_{10}$ sat. $MgSO_4$+Aq at 13.5°. (Fassbender, B. **9.** 1360.)

Sol. in 635 pts. sat. $MgSO_4$+Aq at 19°. (Karsten.)

Absolutely insol. in sat. $MgSO_4$+Aq, and pptd. from aqueous solution by the addition of $MgSO_4$. (Droeze, B. **10.** 340.)

1 l. $^1/_{10}$ sat. $MgSO_4$+Aq dissolves 0.86 g. $CaSO_4+2H_2O$. (Droeze.)

Solubility in $MgSO_4$+Aq at 25°.

g. per l.		Sp. gr. at 25°/25°	g. per l.		Sp. gr. at 25°/25°
$MgSO_4$	$CaSO_4$		$MgSO_4$	$CaSO_4$	
0.0	2.046	1.0032	149.67	1.597	1.1377
3.20	1.620	1.0055	165.7	1.549	1.1479
6.39	1.507	1.0090	171.2	1.474	1.1537
10.64	1.471	1.0118	198.8	1.422	1.1813
21.36	1.478	1.0226	232.1	1.254	1.2095
42.68	1.558	1.0419	265.6	1.070	1.2382
64.14	1.608	1.0626	298.0	1.860	1.2624
85.67	1.617	1.0833	330.6	0.647	1.2877
128.28	1.627	1.1190	355.0	0.501	1.3023

(Cameron and Bell, J. phys. Ch. 1906, **10.** 210.)

K_2SO_4+Aq.

1 g. $CaSO_4$ is sol. in 2325 ccm. sat. K_2SO_4+Aq. at 13.5°; in 664 ccm. $^1/_5$ sat. K_2SO_4+Aq at 13.5.°

Solubility in K_2SO_4+Aq at 25°.

g. per l.		wt. of 1 cc. of solution
K_2SO_4	$CaSO_4$	
0.0	2.08	0.9981
4.88	1.60	1.0036
5.09	1.56	1.0038
9.85	1.45	1.0075
19.57	1.49	0.151
28.35	1.55	1.0229
30.66	1.57	1.0236
32.47*	1.58	. . .

*Solid phase syngenite.

(Cameron and Breazeale, J.phys. Ch. 1904, **8.** 335.)

Solubility in K_2SO_4+Aq. at 25°.

In 1000 g. of the solution

mole K_2SO_4	mole $CaSO_4$
3.223	0.223

(D'Ans, Z. anorg. 1909, **62.** 151.)

Solubility of $CaSO_4$ in K_2SO_4+Aq at t°.

t°	Excess of K_2SO_4		Excess of $CaSO_4$	
	$CaSO_4$	K_2SO_4	$CaSO_4$	K_2SO_4
0	0.1296	2.00	0.0229	6.99
18	0.1531	2.79	0.0271	9.81
51	0.1754	4.21	0.0300	14.18
80	0.1922	5.00	0.0349	17.55
99	0.1980	5.39	0.0371	19.70

(Barre, C. R. 1909, **148.** 1606.)

Ag_2SO_4+Aq.

1 l. of the solution contains 2.31 g. $CaSO_4$ +7.23 g. Ag_2SO_4=9.54 g. mixed salts at 17°. Sp. gr.=1.0083.

1 l. of the solution contains 2.61 g. $CaSO_4$+8.11 g. Ag_2SO_4=10.72 g. mixed salts at 25°. Sp. gr.=1.010. (Euler, Z. phys. Ch. 1904, **49.** 313.)

Na_2SO_4+Aq.

1 g. $CaSO_4$ is sol. in 398 ccm. sat. Na_2SO_4+Aq at 10.5°.

Solubility of $CaSO_4$ in Na_2SO_4+Aq at 22°

G. $CaSO_4$ per l.	G. Na_2SO_4 per l.
2.084	0.000
1.583	2.771
1.433	13.820
1.408	16.360
1.569	39.310
1.841	77.320
2.185	133.00
2.414	193.800
*2.578	*222.580

*Both $CaSO_4$ and Na_2SO_4 as solid phases in contact with the solution.

(Cameron and Seidell, J. phys. Chem. 1901, **5.** 650.)

Solubility in Na_2SO_4+Aq at 25°.

wt. of 1000 ccm. of solution grams	g. Na_2SO_4 per l.	g. $CaSO_4$ per l.
1001.26	2.390	1.650
1007.59	9.535	1.457
1011.45	14.132	1.388
1020.46	24.369	1.471
1031.48	36.979	1.563
1039.12	46.150	1.650
1079.47	94.220	1.980
1096.47	115.084	2.096
1142.66	146.612	2.234
1176.47	205.105	2.503
1212.00	257.100	2.650

(Cameron and Breazeale, J. phys Chem. 1904, **8.** 340.)

1 l. sat. Na_2SO_4+Aq at 25° containing 254.09, Na_2SO_4 dissolves 2.58 g. $CaSO_4$.. (Cameron and Brown, J. phys. Ch. 1905, **9** 214.)

Hydration is retarded by dil. solutions and accelerated by conc. solution of sodium, potassium, ammonium and magnesium sulphates. (Rohland, Z. Elektrochem. 1908, **14.** 422.)

More than 10 times as much $CaSO_4$ dissolves in sat. $Na_2S_2O_8$+Aq as in H_2O. (Diehl.

Insol. in alcohol. of 0.905 sp. gr. or less. (Anthon, J. pr. **14.** 125.)

Solubility in 10% alcohol = 0.0970 g. $CaSO_4$ per 100 g. solution. (Magnanini, Gazz. Ch. it. 1901, **31.** (2) 544.)

Sol. in dil. alcoholic solutions of NH_4NO_3, KNO_3, $NaNO_3$, NH_4Cl, KCl, and NaCl. (Margueritte, C. R. **38.** 308.)

Sol. to considerable extent in $NH_4C_2H_3O_2$ + Aq, especially if freshly pptd. More sol. in $NH_4C_2H_3O_2$+Aq than in NH_4Cl+Aq. (Weppen, J. pr. **11.** 182.)

More sol. in $NH_4C_2H_3O_2$+Aq than in other NH_4 salts. (Cohn, J. pr. (2) **35.** 43.)

More sol. in $NaC_2H_3O_2$+Aq or KCl+Aq than in H_2O. (Mulder.)

Solubility in N/200 potassium hydrogen tartrate+Aq = 0.2323 g. $CaSO_4$ per 100 g. solution. (Magnanini, Gazz. ch. it. 1901, **31.** (2) 544.)

72.61 millimols. per l. of $CaSO_4+2H_2O$ are sol. at 25° in ammonium citrate+Aq (concentration = 0.5 millimols. per l.)

36.39 millimols per l. of $CaSO_4+2H_2O$ are sol. at 25° in sodium citrate+Aq. (Concentration = 0.25 millimols per l. (Rindell, Z. phys. Ch. 1910, **70.** 452.)

100 pts. glycerine dissolve 0.957 pt. $CaSO_4$ $+2H_2O$, and solubility increases with the temp. (Asselin, C. R. **76.** 884.)

100 g. glycerine (sp. gr. 1.256) dissolve 5.17 g. $CuSO_4$ at 15–16°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

Solubility in 10% alcoholic N/200 $KHC_2H_4O_6$+Aq = 0.0866 g. $CaSO_4$ per 100 g. solution.

Solubility in N/200 $KHC_2H_4O_6$+Aq+5% tartaric acid = 0.2556 g. $CaSO_4$ per 100 g. solution.

Solubility in 10% alcoholic N/400 $KHC_2H_4O_6$+5% tartaric acid = 0.1086 g. $CaSO_4$ in 100 g. solution. (Magnanini.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethylacetate. (Naumann, B. 1910, **43.** 314.)

Solubility in sugar+Aq at t°.

% sugar	g. $CaSO_4$ dissolved in 1 l. sugar solutions 30°	40°	50°	60°	70°	80°
0	...	2.157	1.730	1.730	1.652	1.710
10	2.041	1.730	1.730	1.574	1.574	1.613
20	1.808	1.652	1.419	1.380	1.419	1.263
27	1.550	1.438	1.361	1.283	1.283	0.972
35	1.263	1.050	1.088	1.108	0.914	...
42	1.030	...	0.777	0.816	0.855	0.729
49	...	0.564	0.739	0.564	0.603	0.486
55	...	0.486	0.505	0.486	0.369	0.330

(Stolle, Z. Ver. Zuckerind, 1900, **50.** 331).

Min. *Anhydrite.*

$+2H_2O$. Min. *Gypsum.*

Gypsum. A sat. aq. solution of gypsum of particles not less than 2μ contains 2.085 g. $CaSO_4$ per litre at 25°.

A sat. aq. solution of gypsum of particles not smaller than 0.3μ contains 2.476 g. $CaSO_4$ per liter at 25°. (μ = 0.0001 cm.) (Hulett and Allen, Z. phys. Ch. 1901, **37.** 391 and 393.)

Solubility in H_2O at t°.

t°	g. $CaSO_4$ in 100 ccm. of the solution	Density of the solution at t°
0	0.17590	1.001970
10	0.19285	1.001727
18	0.20160	1.000590
25	0.20805	0.999109
30	0.20905	0.997891
35	0.20960	0.996122
40	0.20970	0.994390
45	0.20835	0.992370
55	0.20095	0.987960
65.3	0.19320	0.982560
75	0.18475	0.977724
100	0.16195	...

(Hulett and Allen, J. Am. Chem. Soc. 1902, **24.** 674.)

1 l. H_2O dissolves 2.13 g. $CaSO_4+2H_2O$ at 25°. (Euler, Z. phys. Ch. 1904, **49.** 314.)

2023 mg. are dissolved in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

1 l. H_2O dissolves 2.267 g. $CaSO_4+2H_2O$ at 0°; 2.684 g. at 35°; 2.662 g. at 50°; and 2.155 g. at 100°. (Cavazzi, C. C. 1905, **I.** 1693.)

1 l. H_2O dissolves 29.5 milliequivalents at 18°; 30 at 50°; 23.3 at 100°. (Melcher, J. Am. Chem. Soc. 1910, **32.** 63.)

See also under $CaSO_4$.

Solubility of pulverized gypsum in NaCl+Aq at 23°.

Grams gypsum	G. NaCl per l.	G. $CaSO_4$ per l.
2.99	0.99	2.37
3.82	4.95	3.02
4.48	10.40	3.54
6.31	30.19	4.97
7.51	49.17	5.94
8.53	75.58	6.74
9.42	129.50	7.50
9.17	197.20	7.25
8.88	229.70	7.03
7.19	306.40	5.68
6.79	315.55	5.37

(Cameron, J. phys. Chem. 1901, **5.** 559.)

See also under $CaSO_4$.

$+\frac{1}{2}H_2O$. Plaster of Paris contains $\frac{1}{2}H_2O$ according to Chatelier (C. C. 1889, **1.** 203).

Calcium hydrogen sulphate, $CaH_2(SO_4)_2$.

100 pts. H_2SO_4 of 1.82 sp. gr. dissolve about 2 pts. $CaSO_4$; 100 pts. fuming H_2SO_4 dissolve 10.17 pts. $CaSO_4$ (Struve, Z. anal. **9.** 34); 100 pts. H_2SO_4 dissolve 2.5 pts. $CaSO_4$ (Lies-Bodart and Jacquemin, C. R. **46.** 1206); $CaSO_4$ is precipitated by H_2O from H_2SO_4 solution.

100 pts. boiling H_2SO_4 dissolve 10 pts. $CaSO_4$. (Schultz, Pogg. **133.** 137.)

Solubility of $CaSO_4$ in H_2SO_4+Aq.

wt. of 1000 ccm. of solution at 25°	g. H_2SO_4 per l.	g. $CaSO_4$ per l. at		
		25°	35°	43°
999.1067	0.00	2.126	...	2.145
1002.493	0.48	2.128	2.209	2.236
1002.553	4.87	2.144	2.451	2.456
1005.091	8.11	2.203	...	2.760
1009.787	16.22	2.382	...	3.116
1030.151	48.67	2.727	3.397	3.843
1043.470	75.00	2.841	...	4.146
1075.613	97.35	2.779	3.606	...
...	146.01	2.571	3.150	4.139
1113.392	194.70	2.313	...	3.551
1141.755	243.35	1.901	...	2.959
1168.143	292.02	1.541	...	2.481

(Cameron and Breazeale, J. phys. Chem. 1903, **7.** 574.)

100 pts. hot conc. H_2SO_4 dissolve approx. 10 pts. $CaSO_4$. (Rohland, Z. anorg. 1910, 66. 206.)

Decomp. by H_2O.

Calcium *hexa*hydrogen sulphate, $CaH_6(SO_4)_4$.

Decomp. by H_2O. (Schultz, Pogg. **133.** 137.)

Calcium cupric potassium sulphate, $Ca_2K_2Cu(SO_4)_4+2H_2O$.

(D'Ans, B. 1908, **41.** 1778.)

Calcium magnesium potassium sulphate, $2CaSO_4$, $MgSO_4$, $K_2SO_4+2H_2O$.

Min. *Polyhalite*. Sol. in H_2O with residue of $CaSO_4$.

$4CaSO_4$, $MgSO_4$, $K_2SO_4+2H_2O$. Min. *Krugite*. Decomp. by H_2O.

Calcium potassium sulphate, $CaK_2(SO_4)_2+H_2O$.

Min. *Syngenite*. Sol. in 400 pts. H_2O. (Zepharovitch.) Less sol. than K_2SO_4. Decomp. by heating with separation of $CaSO_4$ Decomp. by H_2O until 25 g. K_2SO_4 are dissolved in a litre, after which there is no decomposition. (Ditte, C. R. **84.** 86.)

Easily sol. in dil. acids. (Phillips.)

Solubility of syngenite, $CaK_2(SO_4)_2+H_2O$ in K_2SO_4+Aq at 25°.

Wt. of 1000 ccm. of solution grams	g. K_2SO_4 per l.	g. $CaSO_4$ per l.
1013.08	16.31	*1.495
1015.78	19.87	1.529
1020.01	25.01	1.537
1021.54	30.83	1.565
1036.82	46.99	0.810
1058.10	75.45	0.451
1085.91	112.87	0.330

*In first four determinations syngenite completely decomposed.

(Cameron and Breazeale, J. phys. Chem. 1904, **8.** 339.)

This double salt is stable between 0° and 99° in the presence of an excess of either $CaSO_4$ or K_2SO_4. In this temp. interval the double sulphate, $2CaSO_4$, K_2SO_4, $3H_2O$ described by Ditte (C. R. **84.** 867) does not exist. (Barre, C. R. 1909, **148.** 1607.)

$Ca_2K_2(SO_4)_3+3H_2O$. Decomp. by cold H_2O. (Ditte, C. R. **84.** 867.)

$5CaSO_4$, $K_2SO_4+H_2O$. Slowly decomp. by H_2O. (van't Hoff and Geiger, B. A. B. **1904.** 935.)

Calcium potassium zinc sulphate, $Ca_2K_2Zn(SO_4)_4+2H_2O$.

(D'Ans, B. 1908, **41.** 1778.)

Calcium rubidium sulphate, $Ca_2Rb_2(SO_4)_3$.

(D'Ans, B. 1907, **40.** 4913.)

$+3H_2O$. Decomp. by H_2O. (Ditte, C. R. **84.** 86.)

$CaRb_2(SO_4)_2+H_2O$. (D'Ans.)

Calcium sodium sulphate, $CaNa_2(SO_4)_2$.

Min. *Glauberite.* Gradually sol. in H_2O, but crystals of $CaSO_4+2H_2O$ soon separate out. (Fritzsche.)

Insol. in alcohol, and conc. $NaC_2H_3O_2+$Aq; decomp. by H_2O. (Folkhard, C. N. **43.** 6.)

$CaNa_4(SO_4)_3+2H_2O$. Decomp. by H_2O. (Fritzsche.)

Calcium titanium sulphate, $CaSO_4$, $Ti(SO_4)_2$.

Ppt.; decomp. by H_2O giving titanic acid. (Weinland, Z. anorg. 1907, **54.** 254.)

Calcium uranium sulphate.

Min. *Uranochalcite.*

Min. *Medjidite.* Easily sol. in dil. HCl+Aq.

Cerous sulphate, $Ce_2(SO_4)_3$.

Anhydrous cerous sulphate is much more sol. in H_2O than the hydrated salt.

Easily sol. in cold H_2O if added thereto in small amounts. If large amount of $Ce_2(SO_4)_3$ is treated with a little H_2O it hardens with evolution of heat, and becomes very difficultly soluble. 100 pts. H_2O dissolve 161 pts. $Ce_2(SO_4)_3$ at 0° and 17.86 pts. at 19°.

$Ce_2(SO_4)_3$+Aq sat. in cold deposits $Ce_2(SO_4)_3$ at 75°, and only 2.25 pts. remain in solution at 100°. (Jolin, Bull. Soc. (2) **21.** 536.)

100 pts. H_2O dissolve 8.31 pts. $Ce_2(SO_4)_3$ at 20°; 8.08 pts. at 45°; 4.95 pts. at 60°; 0.504 pt. at 100°. (Bührig, J. pr. (2) **12.** 240.)

60 pts. anhydrous salt dissolve quickly at 0–3° in 100 pts. H_2O.

At 15° the solution solidifies, and the mother liquor contains only 27.88% $Ce_2(SO_4)_3$. At 15° the maximum attainable strength is 31.62% $Ce_2(SO_4)_3$. (Brauner, Chem. Soc. **53.** 357.)

100 pts. H_2O dissolve 10.747 pts. $Ce_2(SO_4)_3$ at 16°; 9.648 pts. at 19°; 6.949 pts. at 33°.

The solubility of $Ce_2(SO_4)_3$ in H_2O is diminished by the addition of $(NH_4)_2SO_4$, K_2SO_4 or Na_2SO_4. (Barre, C. R. 1910, **151.** 872.)

Sp. gr. of $Ce_2(SO_4)_3$+Aq was found to be constant whether $Ce_2(SO_4)_3$ or $Ce_2(SO_4)_3+8H_2O$ was used. The following results were obtained at 15°.

Pts. $Ce_2(SO_4)_3$ to 100 pts. H_2O	Sp. gr.	Pts. $Ce_2(SO_4)_3$ to 100 pts. H_2O	Sp. gr.
3.17	1.03005	12.66	1.11917
6.11	1.05812	14.56	1.13665
8.35	1.07910	15.64	1.14623
9.61	1.09085	21.19	1.19640
10.55	1.09939	31.62	1.28778
11.66	1.10987	...	...

(Brauner, Chem. Soc. **53.** 357.)

4.5 pts. $Ce_2(SO_4)_3$ dissolve in 100 pts. H_2SO_4. (Wyrouboff, Bull. Soc. (3) **2.** 745.)

Solubility in $(NH_4)_2SO_4$+Aq at 16°.

Per 100 pts H_2O	
$(NH_4)_2SO_4$	$Ce_2(SO_4)_3$
0.00	10.747
2.464	1.026
9.323	0.782
19.240	0.748
29.552	0.701
45.616	0.497
55.083	0.194
63.920	0.090
72.838	0.035

(Barre, A. ch. 1911, (8) **24.** 252.)

Solubility in Na_2SO_4+Aq at 19°–20°.

Per 100 pts. H_2O	
Na_2SO_4	$Ce_2(SO_4)_3$
0.00	9.64
0.328	0.637
0.684	0.259
1.091	0.0937
1.392	0.057
1.699	0.0303
2.640	0.012
3.589	0.0065
5.660	0.0046
7.710	0.0037

(Barre, A. ch. 1911, (8) **24.** 251.)

Solubility in K_2SO_4+Aq at 16°.

Per 100 pts. H_2O	
K_2SO_4	$Ce_2(SO_4)_3$
0.00	10.747
0.178	0.956
0.510	0.432
0.726	0.250
1.290	0.0419

(Barre, A. ch. 1911, (8) **24.** 248.)

$+4H_2O$. 100 g. H_2O dissolve at:

35°	40°	50°	57°
8.5	6.04	3.43	2.34 g. $Ce_2(SO_4)_3$.

65°	70°	82°	100.5° bpt. of sat. solution.
1.883	1.38	1.01	0.43 g. $Ce_2(SO_4)_3$.

(Koppel, Z. anorg. 1904, **41.** 399.)

$+5H_2O$.

100 pts. H_2O dissolve pts. $Ce_2(SO_4)_3$ at t°.

t°	Pts. $Ce_2(SO_4)_3$
100	0.775
80	1.70
60	3.45
50	5.56
40	8.20

(Muthmann and Rolig, Z. anorg. 1898, **16.** 456.)

100 g. H_2O dissolve at:

45°	60°	70°
8.833	3.247	1.929 g. $Ce_2(SO_4)_3$.

80°	90°	100.5° bpt. of sat. solution.
1.207	0.8355	0.469 g. $Ce_2(SO_4)_3$.

Muthmann and Rolig's determinations are inaccurate. (Koppel.)

$+8H_2O$. 100 pts. H_2O dissolve 14.92 pts. $Ce_2(SO_4)_3$ at 20° from $Ce_2(SO_4)_3+8H_2O_3$ (Jolin.)

100 pts. H_2O dissolve pts. $Ce_2(SO_4)_3$ at t°.

t°	Pts. $Ce_2(SO_4)_3$	t°	Pts. $Ce_2(SO_4)_3$
0	19.10	50	12.48
18	17.32	60	9.40
30	16.13	70	4.24

(Muthmann and Rolig.)

100 g. H_2O dissolve at:

0°	15°	20.4°
10.09	11.06	9.525 g. $Ce_2(SO_4)_3$,

30°	40°	50°	60°
7.388	5.947	4.785	4.064 g. $Ce_2(SO_4)_3$.

Previous determinations are inaccurate. (Koppel, Z. anorg. 1904, **41.** 395.)

100 g. sat. solution at 25° contain 7.60 g. anhydrous salt. (Wirth, Z. anorg. **76.** 174.)

Solubility in H_2SO_4+Aq at 25°. Solid phase $Ce_2(SO_4)_3+8H_2O$.

Normality H_2SO_4	In 100 g. of the liquid are dissolved	
	g. Ce_2O_3	g. $Ce_2(SO_4)_3$
0	4.604	7.60
0.1	4.615	7.618
1.1	3.64	6.00
2.16	3.04	5.018
4.32	2.0	3.301
6.685	0.9115	1.505
9.68	0.4339	0.733
15.15	0.145	0.239

(Wirth, Z. anorg. 1912, **76.** 191.)

$+9H_2O$. 100 pts. H_2O dissolve 17.52 pts. $Ce_2(SO_4)_3$ from $Ce_2(SO_4)_3+9H_2O$. (Brauner.

100 g. H_2O dissolve at:

0°	15°	21°	30°	31.2°
20.98	11.87	9.725	7.353	7.185 g. $Ce_2(SO_4)_3$,

31.6°	45°	50°	60°	65°
7.164	5.13	4.673	3.88	3.595 g. $Ce_2(SO_4)_3$.

(Koppel.)

$+12H_2O$.

100 pts. H_2O dissolve pts. $Ce_2(SO_4)_3$ at t°.

t°	Pts. $Ce_2(SO_4)_3$
0	21.40
18	18.44
25	16.22

(Muthmann and Rolig, Z. anorg. 1898, **16.** 457.)

100 g. H_2O dissolve at:

0°	18.8°	19.2°
16.56	17.52	17.70 g. $Ce_2(SO_4)_3$.

Previous determinations are inaccurate. (Koppel.)

Ceroceric sulphate, $Ce_2(SO_4)_3$, $2Ce(SO_4)_2+24H_2O$.

Decomp. by H_2O. Sol. in HCl+Aq with decomp. (Mendelejeff, A. **168. 45.**)

$Ce_2(SO_4)_3$, $3Ce(SO_4)_2+31H_2O$. (Jolin.)

Ceric sulphate, basic, CeO_2, SO_3+2H_2O.

Very sl. sol. in H_2O.

Sol. in 2500 pts. H_2O. (Mosander.)

Boiling H_2O gradually dissolves out H_2SO_4. (Erk.)

Sol. in acids.

$8CeO_2$, $7SO_3+12H_2O$; $8CeO_2$, $7SO_3+15H_2O$; $6CeO_2$, $5SO_3+5H_2O$; $4CeO_2$, $3SO_3+7H_2O$; and $3Ce(SO_4)_2$, $5Ce(OH)_4$. All are insol. ppts.

Ceric sulphate, $Ce(SO_4)_2$.

Anhydrous. Very slowly sol. in cold, more rapidly in hot H_2O. When solution has once begun, almost unlimited quantities may be dissolved. Insol. in conc. H_2SO_4. (Meyer, B. 1904, **37.** 144.)

$+4H_2O$. Sol. in H_2O with immediate decomp. (Rammelsberg.)

Decomp. by H_2O. (Muthmann, B. 1900, **33.** 1764.)

Cerous hydrogen sulphate, $Ce_2(SO_4)_3$, $3H_2SO_4$.

Decomp. by H_2O. (Wyrouboff, Bull. Soc. (3) **2.** 745; Brauner, Z. anorg. 1904, **38.** 329.)

Ceroceric hydrogen sulphate, $Ce_2H(SO_4)_4+13H_2O$.

Sol. in H_2O. Forms very supersat. solutions.

Solubility in H_2SO_4 decreases with increase in concentration of the acid. (Meyer, B. 1904, **37.** 146.)

Cerous potassium sulphate, $Ce_2(SO_4)_3$, K_2SO_4 $+2H_2O$

Sl. sol. in H_2O; insol. in sat. K_2SO_4+Aq. (Czudnowicz, J. pr. **80.** 26.)

$2Ce_2(SO_4)_3$, $3K_2SO_4$. As above. (Hermann, J. pr. **30.** 188.)

$+8H_2O$. (Barre, A. ch. 1911, (8) **24.** 249.)

$Ce_2(SO_4)_3$, $2K_2SO_4+3H_2O$. As above. (Jolin.)

$Ce_2(SO_4)_3$, $3K_2SO_4$. Sol. in about 56 pts. H_2O at 9–20°. Easily sol. in acidified H_2O. Nearly insol. in sat. K_2SO_4+Aq. (Jolin.)

$Ce_2(SO_4)_3$, $5K_2SO_4$. Insol. in K_2SO_4+Aq. (Barre, *l.c.*)

Ceric potassium sulphate, $Ce(SO_4)_2$, $2K_2SO_4$ $+2H_2O$.

Sl. sol. in H_2O with decomp. Insol. in sat K_2SO_4+Aq.

Ceric silver sulphate, $10Ce(SO_4)_2$, $6Ag_2SO_4$.

Only sl. sol. in cold H_2O; decomp. by hot H_2O in which it is readily sol. (Pozzi-Escot, C. R. 1913, **156.** 1074.)

Cerous sodium sulphate, $Ce_2(SO_4)_3$, Na_2SO_4+ $2H_2O$.

Very sl. sol. in H_2O, and still less in Na_2SO_4 +Aq. 100 ccm. sat. Na_2SO_4+Aq dissolve an amount corresponding to 6.2 mg. Ce_2O_3. (Jolin.)

Sl. sol. in HCl+Aq. (Czudnowicz.)

Cerous thallous sulphate, $Ce_2(SO_4)_3$, $3Tl_2SO_4$.

Ppt.

$Ce_2(SO_4)_3$, $Tl_2SO_4+2H_2O$. Sol. in H_2O. (Zschiesche, J. pr. **107.** 98.)

$+4H_2O$. Very sl. sol. in cold, somewhat more in warm H_2O. (Wyrouboff, Bull. Soc. Min. **14.** 83.)

Cerous tin (stannic) hydrogen sulphate, $CeHSn(SO_4)_4$.

Decomp. by H_2O. Sol. in very dil. HCl. (Weinland, Z. anorg. 1907, **54.** 251.)

Chromous sulphate, $CrSO_4+7H_2O$.

100 pts. H_2O dissolve 12.35 pts. $CrSO_4$+ $7H_2O$. Aqueous solution can be boiled without decomp. Sl. sol. in alcohol.

$+H_2O$. (Moissan, Bull. Soc. **37.** 296.)

Chromic sulphate, basic, $3Cr_2O_3$, $2SO_3$+ $12H_2O=2Cr_2(SO_4)(OH)_4$, $Cr_2(OH)_6$+ $5H_2O$.

Insol. in H_2O. Sol. in acids. Slowly decomp. by KOH+Aq or K_2CO_3+Aq.

$5Cr_2O_3$, $3SO_3$. Sol. in H_2O. (Recoura, C. R. **112.** 1439.)

Cr_2O_3, $SO_3=Cr_2O_2(SO_4)$. Ppt. (Schiff, A. **124.** 167.)

$+10H_2O$ or $[Cr(OH)_2(OH_2)_4]_2SO_4$. Nearly insol. in H_2O. (Werner, B. 1908, **41.** 3451.)

$5Cr_2O_3$, $8SO_3$ (?). (Siewert, A. **126.** 97.)

Cr_2O_3, $2SO_3=Cr_2O(SO_4)_2$. Easily sol. in a little H_2O, but a precipitate is thrown down by further addition of H_2O, which redissolves on evaporation.

$5Cr_2O_3$, $12SO_3$ (?). (Siewert.)

$2Cr_2O_3$, $5SO_3+15H_2O$. Sol. in H_2O; insol. in alcohol and acetone by which it is ppt. from aqueous solution. (Nicolardot, C. R. 1907, **145.** 1338.)

Chromic sulphate, $Cr_2(SO_4)_3$.

Anhydrous. Insol. in H_2O, HNO_3, HCl, H_2SO_4, aqua regia, and NH_4OH+Aq. Decomp. by boiling caustic alkalies, and slowly by alkali carbonates+Aq. (Schrötter.) According to Traube (A. **71.** 92) and Siewert (A. **126.** 94), Schrotter's salt is an acid sulphate, $Cr_4(SO_4)_5(OSO_2OH)_2=2Cr_2(SO_4)_3$, H_2SO_4. According to Étard (Bull. Soc. (2) **31.** 200) both salts exist, and formula of above salt is $Cr_2(SO_4)_6Cr_2$. Formula is $2[(Cr_2O_3)_2, (SO_3)_6]$, $17H_2SO_4$ (?). (Cross and Higgins, Chem. Soc. **41.** 113.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

$+6H_2O$ (?). *Green modification.* Readily sol. in H_2O or alcohol. Sol. in conc. H_2SO_4. H_2O solution is converted into the violet modification by standing 3–4 weeks. (Schrötter.)

$+11H_2O$ (?). Extremely deliquescent; becomes liquid in moist air in 2 minutes. Not pptd. by $BaCl_2$+Aq. (Recoura, C. R. **113.** 857.)

$+18H_2O$. *Violet modification.* Sol. in 0.833 pt. H_2O at 20°. When the H_2O solution is heated to 65–70° it begins to be converted into the green modification. This conversion is also brought about by cold HNO_3, H_2SO_4, PCl_3. (Étard, C. R. **84.** 1090.)

Sp. gr. of aqueous solution of violet modification of $Cr_2(SO_4)_3$ containing:

5	10	20% $Cr_2(SO_4)_3+18H_2O$,
1.0275	1.0560	1.1150
30	40	50% $Cr_2(SO_4)_3+18H_2O$.
1.1785	1.2480	1.3250

Sp. gr. of aqueous solution of green modification of $Cr_2(SO_4)_3$ containing:

10	20	30% $Cr_2(SO_4)_3+18H_2O$,
1.0510	1.1070	1.1680
40	50	60% $Cr_2(SO_4)_3+18H_2O$,
1.2340	1.3055	1.3825
70	80% $Cr_2(SO_4)_3+18HO_2$.	
1.4650	1.5535	

(Gerlach, Z. anal. **28.** 494.)

See also **Chromosulphuric acid.**

Chromic hydrogen sulphate, $Cr_2(SO_4)_3$, H_2SO_4 $+16H_2O$.

Two modifications.

a. *Violet.* Decomp. by H_2O.

b. *Green.* Obtained from violet modification on heating. Sol. in H_2O. (Weinland, Z. anorg. 1906, **49.** 157.)

$+24H_2O$. Decomp. by alcohol, giving the normal sulphate. (Weinland.)

$Cr_2(SO_4)_3$, $2H_2SO_4+18H_2O$. Hygroscopic. Decomp. by H_2O. (Weinland.)

$$2Cr_2(SO_4)_3,\ H_2SO_4 = Cr_4\begin{matrix}(OSO_2OH)_2\\(SO_4)_5.\end{matrix}$$

Correct composition of $Cr_2(SO_4)_3$ (Traube), which see.

See also **Chromosulphuric acid.**

Chromic cupric sulphate, $Cr_2(SO_4)_2$, $2CuSO_4$, H_2SO_4.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Cr_2O_3, CuO, $4SO_3$.

Insol. in H_2O. (Recoura, C. R. 1893, **117.** 39.)

Chromous hydrazine sulphate, $CrSO_4$, $2N_2H_4$, H_2SO_4.

Only sl. sol. in H_2O. Sol. in acids. (Traube B. 1913, **46.** 1507.)

Chromic hydroxylamine sulphate, $Cr_2(SO_4)_3$, $(NH_2OH)_2SO_4+24H_2O$.

Sol. in H_2O. (Meyeringh.)

Chromic iron (ferrous) sulphate, $Cr_2(SO_4)_3$, $2FeSO_4$, $H_2SO_4+2H_2O$.

As above. (Étard, *l.c.*)

Chromic iron (ferric) sulphate, $Cr_2(SO_4)_3$, $Fe_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Cr_2(SO_4)_3$, $Fe_2(SO_4)_3$, H_2SO_4. Insol. in H_2O. (Étard.)

Chromic lithium sulphate, $Cr_2(SO_4)_3$, $3Li_2SO_4$.

Resembles the corresponding K salt. (Wernicke.)

Chromic manganous sulphate, $Cr_2(SO_4)_3$, $3MnSO_4$.

(Étard, C. R. **86.** 1402.)

Chromic manganic sulphate, $Cr_2(SO_4)_3$, $Mn_2(SO_4)_3$.

Insol. in H_2O. (Étard, C. R. **86.** 1399.)

$Cr_2(SO_4)_3$, $Mn_2(SO_4)_3$, $2H_2SO_4$. Sl. deliquescent. Sol. in H_2O with decomp. (Étard.)

Chromic nickel sulphate, $Cr_2(SO_4)_3$, $NiSO_4$, $2H_2SO_4+3H_2O$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Chromous potassium sulphate, $CrSO_4$, K_2SO_4 $+6H_2O$.

Sol. in H_2O; less sol. in alcohol. (Peligot, A. ch. (3) **12.** 546.)

Chromic potassium sulphate, $K_2Cr_2(SO_4)_4$.

Anhydrous. *a.* Sol. in H_2O when not heated over 350°.

β. Insol. in cold H_2O and cold acids. When ignited is insol. in hot H_2O and acids, except slightly in boiling conc. H_2SO_4. (Fischer.)

$+2H_2O$ (?). Insol. in cold H_2O or dil. acids. Sol. by long boiling with H_2O, and more quickly when HCl is added. (Hertwig.)

$+4H_2O$. Is potassium chromosulphate, which see.

$+24H_2O$. *Chrome-alum. Violet modification.* Efflorescent at 29°. Sol. in 6–7 pts. cold H_2O. When the H_2O solution is heated to 60–70° it is partially decomp. into a green modification, which is more sol. in H_2O. The green modification on standing in H_2O solution is very slowly converted back into violet modification. The green modification may also be formed by heating dry salt to 100°, at which temp. it melts in its crystal H_2O. When all crystal H_2O has been expelled at 300–350°, it still dissolves in hot H_2O, but when heated above 350° it becomes insol. in H_2O. (Löwel, A. ch. (3) **44.** 313.)

125.1 g. anhydrous, or 243.9 g. hydrated salt, or 0.441 g. mols. anhydrous salt are sol. in 1 l. H_2O at 25°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Melts in crystal H_2O at 89°. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of aqueous solution of violet modification at 15° containing:

5	10	15%	$K_2Cr_2(SO_4)_4+24H_2O$.
1.02725	1.05500	1.08350	

Sp. gr. of sat. solution at 15° = 1.0985.

Sp. gr. of aqueous solution of green modification at 15° containing:

10	20	30%	$K_2Cr_2(SO_4)_4+24H_2O$,
1.050	1.103	1.161	
40	50	60%	$K_2Cr_2(SO_4)_4+24H_2O$,
1.225	1.295	1.371	
70	80	90%	$K_2Cr_2(SO_4)_4+24H_2O$.
1.453	1.541	1.635	

(Gerlach, Z. anal. **28.** 497.)

Sp. gr. of chrome-alum solutions at 15° containing:

5	10	15	20	25	% salt,
1.0174	1.0342	1.0524	1.0746	1.1004	
30	35	40	45	50	% salt,
1.1274	1.1572	1.1896	1.2352	1.2894	
55	60	65	70		% salt.
1.3704	1.4566	1.5462	1.6362		

(Franz, J. pr. (2) **5.** 298.)

Insol. in alcohol.

$3K_2SO_4$, $Cr_2(SO_4)_3$. Insol. in H_2O, acids, or dil. alkalies. Decomp. by boiling with conc. KOH+Aq. (Wernicke, Pogg. **159.** 576.)

Chromic rubidium sulphate, $Rb_2Cr_2(SO_4)_4+$ $24H_2O$.

Sol. in H_2O. (Petersson.)

Solubility in H_2O.

Temp.	G. anhydrous salt per l.	G. mols. of anhydrous salt per l.
25°	25.7	0.079
30°	31.7	0.096
35°	41.1	0.128
40°	59.7	0.181

Melts in crystal H_2O at 107°.

(Locke, Am. Ch. J. 1901, **26.** 180.)

Chromic sodium sulphate, $Na_2Cr_2(SO_4)_4+10H_2O$.

Is sodium chromosulphate, which see.

$+24H_2O$. More efflorescent than K or NH_4 salt. Sol. in H_2O, and properties resemble the corresponding K salt.

$Cr_2(SO_4)_3$, $3Na_2SO_4$. Resembles the corresponding K salt.

Chromic thallous sulphate, $Tl_2Cr_2(SO_4)_4+24H_2O$.

0.212 mols. of anhydrous salt are sol. in 1 l. H_2O at 25°. 1 l. H_2O dissolves 104.8 g. of anhydrous or 163.8 g. hydrated salt at 25°. Melts in crystal H_2O at 92°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Chromic sulphate chloride, $Cr_2(SO_4)_2Cl_2+2H_2O$.

Slightly hydroscopic. Sol. in H_2O. (Schiff, A. **124.** 176.)

$[CrSO_4, 5H_2O]Cl$. Sol. in H_2O. (Weinland, Z. anorg. 1908, **58.** 176.)

Chromyl sulphate, $(CrO_2)SO_4$.

Decomp. by H_2O. (Pictet and Karl, Bull. Soc. 1908, (4) **3.** 1114.)

Cobaltous sulphate, basic.

Ppt. Insol. in H_2O. (Berzelius.)

$6CoO$, SO_3+10H_2O. (Athanasesco, C. R. 103. 271.)

$5CoO$, SO_3+4H_2O. Ppt. Very sl. sol. in H_2O. (Habermann, M. Ch. 5. 432.)

Cobaltous sulphate, $CoSO_4$.

100 pts. H_2O dissolve at:

3°	10°	20°	24°	29°	
26.2	30.5	36.4	38.9	40	pts. anhydrous salt,

35°	44°	50°	60°	70°	
46.3	50.4	55.2	60.4	65.7	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 pts. H_2O at 11–14° dissolve 23.88 pts. anhydrous salt. (v. Hauer, J. pr. 103. 114.)

Solubility in 100 pts. H_2O at t°, using $CoSO_4+7H_2O$.

t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$
0	24.6	36	43.5	72	65.0
1	25.0	37	44.0	73	65.6
2	25.5	38	44.6	74	66.2
3	26.0	39	45.2	75	66.8
4	26.5	40	45.8	76	67.4
5	27.0	41	46.4	77	68.0
6	27.5	42	47.0	78	68.6
7	28.0	43	47.6	79	69.2
8	28.5	44	48.2	80	69.8
9	29.0	45	48.8	81	70.4
10	29.5	46	49.4	82	71.0
11	30.0	47	50.0	83	71.6
12	30.5	48	50.6	84	72.2
13	31.0	49	51.2	85	72.8
14	31.5	50	51.8	86	73.4
15	32.0	51	52.4	87	74.0
16	32.5	52	53.0	88	74.6
17	33.0	53	53.6	89	75.2
18	33.5	54	54.2	90	75.9
19	34.0	55	54.8	91	76.6
20	34.5	56	55.4	92	77.2
21	35.1	57	56.0	93	77.9
22	35.6	58	56.6	94	78.6
23	36.2	59	57.2	95	79.2
24	36.8	60	57.8	96	79.9
25	37.4	61	58.4	97	80.6
26	38.0	62	59.0	98	81.3
27	38.5	63	59.6	99	81.9
28	39.1	64	60.2	100	82.6
29	39.6	65	60.8	101	83.3
30	40.2	66	61.4	102	83.9
31	40.7	67	62.0	103	84.6
32	41.3	68	62.6	104	85.3
33	41.8	69	63.2	105	86.0
34	42.4	70	63.8	106	86.7
35	42.9	71	64.4	106.4	86.9

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. **1864.** 68.)

100 g. H_2O dissolve 37.8 g. $CoSO_4$ at 25°. (Wagner, Z. phys. Ch. 1910, **71.** 430.)

See also $+7H_2O$.

Sp. gr. of $CoSO_4$+Aq at t°. S = pts. $CoSO_4$ in 100 pts. solution; S_1 = mols. $CoSO_4$ in 100 mols. of solution.

S	S_1	Sp. gr.
6.8910	0.852	1.0765
5.8140	0.711	1.0641
4.7095	0.570	1.0517
3.5792	0.429	1.0392
2.4273	0.288	1.0263
1.2099	0.141	1.0131

(Charpy, A. ch. (6) **29.** 26.)

Sp. gr. of $CoSO_4$+Aq at room temp. containing:

7.239	14.156	21.167% $CoSO_4$.
1.0860	1.1591	1.2398

(Wagner, W. Ann. 1883, **18.** 269.)

Sp. gr. of $CoSO_4$+Aq at 25°.

Concentration of $CoSO_4$ +Aq	Sp. gr.
1-normal	1.0750
$^1/_2$– "	1.0383
$^1/_4$– "	1.0193
$^1/_8$– "	1.0110

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

100 pts. sat. solution of $CoSO_4$ and $CuSO_4$ contain 22.70 pts. of the two salts.

Solubility of $CoSO_4$, $7H_2O+Na_2SO_4$, $10H_2O$ in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$ and grams Na_2SO_4.

t°	grams $CoSO_4$	grams Na_2SO_4
0	21.855	10.07
5	23.94	13.155
10	25.41	16.665

(Koppel, Z. phys. Ch. 1905, **52.** 396.)
See also under $CoNa_2(SO_4)_2+4H_2O$.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)
$HC_2H_3O_2$ ppts. it completely from $CoSO_4$+Aq. (Persoz.)
100 pts. absolute methyl alcohol dissolve 1.04 pts. $CoSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10.** 784.)
100 pts. absolute methyl alcohol dissolve 54.5 pts. $CoSO_4+7H_2O$ at 18°; 100 pts. absolute methyl alcohol dissolve 42.8 pts. $CoSO_4$ $+7H_2O$ at 3°; 100 pts. 93.5% methyl alcohol dissolve 13.3 pts. $CoSO_4+7H_2O$ at 3°;100 pts. 50% methyl alcohol dissolve 1.8 pts. $CoSO_4+7H_2O$ at 3°.
100 pts. absolute ethyl alcohol dissolve 2.5 pts. $CoSO_4+7H_2O$ at 3°. (de Bruyn, Z. phys. Ch. **10.** 786.)
100 g. solution in glycol contain 2.5 g. $CoSO_4$. (de Coninck, Bull. Ac. Belg. **1905.** 359.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)
Insol. in ethyl acetate. (Naumann, B. 1904, **37.** 3602.)
$+H_2O$. Sl. sol. in cold, and only very slowly sol. in hot H_2O. (Vortmann, B. **15.** 1888.)
$+4H_2O$. (Fröhde, Arch. Pharm. (2) **127.** 92.)
$+6H_2O$. (Marignac.)
$+7H_2O$. Sol. in 24 pts. cold H_2O. Insol. in alcohol. (Persoz.)

Solubility of $CoSO_4+7H_2O$ in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$.

t°	g. $CoSO_4$	t°	g. $CoSO_4$	t°	g. $CoSO_4$
0	25.53	15	33.045	30	42.26
5	28.05	20	36.21	35	45.80
10	30.55	25	39.35	40	48.85

(Koppel, Z. phys. Ch. 1905, **52.** 395.)

M.-pt. of $CoSO_4+7H_2O$ = 96–98°. (Tilden, Chem. Soc. **45.** 409.)

Cobaltocobaltic sulphate, Co_2O_3, $6CoO$, SO_3+15H_2O.
Precipitate. Insol. in boiling $CoSO_4$+Aq or NH_4OH+Aq. (Gentele, J. pr. **69.** 130.)

Cobaltic sulphate, $Co_2(SO_4)_3+18H_2O$.
Sol. in H_2O with immediate decomp. and liberation of O. Sol. in dil. H_2SO_4+Aq without immediate decomp. Sol. in conc. HNO_3, H_2SO_4, or $HC_2H_3O_2$+Aq. (Marshall, Chem. Soc. **59.** 760.)

Cobaltous cupric sulphate, $2CoSO_4$, $CuSO_4+21H_2O$.
Easily sol. in H_2O. (v. Hauer, Pogg. **125.** 637.)
$+36H_2O$. (Liebig.)
$2CoSO_4$, $2CuSO_4$, H_2SO_4. (Étard.)

Cobaltous cupric magnesium potassium zinc sulphate, $CoSO_4$, $CuSO_4$, $MgSO_4$, $4K_2SO_4$, $ZnSO_4+24H_2O$ (?).
Sol. in H_2O. (Vohl.)

Cobaltous cupric potassium sulphate, $CoSO_4$, $CuSO_4$, $2K_2SO_4+12H_2O$ (?).
Sol. in H_2O. (Vohl.)
Does not exist. (Aston and Pickering, Chem. Soc. **49.** 123.)

Cobaltous hydrazine sulphate, $CoH_2(SO_4)_2$, $2N_2H_4$.
1 pt. is sol. in 305.16 pts. H_2O at 12°. Sol. in HNO_3 with decomp. Insol. in HCl. (Curtius, J. pr. 1894, (2) **50.** 331.)

Cobaltous iron (ferrous) potassium sulphate, $CoSO_4$, Fe_2SO_4, $2K_2SO_4+12H_2O$.
Sol. in H_2O. (Vohl, A. **94.** 57.)
$2CoSO_4$, $2FeSO_4$, H_2SO_4. (Étard.)

Cobaltous magnesium sulphate, $3CoSO_4$, $MgSO_4+28H_2O$.
Easily sol. in H_2O. (Winkelblech.)

Cobaltous magnesium potassium sulphate, $CoSO_4$, $MgSO_4$, $K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Does not exist. (Aston and Pickering Chem. Soc. **49.** 123.)

Cobaltous manganous potassium sulphate, $CoSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Cobaltous nickel potassium sulphate, $CoSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Does not exist. (Thomson, Rep. Brit. Assn. Adv. Sci. **1877.** 209.)

Cobaltous potassium sulphate, $CoSO_4$, K_2SO $+6H_2O$.

Less sol. in H_2O than $CoSO_4$.

100 pts. H_2O dissolve at:

0°	12°	15°	20°	25°	
19.1	30	32.5	39.4	45.3	pts. anhydrous salt.

30°	35°	40°	49°	
51.9	55.4	64.6	81.3	pts. anhydrous salt.

(Tobler, A. **96.** 126.)

100 pts. saturated solution contain at:

20°	40°	60°	80°	
14	19.5	24.4	31.8	pts. anhydrous salt.

(v. Hauer, J. pr. **74.** 433.)

1 l. H_2O dissolves 128.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cobaltic potassium sulphate, $K_2Co_2(SO_4)_4+24H_2O$.

Sol. in H_2O with decomp. (Marshall, Chem. Soc. **59.** 760.)

Cobaltous potassium zinc sulphate, $CoSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Cobaltous rubidium sulphate, $CoSO_4$, Rb_2SO_4 $+6H_2O$.

Sol. in H_2O. (Tutton.)

1 l. H_2O dissolves 92.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cobaltic rubidium sulphate, $Rb_2Co_2(SO_4)_2+24H_2O$.

Decomp. by H_2O. Sol. in dil. HCl and H_2SO_4. Decomp. by conc. HCl or H_2SO_4. (Howe and O'Neal, J. Am. Chem. Soc. 1898, **20.** 762.)

Melts in crystal H_2O at 47°. (Locke, Am. Ch. J. 1901, **26.** 183.)

Cobaltous sodium sulphate, $CoNa_2(SO_4)_2+4H_2O$.

Solubility of $CoNa_2(SO_4)_2$, $4H_2O$ in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$ and grams Na_2SO_4.

t°	g. $CoSO_4$	g. Na_2SO_4
20	26.65	24.91
25	25.365	23.325
30	23.13	21.61
35	22.55	20.85
40	20.975	20.055

(Koppel, Z. phys. Ch. 1905, **52.** 397.)

Solubility of $CoNa_2(SO_4)_2$, $4H_2O+CoSO_4$, $7H_2O$ in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$ and grams Na_2SO_4.

t°	g. $CoSO_4$	g. Na_2SO_4	t°	g. $CoSO_4$	g. Na_2SO_4
13.5	28.61	23.82	30	32.695	18.17
20	29.42	23.015	35	34.065	15.61
25	30.73	20.575	40	35.01	13.715

(Koppel, Z. phys. Ch. 1905, **52.** 397.)

Solubility of $CoNa_2(SO_4)_2$, $4H_2O+NaSO_4$, $10H_2O$ in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$ and grams Na_2SO_4.

t°	g. $CoSO_4$	g. Na_2SO_4
18.5	25.50	25.65
20	23.18	27.26
25	16.07	35.18
30	9.20	43.74

(Koppel.)

Solubility of $CoNa_2(SO_4)$, $4H_2O+Na_2SO_4$ (anhydrous) in H_2O at t°. 100 g. H_2O dissolve grams $CoSO_4$ and grams Na_2SO_4.

t°	g. $CoSO_4$	g. Na_2SO_4
35	7.204	50.79
40	7.456	50.095

(Koppel.)

See also $CoSO_4+Na_2SO_4$ under $CoSO_4$.

Cobaltous zinc sulphate.

Efflorescent. Decomp. on air. (Link, Crell. Ann. **1790, 1.** 32.)

Cobaltous sulphate ammonia, $CoSO_4$, $6NH_3$.

Sol. in H_2O with separation of ppt. (Rose, Pogg. **20.** 152.) Very easily sol. in NH_4OH+Aq. (Fremy.)

Decomp. by alcohol.

Cobaltous sulphate hydrazine, $CoSO_4$, $3N_2H_4$.

Insol. in H_2O. Decomp. by boiling with H_2O. Very sol. in dil. acids and NH_4+Aq. (Franzen, Z. anorg. 1908, **60.** 272.)

Cobaltous sulphate hydroxylamine, $CoSO_4$, NH_2OH+2H_2O.

Insol. in cold; sol. in hot H_2O with decomp. (Feldt, B. 1894, **27.** 403.)

Columbium sulphate.

Sol. in H_2O. (Blomstrand.)

Cuprous sulphate, Cu_2SO_4.

Decomp. by H_2O. Sol. in conc. HCl, in ammonia and sl. sol. in glacial acetic acid. (Recoura, C. R. 1909, **148.** 1107.)

Cupric sulphate, basic, $10CuO, SO_3$.

(Pickering, Chem. Soc. 1907, **91.** 1984.)

$8CuO, SO_3+12H_2O$. Ppt. (Kane, A. ch. **72.** 269.)

$5CuO, SO_3+6H_2O$. Ppt. (Smith, Phil. Mag. J. **23.** 196.)

$4CuO, SO_3+3H_2O$. Insol. in H_2O. (Roucher, J. Pharm. (3) **37.** 50.)

Min. *Brochantite.* Sol. in acids and NH_4OH+Aq.

$+3\frac{1}{2}H_2O$. Insol. in H_2O. Easily sol. in dil. acids, even $HC_2H_3O_2$+Aq. Sl. sol. in $CuSO_4$+Aq. Insol. in $NaC_2H_3O_2$+Aq. (Casselmann, Z. anal. **4.** 24.)

$+4H_2O$. Insol. in H_2O. (Proust.) Sol. in $(NH_4)_2SO_4$+Aq, and more easily in NH_4Cl, and NH_4NO_3+Aq. (Lea.)

1 l. cold H_2O dissolves 0.017 g. (Pickering, C. N. 1883, **47.** 182.)

$+5H_2O$. Min. *Langite.*

$+16H_2O$. (André, C. R. **100.** 1138.)

$7CuO, 2SO_3+5H_2O$. (Reindel, J. pr. **100.** 1.)

$+6H_2O$. Wholly insol. in cold or hot H_2O. (Habermann, M. Ch. **5.** 432.)

$+7H_2O$. Insol. in H_2O; easily sol. in acids. Insol. in boiling $CuSO_4$+Aq. (Reindel.)

$3CuO, SO_3+1\frac{1}{2}H_2O$. Insol. in H_2O; easily sol. in acids. (Steinmann, B. **15.** 1412.)

$+2H_2O$. Insol. in H_2O; sol. in dil. H_2SO_4+Aq. (Shenstone, Chem. Soc. **47.** 375.)

$+2\frac{1}{2}H_2O$. (Reindel, J. pr. **102.** 204.)

$+4H_2O$. Insol. in H_2O. (Grimbert and Barré, J. Pharm. (5) **21.** 414.)

$5CuO, 2SO_3+3H_2O$. (Wibel, Dissert. **1864.**)

$11CuO, 4SO_3+8H_2O$. (Clowes, C. N. 1898, **78.** 155.)

$8CuO, 3SO_3+10H_2O$. (Marchlewski and Sachs, Z. anorg. 1892, **1.** 405.)

$7CuO, 3SO_3+12H_2O$. (Étard, C. R. 1887, **104.** 1615.)

$5CuO, 2SO_3+5H_2O$. (Sabatier, Gm. K. **5.** 1, 839.)

$6H_2O$. Min. *Arnimite.* (Weisbach, J. B. **1886.** 2253.)

$2CuO, SO_3$. Decomp. by cold H_2O into $CuSO_4$ and $4CuO, SO_3$. (Roucher.)

Insol. in H_2O. Decomp. by hot H_2O. Sol. in dil. acids. (Pozzi-Escot, Bull. Soc. 1913 (4) **13.** 816.)

According to Pickering (C. N. **47.** 181) only $3CuO, SO_3+2\frac{1}{2}H_2O$ and $4CuO, SO_3+4H_2O$ are true chemical compounds.

There is at 25° no definite basic sulphate of copper, all the basic sulphates being solid solutions. The solutions in contact with these basic sulphates contain SO_3 and CuO in equivalent quantities and are all sl. acid in reaction. (Bell, J. phys. Chem. 1908, **12.** 179.)

Cupric sulphate, $CuSO_4$.

Anhydrous. Absorbs H_2O from the air. Combines with, and dissolves in H_2O with great evolution of heat.

$+H_2O$. Permanent. Sol. in H_2O. (Étard, C. R. 87. 602.)

$+2H_2O$ (?). (Storer's Dict.)

$+3H_2O$. (Étard, C. R. 104. 1614.)

Does not exist. (Cross, C. N. 49. 220.)

See Foote, p. 965.

$+5H_2O$. Superficially efflorescent in dry air.

Sol. in 2.34 pts. H_2O at 18°, and sat. solution has sp. gr. 1.2147. (Schiff, A. **109.** 326.)

100 pts. $CuSO_4$+Aq sat. at b. pt., 102.2°, contain 45 pts. of the dry salt, or 100 pts. H_2O at 102.2° dissolve 81.82 pts. $CuSO_4$. (Griffiths, Q. J. Sci. **18.** 90.)

Sol. in less than 4 pts. H_2O at ord. temp., and much more sol. in boiling H_2O. (Bergmann.)

Sol. in 4 pts. cold, and 2 pts. hot H_2O. (Schubarth.)

100 pts. H_2O dissolve 33.103 pts. $CuSO_4+5H_2O$ at 15°, and solution has sp. gr. = 1.1859. (Michel and Krafft, A. ch. (3) **41.** 478.)

$CuSO_4$+Aq sat. at 8° has 1.17 sp. gr. (Anthon, A. 24. 210.)

1 pt. $CuSO_4+5H_2O$ dissolves at:

4°	19°	31°	37.5°	56°
in 3.32	2.71	1.84	1.7	1.14 pts. H_2O.
62.5°	75°	87.5°	100°	104°
in 1.27	1.07	0.75	0.55	0.47 pts. H_2O

(Brandes and Gruner, **1826.**)

Sol. at 17.5 in 2.412 pts. H_2O. (Karsten.)

100 pts. H_2O dissolve at:

9°	10°	20°	30°	
31.61	36.95	42.31	48.81	pts. $CuSO_4+5H_2O$,
40°	50°	60°	70°	
56.90	65.83	77.39	94.60	pts. $CuSO_4+5H_2O$,
80°	90°	100°		
118.03	156.44	203.32		pts. $CuSO_4+5H_2O$.

(Poggiale, A. ch. (3) **8.** 463.)

100 pts. H_2O dissolve at:

0°	20°	35°	54°	
17	24.3	28.6	36.1	pts. anhydrous $CuSO_4$.

(Tobler, A. **95.** 193.)

100 pts. $CuSO_4$+Aq sat. at 11–14° contain 16.23 pts. anhydrous $CuSO_4$. (v. Hauer, J. pr. **103.** 114.)

100 pts. H_2O dissolve 15.107 pts. $CuSO_4$ at 0°. (Pfaff, A. **99.** 224.)

100 pts. H_2O dissolve pts. $CuSO_4$ at t°.

t°	Pts. $CuSO_4$
0	14.99
17.9	20.16
24.1	22.37

(Diacon, J. B. **1866.** 61.)

100 pts. H_2O dissolve pts. $CuSO_4$ at t°.

t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$
0	14.15	40	28.50	80	54.53
10	17.50	50	33.31	90	64.35
20	20.53	60	39.01	100	75.22
30	24.34	70	45.74	.	.

(Patrick and Aubert, Transactions of Kansas Acad. of Sci. **1874.** 19.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$	t°	Pts. $CuSO_4$
0	15.5	35	27.5	70	45.7
1	16.3	36	27.9	71	46.4
2	16.6	37	28.3	72	47.2
3	16.9	38	28.7	73	47.9
4	17.2	39	29.1	74	48.7
5	17.5	40	29.5	75	49.5
6	17.8	41	29.9	76	50.3
7	18.1	42	30.3	77	51.1
8	18.4	43	30.7	78	51.9
9	18.7	44	31.1	79	52.7
10	19.1	45	31.5	80	53.5
11	19.3	46	31.9	81	54.3
12	19.6	47	32.3	82	55.1
13	19.9	48	32.7	83	55.9
14	20.2	49	33.2	84	56.8
15	20.5	50	33.6	85	57.8
16	20.8	51	34.1	86	58.7
17	21.1	52	34.5	87	59.7
18	21.4	53	35.0	88	60.7
19	21.7	54	35.5	89	61.7
20	22.0	55	36.0	90	62.7
21	22.3	56	36.6	91	63.7
22	22.6	57	37.2	92	64.8
23	23.0	58	37.8	93	65.8
24	23.3	59	38.4	94	66.9
25	23.7	60	39.0	95	68.0
26	24.0	61	39.6	96	69.1
27	24.4	62	40.2	97	70.2
28	24.7	63	40.9	98	71.3
29	25.1	64	41.5	99	72.4
30	25.5	65	42.2	100	73.5
31	25.9	66	42.9	101	74.6
32	26.3	67	43.6	102	75.7
33	26.7	68	44.3	103	76.8
34	27.1	69	45.0	104	77.95

(Mulder, Scheik. Verhandel. **1864.** 79.)

If solubility S=pts. anhydrous $CuSO_4$ in 100 pts. solution, S=11.6+0.2614t from −2° to 55°; S=26.5+0.3700t from 55° to 105°; S=45.0−0.0293t from 105° to 190°. (Étard, C. R. **104.** 1614.)

Solubility decreases above 120°, owing to formation of basic salt. (Tilden and Shenstone, Phil. Trans. **1884.** 23.)

100 ccm. H_2O dissolve 14.92 g. $CuSO_4$ at 0°. (Engel, C. R. **102.** 113.)

100 ccm. H_2O dissolve 22.28–22.30 g. $CuSO_4$ at 20°. (Trevor, Z. phys. Ch. **7.** 468.)

Sat. $CuSO_4$+Aq contains % $CuSO_4$ at t°.

t°	% $CuSO_4$	t°	% $CuSO_4$
−1	12.1	88	38.8
+7	14.1	89	38.9
9	14.5	94	41.8
18	16.9	96	41.9
20	17.2	97	42.0
20	17.4	100	43.6
35	21.3	108	43.8
39	21.8	110	43.4
45	23.9	116	43.8
54	26.9	116	44.0
54	26.6	120	44.8
61	28.8	132	44.8
63	29.1	133	44.7
65	30.0	143	45.0
70	31.6	160	44.2
71.7	32.6	165	44.5
76	34.5	179	42.9
80	36.6	189	42.2
86	37.8	...	..

(Étard, A. ch. 1894, (7) **2.** 554.)

Solubility in H_2O at t°.

t°	g. $CuSO_4$ per 100 g. H_2O
0	14.15
10	17.68
15	19.25
20	20.78
25	22.29 (by interpolation)

(Cohen, Z. phys. Ch. 1907, **60.** 713.)

1.399 mol. are sol. in 1 l. H_2O at 25°. (Herz, Z. anorg. 1910, **67.** 366.)

100 g. $CuSO_4$+Aq sat. at 30° contain 20.32 anhyd. $CuSO_4$. (Schreinemakers, Z. phys. Ch. 1910, **71.** 110.)

$+7H_2O$. (Boisbaudran, C. R. **65.** 1249.)

$+6H_2O$. (Boisbaudran, C. R. **66.** 487.)

Sp. gr. of $CuSO_4$+Aq at 18°. %=% $CuSO_4+5H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0063	11	1.0716	21	1.1427
2	1.0126	12	1.0785	22	1.1501
3	1.0190	13	1.0854	23	1.1585
4	1.0254	14	1.0923	24	1.1659
5	1.0319	15	1.0993	25	1.1738
6	1.0384	16	1.1063	26	1.1817
7	1.0450	17	1.1135	27	1.1898
8	1.0516	18	1.1208	28	1.1980
9	1.0582	19	1.1281	29	1.2063
10	1.0649	20	1.1354	30	1.2146

(Schiff, calculated by Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $CuSO_4$+Aq at 23.9°. a=no. of ½ mols. in grms. dissolved in 1000 grms. H_2O; b=sp. gr. if a is $CuSO_4=5H_2O$ (½ mol. wt.=125); c=sp. gr. if a is $CuSO_4$ (½ mol. wt.=80).

a	b	c
1	1.076	1.080
2	1.142	1.154
3	1.200	1.225

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $CuSO_4$+Aq at 15°. %=% $CuSO_4+5H_2O$.

%	Sp. gr.	%	Sp. gr.
5	1.0335	20	1.1443
10	1 0688	25	1.1848
15	1.1060	mother liquor	1.185

(Gerlach, Dingl. **181.** 131.)

Sp. gr. of $CuSO_4$+Aq at 18°.

% $CuSO_4$	Sp. gr.	% $CuSO_4$	Sp. gr.
5	1.0513	15	1.1675
10	1.1073	17.5	1.2003

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $CuSO_4$+Aq at 0°. S=pts. $CuSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
11.9315	1.1371	5.2181	1.0578
9.8159	1.1108	2.6460	1.0290
7.5474	1.0833	...	...

(Charpy, A. ch. (6) **29.** 26.)

Sp. gr. of $CuSO_4$+Aq at room temp.

% $CuSO_4$	Sp. gr.
6.79	1.055
12.57	1.1151
17.49	1.1635

(Wagner, W. Ann. 1883, **18.** 265.)

Sp. gr. of $CuSO_4$+Aq at 25°.

Concentration of $CuSO_4$ +Aq	Sp. gr.
1-normal	1.0790
1/2- "	1.0402
1/4- "	1.0205
1/8- "	1.0103
1/16- "	1.0050

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

B.-pt. $CuSO_4$+Aq containing pts. $CuSO_4$ to 100 pts: H_2O.

B.-pt.	Pts. $CuSO_4$	B.-pt.	Pts. $CuSO_4$
100.5°	21.3	103.0°	69.0
101.0	36.9	103.5	74.9
101.5	48.0	104.0	80.1
102.0	56.2	104.2	82.2
102.5	63.0	...	...

(Gerlach, Z. anal. **26.** 434.)

Sat. $CuSO_4$+Aq boils at 102.2°, and contains 81.8 pts. $CuSO_4$ to 100 pts. H_2O. (Griffiths.)

Crust forms at 102.3°, and solution contains 60.3 pts. $CuSO_4$ to 100 pts. H_2O; highest temp. observed, 104.8°. (Gerlach, Z, anal. **26.** 426.)

Sol. in HCl+Aq, causing a reduction of temperature of about 17°.

Very sl. sol. in conc. H_2SO_4. (Schulz.)

Solubility in H_2SO_4+Aq at 0°.

G. per 100 g. H_2O		Sp. gr.
H_2SO_4	$CuSO_4$	
0.00	14.85	1.144
2.03	14.29	1.143
7.16	15.65	1.158
15.20	9.90	1.170
26.57	6.43	1.195
27.57	6.19	1.211
35.2	3.99	1.224

(Engel, C. R. 1887, **104.** 507.)

Solubility in H_2SO_4+Aq at 25°.

Solution			Solid phase
Sp. gr.	% CuO	% SO_3	
1.2142	9.17	9.26	$CuSO_4+5H_2O$
1.2248	5.91	15.90	
1.2593	3.39	23.09	
1.2934	1.82	28.75	
1.4061	1.32	39.74	
1.4256	...	41.29	$CuSO_4+5H_2O$ and $CuSO_4+3H_2O$
1.4249	...	41.04	$CuSO_4+3H_2O$
1.4516	1.38	43.63	
1.4915	1.02	47.82	
1.5124	...	49.07	$CuSO_4+H_2O$
1.5408	0.38	51.46	
1.5643	0.368	53.51	
1.6824	0.109	62.14	
1.7752	0.105	68.34	
1.8118	0.15	72.41	
1.8266	0.07	74.26	$CuSO_4$

These results show that the hydrates of $CuSO_4$ which are stable at 25° are $CuSO_4$+ $5H_2O$, $+3H_2O$ and $+H_2O$.

(Bell and Taber, J. phys. Chem. 1908, **12.** 175.)

Solubility in H_2SO_4+Aq at 25°.

Solution contains		Solid phase
% CuSO	% H_2SO_4	
18.47	none	$CuSO_4+5H_2O$
12.62	11.14	
5.92	25.53	
3.25	36.77	
2.63	42.15	
2.59	47.66	
2.83	49.00	$CuSO_4+5H_2O$ and $CuSO_4+3H_2O$
2.83	49.20	
2.84	49.29	
2.70	50.23	$CuSO_4+3H_2O$
2.19	54.78	
2.11	55.84	$CuSO_4+3H_2O$ and $CuSO_4+H_2O$
2.15	55.60	
0.95	61.79	$CuSO_4+H_2O$
0.17	77.93	
0.15	83.29	
0.19	85.46	
0.44	85.72	$CuSO_4+H_2O$ and $CuSO_4$
0.42	85.81	
0.40	86.04	$CuSO_4$
0.19	92.70	

These results show that the hydrates of $CuSO_4$ which are stable at 25° are $CuSO_4$+ $5H_2O$, $+3H_2O$ and $+H_2O$.
(Foote, J. Am. Chem. Soc. 1915, **37.** 290.)

Sl. sol. in sat. NH_4Cl+Aq, with separation of a double sulphate.

Solubility of $CuSO_4$ in $CuCl_2$+Aq at 30°.

% $CuCl_2$	% $CuSO_4$	Solid phase
0	20.32	$CuSO_4$, $5H_2O$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.47	2.90	$CuSO_4$, $5H_2O$ + $CuCl_2$, $2H_2O$
43.25	1.14	$CuCl_2$, $2H_2O$
45.95	0	"

(Schreinemakers, Arch. Néer. Sci. 1910, (2) **15.** 117.)

Solubility of $CuSO_4$ in LiCl+Aq at 25°.
Solid phase, $CuSO_4$, $5H_2O$.
(G. mols. per l. of solution.)

LiCl	$CuSO_4$
0	1.399
0.73	1.257
1.40	1.176
2.83	1.067

(Herz, Z. anorg. 1910, **67.** 366.)

Solubility of $CuSO_4$ in KCl+Aq at 25°.
Solid phase, $CuSO_4+5H_2O$.
(G. mols. per l. of solution.)

KCl	$CuSO_4$
0.56	1.496
1.17	1.561
2.34	1.819

(Herz.)

Solubility of $CuSO_4$ in NaCl+Aq at 25°.
Solid phase, $CuSO_4+5H_2O$.
(G. mols. per l. of solution.)

NaCl	$CuSO_4$
0	1.399
0.36	1.404
1.32	1.426
2.53	1.507

(Herz.)

Solubility of $CuSO_4$ in RbCl+Aq at 25°, containing 1.094 g. mols. per l.=1.568 g. mols. (Herz.)

Slowly sol. in sat. KNO_3+Aq, with separation of a double sulphate.

Very slowly sol. in sat. $NaNO_3$+Aq, with separation of a double sulphate. (Karsten, Berl. Abhandl. **1840.** 10.)

Solubility of $CuSO_4$ in $(NH_4)_2SO_4$+Aq at 0°.

g. per 100 cc. solution $(NH_4)_2SO_4$	g. per 100 cc. solution $CuSO_4$	Sp. gr.	g. per 100 cc. solution $(NH_4)_2SO_4$	g. per 100 cc. solution $CuSO_4$	Sp. gr.
0	14.79	1.144	5.59	5.13	1.081
3.61	16.09	1.190	7.51	2.95	1.071
4.63	8.38	1.108	12.31	0.94	1.082
4.90	7.26	1.099	20.65	0.80	1.116

(Engel, C. R. 1886, **102.** 114.)

See also under $(NH_4)_2SO_4$.

Solubility of $CuSO_4$ in Li_2SO_4+Aq at 30°.

Composition of the solution % by wt. $CuSO_4$	% by wt. Li_2SO_4	Solid phase
20.32	0	$CuSO_4$, $5H_2O$
17.50	3.54	"
16.10	6.08	"
13.55	11.94	"
12.14	15.72	"
11.04	17.92	"
10.05	20.55	$CuSO_4$, $5H_2O$+Li_2SO_4, H_2O
10.08	20.51	"
10.07	20.49	"
6.41	22.23	Li_2SO_4, H_2O
3.39	23.59	"
0	25.24	"

(Schreinemakers, Z. phys. Ch. 1909, **66.** 692.)

Sol. in $CuCl_2$, $(NH_4)_2SO_4$, NH_4Cl+Aq at 30°. (Schreinemakers, Z. phys. Ch. 1909, **69.** 565.)

Sol. in $(NH_4)_2SO_4$, Li_2SO_4+Aq. at 30°. (Schreinemakers, Z. phys. Ch. 1909, **66.** 694.)

100 pts. sat. solution of $CuSO_4$ and $FeSO_4$ contain 17.43 pts. of the salts at 11–14.° (v. Hauer, J. pr. **103.** 114.)

100 pts. H_2O dissolve 10.85 pts. $CuSO_4$, 17.47 pts. $MgSO_4$, and 5.78 pts. Na_2SO_4 at 0°. (Diacon.)

100 pts. H_2O dissolve 7.169 pts. $CuSO_4$, 21.319 pts. $MgSO_4$, and 6.830 pts. Na_2SO_4 at 0°. (Pfaff.)

Slowly and sl. sol. in sat. $MgSO_4$+Aq. (Karsten.)

Solubility of $CuSO_4$ in H_2O in presence of $MgSO_4$. 100 pts. H_2O dissolve—

No.	$CuSO_4$	$MgSO_4$	No.	$CuSO_4$	$MgSO_4$
1	0	26.37	5	12.03	15.67
2	2.64	25.91	6	13.61	8.64
3	4.75	25.30	7	14.99	0
4	9.01	23.54	.	. . .	. . .

In 1, 2, and 3, $MgSO_4$ was in excess and given amt. $CuSO_4$ added; in 4, both $CuSO_4$ and $MgSO_4$ were in excess; in 5, 6, and 7, $CuSO_4$ was in excess. (Diacon, *l. c.*)

100 pts. sat. solution of $CuSO_4$ and $MgSO_4$ contain 28.58 pts. of the salts at 11–14°. (v. Hauer, J. pr. **103.** 114.)

100 pts. sat. solution of $CuSO_4$ and $MnSO_4$ contain 37.90 pts. of the salts at 11–14.° (v. Hauer.)

Solubility of $CuSO_4$+$MnSO_4$ in H_2O at 25°.

G. per 100 g. H_2O $CuSO_4$	G. per 100 g. H_2O $MnSO_4$	G. per 100 g. H_2O $CuSO_4$	G. per 100 g. H_2O $MnSO_4$
20.2	0	9.39	46.77
19.76	3.69	6.47	53.39
13.65	31.52	3.01	58.93
11.61	39.41	0.0	61.83

(Stortenbecker, Z. phys. Ch. 1900, **34.** 112.)

100 pts. sat. solution of $CuSO_4$ and $NiSO_4$ contain 31.03 pts. of the salts at 11-14.° (v. Hauer.)

Solubility of $CuSO_4$+$NiSO_4$ in H_2O.

t°	g. per 100 g. H_2O $CuSO_4$	g. per 100 g. H_2O $NiSO_4$	Mol. % $CuSO_4$ Solution	Mol. % $CuSO_4$ Solid phase
35	9.62	583.9	1.57	0.35
	41.66	484.4	7.69	2.12
	75.39	553.5	11.66	4.77
	106.40	506.5	16.92	6.52
	172.0	483.8	25.6	13.88
	186.9	468.8	27.90	18.77; 94.91
67	20.04	729.3	2.65	0.93
	66.01	706.2	8.31	2.86
	88.08	501.6	13.55	3.92
	147.94	675.0	16.39	6.66
	249.9	747.8	24.46	23.32

(Fock, Z. Kryst. Min. 1897, **28.** 387.)

More easily sol. in sat. K_2SO_4+Aq than in Na_2SO_4 or $MgSO_4$+Aq, forming a double sulphate, which separates out. (Karsten.)

K_2SO_4 and $CuSO_4$ mutually displace each other in saturated solutions. (Rüdorff, Pogg. **148.** 555.)

When K_2SO_4 and $CuSO_4$, both in excess, are dissolved in H_2O, a maximum of solubility of 15.61 pts. of the two salts in 100 pts. H_2O at 25° is reached in 30 minutes, after which the solubility decreases. This result is obtained either by treating excess of the two salts with H_2O at 25°, or cooling solutions of the two salts sat. at higher temp. to 25°. The salts are in the proportion of 5.2 pts. K_2SO_4 to 10.4 pts. $CuSO_4$. If present in the same proportion as in their saturated solutions, 5.41 pts. K_2SO_4 to 10.13 pts. $CuSO_4$ would be required.

If sat. solution of one salt is added to sat. solution of the other, $K_2Cu(SO_4)_2+6H_2O$ separates, as it is less sol. than either simple salt, until a state of equilibrium is reached, after which there is no separation, contrary to Rüdorff (see above). (Trevor, Z. phys. Ch. **7.** 486.)

$CuSO_4+Na_2SO_4$.

Solubility of $CuSO_4$ in presence of Na_2SO_4 at 0°. 100 pts. H_2O dissolve—

No.	$CuSO_4$	Na_2SO_4	No.	$CuSO_4$	Na_2SO_4
1	0	4.53	5	15.84	3.55
2	6.01	5.34	6	15.33	1.98
3	9.81	5.73	7	14.99	0
4	16.67	6.48			

In 1, 2, and 3, Na_2SO_4 was in excess and given amt. $CuSO_4$ added; in 4, both $CuSO_4$ and Na_2SO_4 were in excess; in 5, 6, and 7, $CuSO_4$ was in excess and Na_2SO_4 added. (Diacon, J. B. **1866.** 61.)

100 pts. H_2O dissolve 8.038 pts. $CuSO_4$ and 6.31 pts. Na_2SO_4 at 0°. (Pfaff, A. **99.** 224.)

100 pts. H_2O dissolve 20.7 pts. $CuSO_4$ and 15.9 pts. Na_2SO_4 at 15°. (Rüdorff, B. **6.** 484.)

Solubility of $CuSO_4+Na_2SO_4$.

1. Solid phase, 3 mol. $CuSO_4$+1 mol. Na_2SO_4.
2. Solid phase, 1 mol. $CuSO_4$+1 mol. Na_2SO_4.
3. Solid phase, 1 mol. $CuSO_4$+3 mol. Na_2SO_4.

(G. in 100 g. H_2O.)

t°	1		2		3	
	$CuSO_4$	Na_2SO_4	$CuSO_4$	Na_2SO_4	$CuSO_4$	Na_2SO_4
10	19.75	12.49	19.70	12.50	19.69	12.55
15	20.69	15.88	20.75	15.90	20.70	15.92
30	22.03	16.36	21.00	20.14	15.28	22.70
50	32.37	11.75	31.45	13.41	28.76	15.25

(Massol and Maldes, C. R. 1901, **133.** 287.)

Solubility of $CuSO_4$, $5H_2O+Na_2SO_4$, $10H_2O$.

t°	% $CuSO_4$	% Na_2SO_4
0	13.40	6.23
12	14.83	9.82
15	15.00	....

(Koppel, Z. phys. Ch. 1903, **42.** 8.)

See also under $CuNa_2(SO_4)_2+6H_2O$.

$CuSO_4+ZnSO_4$.

Very slowly sol. in sat. $ZnSO_4$+Aq, forming a double salt which separates. (Karsten.)

100 pts. sat. solution of $CuSO_4$ and $ZnSO_4$ contain 32.70 pts. of the salts at 11–14°. (v. Hauer.)

Solubility of $CuSO_4+ZnSO_4$ in H_2O at 25°.

Mols. per 100 mols. H_2O		Mols. per 100 mols. H_2O	
Cu	Zn	Cu	Zn
2.28	0	0.82	5.03
1.83	2.08	0.51	5.59
1.41	3.60	0.30	5.56
1.19	5.01	0.00	6.42
1.86	3.[illegible]6	1.19	5.01
1.22	4.45	0.[illegible]1	5.59
1.31	4.72	0.267	5.77
...	...	0.00	5.94

(Stortenbecker, Z. phys. Ch. 1897, **22.** 62.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

100 pts. of a sat. solution in 40% alcohol contains 0.25 pt. $CuSO_4+5H_2O$; 20% alcohol, 3.1 pts.; 10% alcohol, 13.3 pts. (Schiff, A. **118.** 362.)

Anhydrous $CuSO_4$ is sol. in absolute methyl alcohol, but insol. in absolute ethyl alcohol. $CuSO_4+xH_2O$ is insol. in methyl or ethyl alcohol. (Klepl, J. pr. (2) **25.** 526.)

100 pts. absolute methyl alcohol dissolve 1.05 pts. anhydrous $CuSO_4$ at 18°.

100 pts. absolute methyl alcohol dissolve 15.6 pts. $CuSO_4+5H_2O$ at 18°; 100 pts. 93.5% methyl alcohol dissolve 0.93 pt. $CuSO_4+5H_2O$ at 18°; 100 pts. 50% methyl alcohol dissolve 0.4 pt. $CuSO_4+5H_2O$ at 18°; 100 pts. absolute methyl alcohol dissolve 13.4 pts. $CuSO_4+5H_2O$ at 3°.

100 pts. absolute ethyl alcohol dissolve 1.1 pts. $CuSO_4+5H_2O$ at 3°. (de Bruyn, Z. phys. Ch. **10.** 786.)

Methyl alcohol dissolves 11.5% $CuSO_4+5H_2O$ at 0°. (Auger, C. R. 1906, **142.** 1272.)

Glacial acetic acid precipitates $CuSO_4$ completely from $CuSO_4$+Aq.

100 g. 95% formic acid dissolve 0.05 g. $CuSO_4+5H_2O$ at 18.5°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Sol. in glycerine (Pelouze), picoline (Unverdorben).

100 g. glycerine dissolve 36.3 g. $CuSO_4+5H_2O$ at 15–16°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

100 g. glycerine dissolve 30.0 g. $CuSO_4$ at 15.5°.

100 g. solution of $CuSO_4$ in glycol contain 7.6 g. at 14.6°. (de Coninck, Bull. Ac. Belg. **1905.** 257.)

Anhydrous $CuSO_4$ is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014); methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314); benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Min. *Chalcanthite.*

Cupric glucinum sulphate, $CuSO_4$, $4GlSO_4+20H_2O$.

Sol. in H_2O. (Klatzo, J. B. **1868.** 205.)
Does not exist. (Marignac, A. ch. (4) **30.** 45.)
$9CuSO_4$, $GlSO_4+50H_2O$. As above.
Does not exist. (Marignac, *l. c.*)

Cupric hydrazine sulphate, $CuH_2(SO_4)_2$, $2N_2H_4$.

1 pt. is sol. in 1148 pts. H_2O at 10°.
Decomp. by acids.
Sol. in NH_4OH+Aq with decomp. (Curtius, J. pr. 1894, (2) **50.** 331.)

Cupric iron (ferrous) sulphate, $CuSO_4$, $FeSO_4$.

Insol. in H_2O. (Étard, C. R. **87.** 602.)
$+2H_2O$. (Étard.)
$CuSO_4$, $2FeSO_4+21H_2O$. Sol. in H_2O. (v. Hauer.)
$CuSO_4$, $3FeSO_4+28H_2O$. 100 pts. H_2O dissolve 75 pts. salt at 7°. (Lefort.)
$4CuSO_4$, $FeSO_4+34H_2O$. 100 pts. H_2O at 15.5° dissolve 75.91 pts. (Thomson.)

Cupric iron (ferric) sulphate, $CuSO_4$, $Fe_2(SO_4)_3+24H_2O$.

Sol. in H_2O. (Bastick.)

Cupric iron (ferrous) potassium sulphate, $CuSO_4$ $FeSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric lead sulphate, CuO, PbO, SO_3+H_2O.

Min. *Linarite.*
$3CuO$, $7PbO$, $5SO_3+5H_2O$. Min. *Caledonite.* Sol. in HNO_3+Aq.

Cupric magnesium sulphate, $CuSO_4$, $MgSO_4+14H_2O$.

Efflorescent. Sol. in H_2O. (Vohl, A. **94.** 57.)
$+2H_2O$. (Arrot, **1834.**)
$CuSO_4$, $2MgSO_4+21H_2O$. Sol. in H_2O. (v. Hauer, Pogg. **125.** 638.)
$CuSO_4$, $7MgSO_4+56H_2O$. Sol. in H_2O. (Schiff, A. **107.** 64.)

Cupric magnesium manganous potassium sulphate, $CuSO_4$, $MgSO_4$, $MnSO_4$, $3K_2SO_4+18H_2O$.

Sol. in H_2O. (Vohl.)

Cupric magnesium potassium sulphate, $CuSO_4$, $MgSO_4$, $2K_2SO_4+6H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)
Does not exist. (Aston and Pickering, Chem. Soc. **49.** 123.)

Cupric magnesium potassium zinc sulphate, $CuSO_4$, MgO_4, $3K_2SO_4$, $ZnSO_4+18H_2O$.

Sol. in H_2O. (Vohl.)

Cupric manganous sulphate, $5CuSO_4$, $2MnSO_4+35H_2O$.

Sol. in H_2O. (Schäuffele, J. B. **1852.** 340.)
$2CuSO_4$, $3MnSO_4+25H_2O$. As above. (S.)
$CuSO_4$, $MnSO_4+H_2O$. (Étard, C. R. **87.** 602.)

Cupric manganous potassium sulphate, $CuSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric nickel sulphate, $CuSO_4$, $NiSO_4+3H_2O$.

(Étard, C. R. **87.** 602.)
$CuSO_4$, $2NiSO_4+21H_2O$. Sol. in H_2O. (v. Hauer.)
$+18H_2O$. Sol. in H_2O. (Boisbaudran, C. R. **66.** 497.)
$2CuSO_4$, $2NiSO_4$, $3H_2SO_4$. (Étard.)

Cupric nickel potassium sulphate, $CuSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl.)
Sol. in 4 pts. H_2O; insol. in alcohol. (Bette.)
$4CuSO_4$, $K_2SO_4+4H_2O$. Very sl. sol. in H_2O.
K_2O, $4CuO$, $4SO_3+4H_2O$. Insol. in H_2O, but decomp. by boiling H_2O into $3CuO$, SO_3.

Cupric potassium sulphate, $K_2Cu(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 66.666 pts. at 102.8°. (Griffiths.)
Much more sol. in hot than cold H_2O. (Pierre.)
Easily sol. in H_2O; by boiling, decomp. into basic salt. (Persoz, A. ch. (3) **25.** 272.)

100 pts. H_2O dissolve 11.14 pts. anhydrous salt at 25°. (Trevor, Z. phys. Ch. **7.** 470.)
1 l. H_2O dissolves 116.9 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)
See also $CuSO_4+K_2SO_4$.
Min. *Cyanochroite.*

Cupric potassium zinc sulphate, $CuSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Cupric rubidium sulphate, $CuSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton.)
1 l. H_2O dissolves 102.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Cupric sodium sulphate, basic, Na_2SO_4, $Cu(OH)_2$, $3CuSO_4+2H_2O$.

Min. *Natrochalcite.*
Sl. sol. in H_2O; easily sol. in acids. (Palache and Warren, Am. J. Sci. 1908, (4) **26.** 346.)

Cupric sodium sulphate, $CuSO_4$, $Na_2SO_4+2H_2O$.

Solubility of the pure double salt $CuSO_4$, $Na_2SO_4+2H_2O$.

t°	100 grams solution contain	
	$CuSO_4$ grams	Na_2SO_4 grams
17.7	14.34	13.34
19.5	14.54	12.90
23	14.36	12.76
30	14.07	12.37
40.15	13.73	12.23

(Koppel, Z. phys. Ch. 1903, **42.** 8.)

Solubility of the mixture of $CuSO_4$, $Na_2SO_4+H_2O$ and $CuSO_4$.

t°	100 g. solution contain	
	$CuSO_4$ grams	Na_2SO_4 grams
17.7	14.99	13.48?
19.5	15.62	12.06
23	16.41	11.35
30	17.97	9.95
40.15	20.56	8.00

(Koppel.)

Solubility of the mixture of $CuSO_4$, $Na_2SO_4+2H_2O$ and Na_2SO_4.

t°	100 g. solution contain	
	$CuSO_4$ grams	Na_2SO_4 grams
18	13.53	13.844
19.5	11.847	15.116
20	11.339	15.697
23	8.185	18.723
25	6.284	21.198
26	5.507	22.44
28	3 746	24.963
28.3	3.661	...
30	2.607	28.383
30.2	2.422	...
32.2	1.465	32.442
33.9	1.475	32.299
35.3	1.471	32.072
37.2	1.494	31.96

(Koppel.)

Solubility of $CuSO_4$, $Na_2SO_4+2H_2O$ in presence of varying amounts of Na_2SO_4.

t°	100 g. solution contain	
	$CuSO_4$ grams	Na_2SO_4 grams
30	5.38	22.17
30	5.41	21.92
30.1	3.69	25.37
40.15	3.97	23.90
30	1.57	32.09

(Koppel.)

Copper sulphate and sodium sulphate unite to form a double salt, $CuSO_4$, $Na_2SO_4+2H_2O$, which is stable in the presence of the solution above 16.7°. In the presence of copper sulphate the solubility of $Na_2SO_4+10H_2O$ is greater than that of the pure salt. (Koppel.)

Cupric thallous sulphate, $CuSO_4$, $Tl_2SO_4+6H_2O$.

Decomp. by recrystallising from H_2O. (Wyrouboff? W.llın, A. ch. (4) **5.** 55.)

1 l. H_2O dissolves 81 g. anhydrous salt at 25° (Locke, Am. Ch. J. 1902, **27.** 459.)

Cupric zinc sulphate, $CuSO_4$, $3ZnSO_4+28H_2O$

Efflorescent. 100 pts. H_2O dissolve 80 pts. salt at 8° Sol. in all proportions in boiling H_2O. (Lefort.)

$CuSO_4$, $2ZnSO_4+21H_2O$. (v. Hauer, Pogg. **125.** 637.)

$CuSO_4$, $ZnSO_4+12H_2O$. (Boisbaudran.)

$2CuSO_4$, $2ZnSO_4$, H_2SO_4. (Étard.)

Cuprous sulphate ammonia, Cu_2SO_4, $4NH_3$.

Sol. in NH_4OH+Aq; decomp. by pure H_2O. (Péchard, C. R. 1903, **136.** 504.)

$+H_2O$. Decomp. by H_2O. (Foerster and Blankenburg, B. 1906, **39.** 4434.)

Cupric sulphate ammonia, basic, $CuSO_4$, $3CuO$, $2NH_3+5H_2O$.

Decomp. by hot H_2O. (Pickering, Chem. Soc. **43.** 336.)

Cupric sulphate ammonia (Cuprammonium sulphate), $CuSO_4$, NH_3.

Decomp. by H_2O. (Kane.)

Decomp. by H_2O giving a basic sulphate. (Bouzat, C. R. 1902, **135.** 535.)

$CuSO_4$, $2NH_3$ [$CuSO_4$, $2NH_3+3H_2O$. (Mendelejeff, B. **3.** 422.)]. Decomp. by excess of H_2O into—

$CuSO_4$, $4NH_3+H_2O$. Sol. in 1.5 pts. H_2O, but decomp. by much H_2O. Insol. in alcohol. Insol. in conc. NH_4OH+Aq. (André, C. R. **100.** 1138.)

Sol. in small quantity of H_2O; decomp. in dil. solution. (Bouzat.)

100 g. H_2O dissolve 44.56 g. anhydrous comp. at 25°. (Pudschies, Dissert.)

100 g. H_2O dissolve 18.05 g. at 21–22°. (Horn and Taylor, Am. Ch. J. 1904, **32.** 268.)

$CuSO_4$, $5NH_3$. Completely sol. in H_2O. (Rose, Pogg. **20.** 150.)

Sol. in small amt. of H_2O; decomp. in dil. solution. Insol. in liquid NH_3. (Bouzat, C. R. 1902, **135.** 535.)

Cuprous sulphate carbon *monoxide*, Cu_2SO_4, $2CO+H_2O$.

Very unstable. (Joannis, C. R. 1903, **136.** 615.)

Cupric sulphate zinc oxide, $CuSO_4$, $2ZnO+21H_2O$.

(Larsen, Ch. Z. Repert. 1896, **20.** 317.)

$2CuSO_4$, $3ZnO+12H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 169.)

Didymium sulphate, basic, Di_2O_3, $SO_3=(DiO)_2SO_4$.

Insol. in cold or boiling H_2O. (Marignac.)

Slowly sol. in hot dil. $HCl+Aq$. Easily sol. in conc. acids.

$+8H_2O$. Precipitate. (Hermann.).

Composition is $2Di_2O_3$, $3SO_3+3H_2O$ or $Di_2(SO_4)_3+Di_2O_6H_6$. (Frerichs and Smith.)

Composition is $5Di_2O_3$, $3SO_3+xH_2O$. (Cleve, B. **11.** 910.)

Didymium sulphate, $Di_2(SO_4)_3$.

Anhydrous. By saturating cold H_2O and warming the solution, the following results were obtained—100 pts. H_2O dissolve at:

12°	18°	25°	38°	50°
43.1	25.8	20.6	13.0	11.0 pts. $Di_2(SO_4)_3$.

$+6H_2O$. H_2O dissolves this salt very slowly; 100 pts. H_2O dissolve 13 pts. $Di_2(SO_4)_3$ in 24 hours, and 16.4 pts. in 2 days. If solution is evap. in vacuo until $Di_2(SO_4)_3+8H_2O$ separates out, 34 pts. $Di_2(SO_4)_3$ remain dissolved in 100 pts. H_2O.

$+5H_2O$. (Cleve.)

$+8H_2O$. Solutions of this salt contain at:

19°	40°	50°	100°
11.7	8.8	6.5	1.6 pts. $Di_2(SO_4)_3$.

(Marignac, A. ch. (3) **38.** 170.)

$+9H_2O$. (Zschiesche, J. Pr. **107.** 75.)

Didymium potassium sulphate, K_2SO_4, $Di_2(SO_4)_3+2H_2O$.

Sol. in 63 pts. H_2O. Insol. in sat. K_2SO_4+Aq. (Marignac.)

$3K_2SO_4$, $Di_2(SO_4)_3$. Sol. in 83 pts. H_2O at 18°. Insol. in cold, sl. sol. in boiling sat. K_2SO_4+Aq, 100 ccm. of which retain 55 mg. Di_2O_3 in solution. (Cleve.)

$4K_2SO_4$, $Di_2(SO_4)_3$. (Cleve.)

$9K_2SO_4$, $2Di_2(SO_4)_3+3H_2O$. (Cleve.)

Didymium sodium sulphate, $Di_2(SO_4)_3$, Na_2SO_4, and $+2H_2O$.

Sol. in 200 pts. H_2O (Marignac), and still less in sat. Na_2SO_4+Aq, 100 ccm. of which dissolve only 70 mg. Di_2O_3 at ord. temp. (Cleve.)

Didymium thallous sulphate, $(Di_2SO_4)_3$, $3Tl_2SO_4$.

Ppt.

$Di_2(SO_4)_3$, $Tl_2SO_4+2H_2O$. Sol. in H_2O. (Zschiesche, J. pr. **107.** 98.)

Erbium sulphate, $Er_2(SO_4)_3$.

Anhydrous. Easily and rapidly sol. in H_2O. 100 pts. H_2O dissolve 43 pts. anhydrous salt at 0°.

$+8H_2O$. Less sol. in H_2O than anhydrous salt. 100 pts. H_2O dissolve 30 pts. $Er_2(SO_4)_3+8H_2O$ (=23 pts. $Er_2(SO_4)_3$) at about 20°; at 100°, 100 pts. $Er_2(SO_4)_3+8H_2O$ remain dissolved. Sat. solution deposits crystals when heated to 55°. (Höglund.)

100 g. of sat. solution of $Er_2(SO_4)_3+8H_2O$ at 25° in H_2O contains 11.94 g. anhyd. $Er_2(SO_4)_3$. (Wirth, Z. anorg. 1912, **76.** 174.)

Solubility of $Er_2(SO_4)_3+8H_2O$ in H_2SO_4 at 25°.

N = equiv. g. H_2SO in 1 l. of solvent.
C = g. oxide in 100 g. of solution.
C^1 = g. anhyd. salt in 100 g. of solution.

N	C	C^1	N	C	C^1
0	4.604	7.60	4.32	2.00	3.301
0.1	4.615	7.618	6.685	0.9115	1.505
1.1	3.64	6.00	9.68	0.4439	0.733
2.16	3.04	5.018	15.15	0.145	0.239

(Wirth, Z. anorg. 1912, **76.** 174.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Erbium potassium sulphate, $Er_2(SO_4)_3$, $3K_2SO_4$.

Slowly sol. in H_2O. (Höglund.)

Erbium sodium sulphate, $Er_2(SO_4)_3$, $5Na_2SO_4+7H_2O$.

Sol. in H_2O. (Cleve.)

Europium sulphate, $Eu_2(SO_4)_3+8H_2O$.

Stable in the air. (Urbain and Lacombe, C. R. 1904, **138.** 628.)

Gadolinium sulphate, $Gd_2(SO_4)_3+8H_2O$.

Solubility in H_2O.

Temp.	Pts. of $Gd_2(SO_4)_3$ in 100 pts. H_2O
0°	3.98
9.3–10.6°	3.33
14.0°	2.80
25.0°	2.40
34.4°	2.26

(Benedicks, Z. anorg. 1899, **22.** 409–410.)

100 g. sat. solution of $Gd(SO_4)_3+8H_2O$ at 25° in H_2O contain 2.981 g. anhyd. $Gd_2(SO_4)_3$. (Wirth, Z. anorg. 1912, **76.** 174.)

Solubility in H_2SO_4. Solid phase, $Gd_2(SO_4)_3+8H_2O$.

N = equiv. g. H_2SO_4 in 1 l. of solvent.
C = g. oxide in 100 g. of solution.
C_1 = g. anhyd. $Gd_2(SO_4)_3$ in 100 g. of solution.

N	C	C_1	N	C	C_1
0	1.793	2.981	2.16	1.789	2.974
0.1	1.98	3.291	6.175	0.528	0.8777
0.505	2.365	3.931	12.6	0.0521	0.0867
1.1	2.29	3.807	...	...	...

(Wirth.)

Sol. in sat. K_2SO_4+Aq.

Gadolinium potassium sulphate, $Gd_2(SO_4)_3, K_2SO_4+2H_2O$.

100 grams. sat. solution in K_2SO_4+Aq contains 0.87—0.77 grams Gd_2O_3. (Benedicks, Z. anorg. 1900, **22.** 410.)

Gallium sulphate, $Ga_2(SO_4)_3$.

Not deliquescent, but very sol. in H_2O. Sol. in 60% alcohol; insol. in ether. (Boisbaudran.)

Aqueous solution decomp. into basic salt by boiling, which redissolves, however, on cooling.

Gallium potassium sulphate, $Ga_2K_2(SO_4)_4+24H_2O$.

(Soret, Arch. sc. phys. nat. 1885, **14.** 96.)

Gallium rubidium sulphate, $Rb_2Ga_2(SO_4)_4+24H_2O$.

(Soret, Arch. sc. phys. nat. 1885, **14.** 96.)

Glucinum sulphate, basic, $3GlO, SO_3+4H_2O$.

Sol. in H_2O, but decomp. by heating or dilution. (Berzelius.)

$2GlO, SO_3+3H_2O$. Sol. in H_2O.

$9GlO, SO_3+14H_2O$ (?). Precipitate. Insol. in H_2O. (Berzelius.)

According to Debray, this salt when carefully washed is GlO_2H_2.

Glucinum sulphate, $GlSO_4$.

Anhydrous.

Nearly insol. in H_2O, but slowly attacked by cold, rapidly by hot H_2O, and is converted into $GlSO_4+4H_2O$ before dissolving. (Parsons, Z. anorg. 1904, **42.** 253.)

Sp. gr. of $GlSO_4+Aq$ at 25°.

Concentration of $GlSO_4+Aq$	Sp. gr.
1—normal	1.0451
1/2— "	1.0229
1/4— "	1.0114
1/16— "	1.0027

(Wagner, Z. phys. Ch. 1890, **5.** 35.)

Solubility of $GlSO_4$ in H_2SO_4+Aq at 25°.

H_2SO_4+Aq % H_2SO_4	100 g. of the solution contain g. $GlSO_4$	Solid phase
...	8.212	$GlSO_4+6H_2O$
5.23	8.429	
9.61	7.944	
18.70	6.603	
34.00	[illegible].631	
40.35	[illegible].773	
45.51	[illegible].628	
50.63	5.438	$GlSO_4+4H_2O$
56.59	3.640	
63.24	2.244	
65.24	2.128	
73.64	2.185	

(Wirth, Z. anorg. 1913, **79.** 359.)

See also under +2, 4, and $6H_2O$.

Insol. in liquid NH_3 (Gore, Am. Ch. J., 1898, **20.** 828.)

$+H_2O$. (Levi-Malvano, Z. anorg. 1906, **48.** 447.)

$+2H_2O$.

Solubility in H_2O at t°.

t°	G. $GlSO_4$ per 100 g.	
	H_2O	Solution
80	84.76	45.87
91.4	97.77	49.42
105	118.4	54.21
119	149.3	59.88

(Levi-Malvano.)

$+4H_2O$. Very sol. in H_2O.

Sol. in its own weight of H_2O at 14°, and in every proportion of boiling H_2O. Less sol. in dil. H_2SO_4+Aq than in water. (Debray, A. ch. (3) **44.** 25.)

Solubility in H_2O at t°.

t°	g. $GlSO_4$ per 100 g.		t°	g. $GlSO_4$ per 100 g.	
	H_2O	solution		H_2O	solution
30	43.78	30.45	95.4	90.63	47.55
40	46.74	31.85	107.2	115.3	53.58
68	61.95	38.27	111	128.3	56.19
85	76.30	43.28	...	...	...

(Levi-Malvano.)

Sl. sol. in dilute, insol. in absolute alcohol. Can be completely pptd. from $GlSO_4+Aq$ by $HC_2H_3O_2$. (Persoz.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+6H_2O$.

Solubility in H_2O at t°.

t°	g. $GlSO_4$ per 100 g.	
	H_2O	solution
31	52.23	34.32
50	60.67	37.77
72.2	74.94	42.85
77.4	81.87	45.01

(Levi-Malvano.)

100 g. of the aqueous solution contain at 25°, 8.212 g. $GlSO_4$. (Wirth, Z. anorg. 1913, **79.** 358.)

Glucinum iron (ferrous) sulphate, $GlSO_4$, $FeSO_4+17\frac{1}{2}H_2O$.

Sol. in H_2O. (Klatzo, J. B. **1868.** 204.)

$3GlSO_4$, $FeSO_4+28H_2O$. Sol. in H_2O. (Klatzo.)

Do not exist. (Marignac, A. ch. (4) **30.** 45.)

Glucinum nickel sulphate, $(Gl,Ni)SO_4+4H_2O$, or $7H_2O$.

(Klatzo, J. B. **1868.** 205.)

Does not exist. (Atterberg, Sv. V. A. F. **1873, 4.** 81.)

Glucinum potassium sulphate, $GlSO_4$, $K_2SO_4+2H_2O$.

Sl. sol. in cold, slowly but more sol. in hot H_2O. (Debray.)

$+3H_2O$. (Klatzo.)

Glucinum potassium hydrogen sulphate, $GlH_2(SO_4)_2$, $2K_2SO_4+4H_2O$.

Easily sol. in H_2O. Partly decomp. by recrystallisation. (Atterberg.)

Glucinum sodium sulphate, $2GlSO_4$, $3Na_2SO_4+18H_2O$.

Sol. in H_2O. (Atterberg.)

Glucinum zinc sulphate, $2GlSO_4$, $3ZnSO_4+35H_2O$.

Sol. in H_2O. (Klatzo, J. B. **1868.** 205.)

Does not exist. (Atterberg.)

Gold (auroauric) sulphate, $Au_2(SO_4)_2$.

Decomp. by moist air, H_2O, glacial acetic acid, or HNO_3+Aq (1.42 sp. gr.) Insol. in conc. H_2SO_4. (Schottländer, A. **217.** 375.)

Gold (auric) sulphate, Au_2O_3, $2SO_3+H_2O$, *or* **Auryl hydrogen sulphate,** $(AuO)HSO_4$.

Deliquescent. Decomp. by H_2O. Sol. in HCl+Aq; not attacked by conc. HNO_3+Aq. Sol. in 6 pts. conc. H_2SO_4. (Schottländer.)

Gold (auric) potassium sulphate, $Au_2(SO_4)_3$, K_2SO_4.

Not decomp. immediately by cold H_2O. (Schottländer.)

Hydrazine mercuric sulphate hydrazine, $(N_2H_5)_2SO_4$, $3HgSO_4$, $2N_2H_4$.

Insol. in H_2O. Sol. in H_2O containing HCl. (Ferratini, Gazz. ch. it. 1912, **42.** (1) 142.)

Hydroxylamine uranyl sulphate, $(NH_2OH)_2$, H_2SO_4, $2(UO_2)SO_4+5H_2O$.

Extremely sol. in H_2O from which it can be cryst. (Rimbach, Dissert. **1904.**)

Indium sulphate, $In_2(SO_4)_3$.

Easily sol. in H_2O.

$+9H_2O$. Easily sol. in H_2O.

Indium hydrogen sulphate, $InH(SO_4)_2+4HO$.

Very deliquescent. (Meyer.)

Indium potassium sulphate, $InK(SO_4)_2+4H_2O$.

Sol. in H_2O, but decomp. by boiling. (Rössler, J. pr. (2) **7.** 14.)

$(InO)_3K(SO_4)_2+3H_2O$. Insol. in H_2O. (Rössler.)

Indium rubidium sulphate, $In_2(SO_4)_3$, $Rb_2SO_4+24H_2O$.

44.28 pts. are sol. in 100 pts. H_2O at 15°. (Chabrié, C. R. 1901, **132.** 473.)

Melts in crystal H_2O at 42°. (Locke, Am. Ch. J. 1901, **26.** 183.)

Indium sodium sulphate, $InNa(SO_4)_2+4H_2O$.

Sol. in H_2O. (Rossler, J. pr. (2) **7. 14.**)

Iodine sulphate, $I_2(SO_4)_3$.

Ppt. Decomp. by H_2O. (Fichter, Z. anorg. 1915, **91.** 140.)

Iodyl sulphate, $(IO)_2(SO_4)_3$.

Possible composition of Weber's (B. **20.** 86) I_2O_5, $3SO_3$.

Iridium sulphate.

Sol. in H_2O or alcohol. (Berzelius.)

$Ir(SO_4)_2$. Sol. in H_2O. (Rimbach, Z anorg. 1907, **52.** 409.)

Iridium potassium sulphate, $Ir_2(SO_4)_3$, $K_2SO_4+24H_2O$.

Mpt. 102–103°.

Easily sol. in H_2O. (Marino, Z. anorg. 1904, **42.** 220.)

$Ir_2(SO_4)_3$, $3K_2SO_4$. Sol. in H_2O or dil. H_2SO_4+Aq; nearly insol. in sat. K_2SO_4+Aq. (Boisbaudran, C. R. **96.** 1406.)

Iridium rubidium sulphate, $Ir_2(SO_4)_4Rb_2$.

Sol. in cold; very sol. in hot H_2O. (Marino, Gazz. ch. it. 1903, **32,** (2) 511.)

Mpt. 108–109°. (Marino, Z. anorg. 1904, **42.** 219.)

Iridium thallium sulphate, $Ir_2(SO_4)_3$, $Tl_2SO_4+24H_2O$.

Very sol. in H_2O. (Marino, Z. anorg. 1904, **42.** 222.)

Iron (ferrous) sulphate, $FeSO_4$.

$+H_2O$.

$+2H_2O$. Not more sol. in H_2O than gypsum. (Mitscherlich.)

$+3H_2O$. Sol. in H_2O. (Kane.)

$+4H_2O$. Separates from conc. $FeSO_4$+Aq at 80°.

$+7H_2O$. Efflorescent at 33°.

1 pt. $FeSO_4+7H_2O$ dissolves in 1.6 pts cold, and 0.3 pt. boiling H_2O.

1 pt. $FeSO_4+7H_2O$ dissolves at:

	10°	15°	25°	33°	46°	60°	81°	90°	100°
in	1.64	1.43	0.87	0.66	0.44	0.38	0.37	0.27	0.3 pts. H_2O

(Brandes and Firnhaber, Br. Arch. **7.** 83.)

When boiled with insufficient H_2O for solution a white hydrate is formed which separates out. Solubility increases up to 87.5°, and then diminishes, owing to the above separation. (Brandes, Pogg. **20.** 581.)

Sol. in 2 pts. cold, and 1 pt. boiling H_2O (Fourcroy); sol. in 2 pt.s cold H_2O at 18.75° (Abl); sol. in 6 pts. H_2O at moderate heat, and 0.75 pt. at 100°. (Bergmann.)

100 pts. H_2O at 15.5° dissolve 45–50 pts. (Ure's Dict.)

100 pts. H_2O dissolve pts. $FeSO_4$ at t°.

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	15.8	21	27.4	45	42.9
10	19.9	30	32.6	55	47.0
12	21.3	37	36.5	70	56.5
20	26.0	..	.	..	..

(Tobler, A. **95.** 198.)

100 pts. $FeSO_4$+Aq sat. at 11–14° contain 17.02% $FeSO_4$. (v. Hauer, J. pr. **103.** 114.)

100 pts. $FeSO_4$+Aq. sat at 15° contain 37.2% $FeSO_4+7H_2O$; solution has sp. gr. 1.2232. (Schiff, A. 118. 362.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	7.9	34	37.1	67	65.1
1	8.7	35	38.0	68	65.0
2	9.5	36	38.9	69	64.9
3	10.4	37	39.8	70	64.8
4	11.2	38	40.7	71	64.7
5	12.0	39	41.7	72	64.5
6	12.9	40	42.6	73	64.4
7	13.7	41	43.5	74	64.2
8	14.5	42	44.4	75	64.0
9	15.5	43	45.3	76	63.7
10	16.2	44	46.2	77	63.4
11	17.0	45	47.1	78	63.1
12	17.9	46	48.1	79	62.7
13	18.7	47	49.0	80	62.3
14	19.5	48	50.0	81	61.9
15	20.4	49	51.0	82	61.5
16	21.2	50	51.9	83	61.0
17	22.1	51	52.9	84	60.4
18	23.0	52	53.8	85	59.8
19	23.8	53	54.8	86	59.2
20	24.7	54	55.7	87	58.5
21	25.6	55	56.7	88	57.7
22	26.4	56	57.7	89	57.0
23	27.3	57	58.7	90	56.2
24	28.1	58	59.7	91	55.3
25	29.0	59	60.7	92	54.3
26	29.9	60	61.7	93	53.3
27	30.8	61	62.7	94	52.2
28	31.7	62	63.7	95	51.0
29	32.6	63	64.8	96	49.6
30	33.5	63.5	65.4	97	48.0
31	34.4	64	65.4	98	46.3
32	35.3	65	65.3	99	44.5
33	36.2	66	65.2	100	42.6

(Mulder, Scheik. Verhandel. **1864.** 141.)

If solubility S = pts. anhydrous $FeSO_4$ in 100 pts. solution, $S=13.5+0.3788t$ from —2° to +65°; $S=37.5$ constant from 65° to 98°; $S=37.5-0.6685t$ from 98° to 156°. Practically insol. at 156°. (Étard, C. R. **106.** 740.)

Sat. $FeSO_4$+Aq contains at:

—1°	+5°	24°	34°	52°
13.0	15.1	22.7	26.3	32.5% $FeSO_4$,
60°	67°	77°	86°	94°
36.4	37.7	37.8	37.8	36.7% $FeSO_4$,
102°	112°	130°	152°	
34.7	28.0	17.3	2.5% $FeSO_4$.	

(Étard, A. ch. 1894, (7) **2.** 553.)

100 g. H_2O dissolve 26.69 g. $FeSO_4$ at 25°. (Stortenbecker, Z. phys. Ch. 1900, **34.** 109.)

Solubility of $FeSO_4$ in H_2O at t°.
100 g. H_2O dissolve g. $FeSO_4$.

t°	G. $FeSO_4$	t°	G. $FeSO_4$
0.00	15.65	52.00	50.20
10.00	20.51	54.03	52.07
15.25	23.86	60.01	54.95
20.13	26.56	65.00	55.59
25.02	29.60	68.02	52.31
30.03	32.93	70.04	56.08
35.07	36.87	77.00	45.90
40.05	40.20	80.41	43.58
45.18	44.32	85.02	40.46
50.21	48.60	90.13	37.27

$FeSO_4+7H_2O$ is stable from —1.82° to +56.6°; $FeSO_4+4H_2O$ from 56.6° to 64.4°; $FeSO_4+H_2O$ above this point.

(Fraenckel, Z. anorg. 1907, **55.** 228.)

$FeSO_4$+Aq sat. at 30° contains 24.9 g. $FeSO_4$ in 100 g. of solution. (Schreinemakers, Z. phys. Ch. 1912, **71.** 110.)

Sp. gr. of $FeSO_4$+Aq at 15°.
% = % $FeSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.005	15	1.082	28	1.161
2	1.011	16	1.088	29	1.168
3	1.016	17	1.094	30	1.174
4	1.021	18	1.100	31	1.180
5	1.027	19	1.106	32	1.187
6	1.032	20	1.112	33	1.193
7	1.037	21	1.118	34	1.200
8	1.043	22	1.125	35	1.206
9	1.048	23	1.131	36	1.213
10	1.054	24	1.137	37	1.219
11	1.059	25	1.143	38	1.226
12	1.065	26	1.149	39	1.232
13	1.071	27	1.155	40	1.239
14	1.077	..	. .	..	. . .

(Gerlach, Z. anal. **8.** 287.)

Sp. gr. 16.6° of sat. solution = 1.219. (Greenish and Smith, Pharm. J. 1903, **71.** 881.)

Sat. $FeSO_4$+Aq boils at 102.2° (Griffiths), and solution contains 64% $FeSO_4$. Crust forms at 102.3°; highest temp. observed, 104.8°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $FeSO_4$+Aq containing pts. $FeSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $FeSO_4$	B.-pt.	Pts. $FeSO_4$
100.5°	17.7	101.5°	50.4
101.0	34.4	101.6	53.2

(Gerlach, Z. anal. **26.** 433.)

100 g. of the sat. solution contain 22.84 g. $FeSO_4$ at 25°. (Wirth, Z. anorg. 1913, **79.** 364.)

Sol. in hot HCl+Aq. (Kane.)

Somewhat sol. in conc. H_2SO_4. (Bussy and Lecann.)

Solubility in H_2SO_4+Aq at 25°.

H_2SO_4+Aq Normality	100 g. of the solution contain g. $FeSO_4$	Solid phase
0	22.84	$FeSO_4+7H_2O$
2.25	19.03	$FeSO_4+7H_2O$
6.685	13.40	$FeSO_4+7H_2O$
10.2	10.30	$FeSO_4+7H_2O$
12.46	7.26	$FeSO_4+H_2O$
15.15	4.015	$FeSO_4+H_2O$
19.84	0.1522	$FeSO_4+H_2O$

(Wirth, Z. anorg. 1913, **79.** 364.)

More sol. in water containing NO than in pure H_2O. (Gay, Bull. Soc. (2) **44.** 175.)

Completely pptd. from $FeSO_4$+Aq by glacial $HC_2H_3O_2$. (Persoz.)

Solubility in $(NH_4)_2SO_4$+Aq. *See* under $(NH_4)_2SO_4$.

Solubility in Li_2SO_4+Aq at 30°.

Composition of the solution		Solid phase
% by wt. $FeSO_4$	% by wt. Li_2SO_4	
24.87	0	$FeSO_4, 7H_2O$
22.45	4.00	"
21.15	5.58	"
18.79	11.16	"
16.51	15.81	"
16.18	16.52	$FeSO_4, 7H_2O+Li_2SO_4, H_2O$
16.04	16.49	"
15.39	16.80	Li_2SO_4, H_2O
12.68	18.31	"
5.32	22.15	"
3.74	23.15	"
0	25.1	"

(Schreinemakers, Z. phys. Ch. 1910, **71.** 110.)

Solubility of $FeSO_4$, $H_2O+Na_2SO_4$, $10H_2O_4$, in 100 g. H_2O at t°.

t°	Grams $FeSO_4$	Grams Na_2SO_4
0	18.06	6.13
15.5	25.05	15.97

(Koppel, Z. phys. Ch. 1905, **52.** 405.)
See also under $FeNa_2(SO_4)_2$.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Insol. in liquid CO_2. (Büchner, Z. phys. Ch. 1906, **54.** 674.)

100 pts. sat. solution of $FeSO_4$ in 40% alcohol contains 0.3% $FeSO_4$. (Schiff.)

Insol. in alcohol of 0.905 sp. gr. or less. (Anthon, J. pr. **14.** 125.)

Alcohol and H_2SO_4 precipitate $FeSO_4$ from $FeSO_4$+Aq, also glacial acetic acid.

Anhydrous $FeSO_4$ is insol. in acetone. (Krug and M'Elroy, **1893.**)

Insol. in acetone. (Eidmann, C. C **1899,** II. 1014.)

100 g. sat. solution in glycol contain 6.0 g. $FeSO_4$ at ord. temp. (de Coninck.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Iron (ferrous) sulphate, acid, 2FeO, $3SO_3$, $2H_2O$.

This salt exists in contact with solutions containing $SO_3+1.637$ H_2O to about SO_3+ 2.186 H_2O. (Kenrick, J. phys. Chem. 1908, **12.** 704.)

FeO, $2SO_3+H_2O$. This compd. exists with solutions containing $SO_3+1.342$ H_2O to (about) $SO_3+1.595$ H_2O. (Kenrick.)

FeO, $4SO_3+3H_2O$. This compd. is stable with solutions containing from $SO_3+1.122$ H_2O to (about) $SO_3+1.342$ H_2O. Rapidly sol. in H_2O with ppt. of $FeSO_4+H_2O$. (Kenrick.)

Min. *Melanterite.*

Iron (ferric) sulphate, basic, $10Fe_2O_3$, SO_3+ H_2O.

(Athanasesco, C. R. **103.** 27.)

$6Fe_2O_3$, SO_3+10H_2O. Insol. in H_2O. Sl. sol. in warm HCl+Aq. (Scheerer, Pogg. **45.** 188.)

$4Fe_2O_3$, SO_3+11H_2O. (Anthon, Repert. **81.** 237.)

$3Fe_2O_3$, SO_3+4H_2O. Insol. in H_2O. Rather easily sol. in acids. (Scheerer, Pogg. **44.** 453; Meister, B. **8.** 771.)

$2Fe_2O_3$, SO_3+6H_2O. When pptd. from cold solutions, is sol. in $Fe_2(SO_4)_3$+Aq, but insol. therein when pptd. from hot solutions. (Maus.)

Only basic sulphate which is a true chemical compound. (Pickering, Chem. Soc. **37.** 807.)

Min. *Glockerite.* Insol. in H_2O. Sol. in conc. H_2SO_4.

$+7H_2O$. (Meister.)

$+8H_2O$. (Mühlhauser.)

$+15H_2O$. Min. *Pissophanite.*

Fe_2O_3, $SO_3=(FeO)_2SO_4+3H_2O$. Insol. in H_2O. (Soubeiran, A. ch. **44.** 329.)

$3Fe_2O_3$, $4SO_3+9H_2O$. (Athanasesco.)

$2Fe_2O_3$, $3SO_3+8H_2O$. Insol. in H_2O. (Wittstein.)

$+18H_2O$. Min. *Fibroferrite.* Sl. sol. in cold, more easily in hot H_2O.

Fe_2O_3, $2SO_3+10H_2O$. Min. *Stypticite.*

$+15H_2O$. Sol. in H_2O; decomp. by heat or evaporation. (Muck, J. pr. **99.** 103.)

$2Fe_2O_3$, $5SO_3+13H_2O$. Min. *Copiapite.*

$Fe_4S_5O_2+18H_2O=2Fe_2O_3$, $5SO_3+18H_2O$. *a-Copiapit.* This salt is in equilibrium at 25° with solutions in which the molecular ratio $Fe_2O_3:SO_3$ lies between 1 : 2.889 and 1 : 2.614. (Wirth, Z. anorg. 1914, **87.** 37.)

$(OH)Fe_3(SO_4)_4+13H_2O$. *β-Copiapit.* This salt is in equilibrium at 25° with solutions in which the molecular ratio $Fe_2O_3:SO_3$ lies between 1:3.472 and 1:2.889. (Wirth, Z. anorg. 1914, **87.** 37.)

According to Pickering (Chem. Soc. **37.** 807), all basic ferric sulphates are mixtures excepting $2Fe_2O_3$, SO_3.

Iron (ferric) sulphate, $Fe_2(SO_4)_3$.

Anhydrous. Slowly deliquescent. Nearly insol. in H_2O, and HCl+Aq. Insol. in conc. H_2SO_4. Very rapidly sol. in $FeSO_4$+Aq, even when very dil. (Barreswil, C. R. **20.** 1366.)

Sp. gr. of $Fe_2(SO_4)_3$+Aq. According to F =Franz at 17.5° (J. pr. (2) **5.** 280); G=Gerlach at 15° (Z. anal. **28.** 494); H=Hager at 18° (Z. anal. **27.** 280).

	5	10	15	20 % $Fe_2(SO_4)_3$,
F	1.0426	1.0854	1.1324	1.1826
G	...	1.096	..	1.205
H	1.046	1.097	1.151	1.208

	25	30	35	40 % $Fe_2(SO_4)_3$,
F	1.2426	1.3090	1.3782	1.4506
G	...	1.331	...	1.478
H	1.271	1.337	1.411	1.490

	45	50	55	60 % $Fe_2(SO_4)_3$.
F	1.5298	1.6148	1.7050	1.8006
G	...	1.650	...	...

Solubility in H_2SO_4+Aq at 25°.

H_2SO_4+Aq Normality	100 g. of the solution contain g. $Fe_2(SO_4)_3$
2.25	25.02
6.685	14.58
19.84	0.05

(Wirth, Z. anorg. 1913, **79.** 364.)

Solubility in $Al_2(SO_4)_3$+Aq at 25°.

100 g. of the solution contain	
G. $Al_2(SO_4)_3$	G. $Fe_2(SO_4)_3$
...	44.97
2.342	42.44
5.200	38.83
6.626	35.82
8.819	34.02
10.03	32.42
*10.23	31.90
10.70	31.91

*Solution sat. with respect to both salts. (Wirth and Bakke, Z. anorg. 1914, **87.** 48.)

See also under $Al_2(SO_4)_3$.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 828.)

Completely pptd. from $Fe_2(SO_4)_3$+Aq by $HC_2H_3O_2$. Sol. to large extent in alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in acetone.

$+xH_2O$. Very deliquescent, and sol. in H_2O. Conc. $Fe_2(SO_4)_3$+Aq may be boiled without decomp., but dil. solutions are decomp. on heating. A solution containing 1 pt. salt to 100 pts. H_2O becomes turbid at 76°; 1 pt. to 200 pts., at 56°; 1 pt. to 400 pts., at 47°; 1 pt. to 800 pts., at 40°; 1 pt. to 1000 pts., at 38°; 1 pt. to 10,000 pts., at 14°. (Scheerer.)

$+9H_2O$. Min. *Coquimbite.*

81.43 pts. are sol. in 18.57 pts. H_2O. (Wirth, Z. anorg. 1914, **87.** 23.)

This salt is stable at 25° only in contact with solutions in which the molecular ratio $Fe_2O_3 : SO_3$ lies between 1 : 3.472 and 1 : 6.699. (Wirth, Z. anorg. 1914, **87.** 35.)

$+10H_2O$. Slowly sol. in H_2O. (Oudemans, R. t. c. **3.** 331.)

Iron (ferroferric) **sulphate,** $6FeSO_4$, $Fe_2(SO_4)_3+60H_2O$.

Sol. in all proportions in H_2O. (Poumarède, C. R. **18.** 854.)

$3FeSO_4$, $2Fe_2(SO_4)_3+12H_2O$. Decomp. by H_2O. Easily sol. in dil. HCl+Aq. Insol. in alcohol. (Abich, **1842.**)

$FeSO_4$, $Fe_2(SO_4)_3+12H_2O$. Min. *Voltaite.* Difficultly sol. in H_2O.

FeO, Fe_2O_3, $6SO_3+15H_2O$. Deliquescent. (Lefort, J. Pharm. (4) **10.** 87.)

Iron (ferrous) *pyro***sulphate,** FeS_2O_7.

Deliquescent. Decomp. by H_2O. (Bolas, Chem. Soc. (2) **12.** 212.)

Iron (ferric) **hydrogen sulphate,** $Fe_2(SO_4)_3$, $H_2SO_4+8H_2O$.

This salt is in equilibrium at 25° only with solutions where the molecular ratio $Fe_2O_3 : SO_3$ is more acid than 1 : 6.699. (Wirth and Bakke, Z. anorg. 1914, **87.** 34.)

Sat. solution of $Fe_2(SO_4)_3$, $H_2SO_4+8H_2O$ in abs. alcohol at 25° contains 8 g. Fe_2O_3+ 17.18 g. SO_3 per 100 g. sat. solution. (Wirth and Bakke.)

Decomp. by H_2O. (Recoura, C. R. 1903, **137.** 118.)

In contact with solutions containing 25% to 28% SO_3 at 25°, the stable solid is Fe_2O_3, $3SO_3+10H_2O$. In contact with solutions containing more than 28%, the stable solid is Fe_2O_3, $4SO_3+10H_2O$. (Cameron and Robinson, J. phys. Chem. 1907, **11.** 650.)

Iron (ferroferric) **hydrogen sulphate,** $Fe_2(SO_4)_3$, $FeSO_4$, $2H_2SO_4$.

Insol. in H_2O, but slowly decomp. thereby. Sol. in H_2SO_4. (Étard, C. R. **87.** 602.)

Iron (ferrous) **hydrazine sulphate,** $FeH_2(SO_4)_2$, $2N_2H_4$.

1 pt. is sol. in 325 pts. H_2O at 12°. (Curtius, J. pr. 1894, (2) **50.** 331.)

Iron (ferrous) **magnesium sulphate,** $FeSO_4$, $MgSO_4+4H_2O$.

Sol. in H_2O. (Schiff.)

Iron (ferric) **magnesium sulphate,** $Fe_2(SO_4)_3$, $MgSO_4+24H_2O$.

(Bastick.)

Iron (ferrous) **magnesium potassium sulphate,** $2K_2SO_4$, $FeSO_4$, $MgSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Iron (ferric) **manganous hydrogen sulphate,** $Fe_2(SO_4)_3$, $2MnSO_4$, H_2SO_4.

Insol. in cold H_2O. (Étard.)

$Fe_2(SO_4)_3$, $2MnSO_4$, $3H_2SO_4$. Sol. in H_2O. (Étard, C. R. **86.** 1399.)

Iron (ferric) **manganic sulphate,** $Fe_2(SO_4)_3$, $Mn_2(SO_4)_3$.

Insol. in cold H_2O; decomp. by hot H_2O and HCl +Aq. (Étard.)

Iron (ferrous) **manganous potassium sulphate,** $FeSO_4$, $MnSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Iron (ferrous) **nickel sulphate,** $2FeSO_4$, $2NiSO_4$, H_2SO_4.

(Étard, C. R. **87.** 602.)

Iron (ferric) **nickel sulphate,** $Fe_2(SO_4)_3$, $NiSO_4$, $2H_2SO_4$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **87.** 602.)

Iron (ferrous) **nickel potassium sulphate,** $FeSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Iron (ferrous) **potassium sulphate,** $FeSO_4$, K_2SO_4.

$+2H_2O$. (Marignac, Ann. Min. (5) **9.** 19.)

Solubility in H_2O at t°.

t°	% $FeK_2(SO_4)_2$	t°	% $FeK_2(SO_4)_2$
0.5	22.79	80	42.34
17.2	31.98	90	42.73
40.1	40.86	95	41.01
60	42.63	..	...

(Küster and Thiel, Z. anorg. 1899, **21.** 116.)

$+4H_2O$.

Solubility in H_2O at t°.

t°	% $FeK_2(SO_4)_2$	t°	% $FeK_2(SO_4)_2$
0.5	22.94	80	40.46
17.2	26.79	90	43.82
40.1	32.41	95	44.11
60	35.68	..	...

(Küster and Thiel.)

$+6H_2O$. 100 pts. H_2O dissolve at t°:

0°	10°	14.5°	16°	25°	
19.6	24.5	29.1	30.9	36.5	pts. anhydrous salt,

35°	40°	55°	65°	70°	
41	45	56	59.3	64.2	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

Solubility in H_2O at t°.

t°	% $FeK_2(SO_4)_2$	t°	% $FeK_2(SO_4)_2$
0.5	18.36	60	42.93
17.2	25.16	80	45.29
40.1	36.72	..	...

(Küster and Thiel.)

Iron (ferric) potassium sulphate, basic, $4Fe_2O_3$, K_2O, $7SO_3+9H_2O=4(Fe_2O_3$, $2H_2O$, $SO_3)$, $K_2SO_4+7H_2O$.

Insol. in boiling H_2O. Sl. sol. in HCl+Aq, more readily in aqua regia. (Rammelsberg.)

$3Fe_2O_3$, K_2O, $4SO_3+6H_2O=K(FeO)_3(SO_4)_2+3H_2O$. Min. *Jarosite.*

Fe_2O_3, H_2O, $2SO_3$, $2K_2SO_4+5H_2O$. Sol. in 6 pts. cold H_2O. Solution soon decomposes. (Maus, Pogg. **11.** 78.)

Sol. in 12.5 pts. H_2O at 10°. (Anthon, Repert. **76.** 361.)

Formula is given as $3Fe_2O_3$, $5K_2O$, $12SO_3+18H_2O$ by Marignac.

$3Fe_2O_3$, $6SO_3$, $2K_2SO_4+22H_2O$. Sol. when moist in H_2O. Solution soon decomposes. Insol. in alcohol. (Soubeiran, A. ch. **44.** 329.)

$3Fe_2O_3$, $7SO_3$, $5K_2SO_4+12H_2O$, and $+17H_2O$. (Scheerer, Pogg. **87.** 81.)

$2Fe_2O_3$, $5SO_3$, $3K_2SO_4+9H_2O$. (S.)

$3Fe_2O_3$, $8SO_3$, $4K_2SO_4+20H_2O$ and $24H_2O$. (S.)

Iron (ferric) potassium sulphate, K_2SO_4, $2Fe_2(SO_4)_3$.

Insol. in H_2O, but is gradually decomp. thereby. (Grimm and Ramdohr, A. **98.** 127.)

$+2H_2O$. Nearly insol. in H_2O. (Weinland, Z. anorg. 1913, **84.** 364.)

$K_2Fe_2(SO_4)_4+24H_2O$. *Iron alum.*

Sol. in 5 pts. H_2O at 12.5°. (Anthon.)

Aqueous solution is decomp. by heating. Insol. in alcohol.

Sp. gr. of aqueous solution. According to G=Gerlach, at 15° (Z. anal. **28.** 496); F=Franz, at 17.5° (J. pr. (2) **5.** 288), containing:

	5	10	15% $K_2Fe_2(SO_4)_4+24H_2O$,
F	1.0268	1.0466	1.0672
G	1.025	1.0507	1.0773

	20	25	30% $K_2Fe_2(SO_4)_4+24H_2O$,
F	1.0894	1.1136	1.1422
G	1.1050	1.1340	1.1645

	35 % $K_2Fe_2(SO_4)_4+24H_2O$.
G	1.1967.

Melts in crystal H_2O at 28°. (Locke, Am. Ch. J. 1901, **26.** 183.)

$Fe_2(SO_4)_3$, $3K_2SO_4$. Insol. in H_2O, but slowly decomp. thereby. (Étard, C. R. **84.** 1089.)

Iron (ferric) potassium sulphate sulphite. *See* **Sulphite sulphate, ferric potassium.**

Iron (ferrous) potassium zinc sulphate, $FeSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O.

Iron (ferrous) rubidium sulphate, $FeSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

1 l. H_2O dissolves 242 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Iron (ferric) rubidium sulphate, $Rb_2Fe_2(SO_4)_2+24H_2O$.

Solubility in H_2O.

Temp.	G. per litre	Gram mols. of anhydrous salt per litre
25	97.4	0.294
30	202.4	0.617
35	Basic salt formed	...

(Locke, Am. Ch. J. 1901, **26.** 180.)

Iron (ferrous) sodium sulphate, $FeSO_4$, $Na_2SO_4+4H_2O$.

Sol. in H_2O. (Marignac, Ann. Min. (5) **9.** 25.)

Solubility of $FeNa_2(SO_4)_2+4H_2O$ in 100 g. H_2O at t°.

t°	Grams $FeSO_4$	Grams Na_2SO_4
21.8	24.34	22.51
24.92	23.62	22.04
34.95	23.91	21.83
40	24.01	22.62

(Koppel, Z. phys. Ch. 1905, **52.** 406.)

Solubility of $FeNa_2(SO_4)_2.4H_2O+FeSO_4.7H_2O$ in 100 g. H_2O at t°.

t°	grams $FeSO_4$	grams Na_2SO_4	t°	grams $FeSO_4$	grams Na_2SO_4
18.8	26.63	20.28	31°	33.99	14.41
23	28.82	18.40	35°	35.66	13.85
27	30.95	16.68	40°	39.98	11.92

(Koppel.)

Solubility of $FeNa_2(SO_4)_2.4H_2O+Na_2SO_4.10H_2O$ in 100 g. H_2O at t°.

t°	grams $FeSO_4$	grams Na_2SO_4	t°	grams $FeSO_4$	grams Na_2SO_4
18.8	27.23	22.16	28°	11.28	35.94
23	20.31	26.48	31°	6.95	44.75

(Koppel.)

Solubility of $FeNa_2(SO_4)_2.4H_2O+Na_2SO_4$ (anhydrous) in 100 g. H_2O at t°.

t°	grams $FeSO_4$	grams Na_2SO_4
35	6.16	46.58
40	6.27	46 99

(Koppel.)

See also under $FeSO_4$.

Iron (ferric) sodium sulphate, basic, $2Na_2O$, Fe_2O_3, $4SO_3+7H_2O$.

Only sl. sol. in H_2O with decomp. (Skrabal, Z. anorg. 1904, **38.** 319.)

$+8H_2O$. Min. *Urusite.* Insol. in H_2O; easily sol. in $HCl+Aq$.

$3Na_2O$, Fe_2O_3, $6SO_3+6H_2O$. Sol. in H_2O with decomp. (Skrabal.)

$4Fe_2O_3$, Na_2O, $5SO_3+9H_2O$.

Insol. in H_2O; difficultly sol. in $HCl+Aq$. (Scheerer, Pogg. **45.** 190.)

Iron (ferric) sodium sulphate, $[Fe(SO_4)_3]Na_3+3H_2O$.

Ppt. Nearly insol. in H_2O. (Weinland, Z. anorg. 1913, **84.** 365.)

Iron (ferrous) thallium sulphate, $FeSO_4$, $Tl_2SO_4+6H_2O$.

Easily decomp. by solution in H_2O. (Willm, A. ch. (4) **5.** 56.)

Iron (ferric) thallium sulphate, $Tl_2Fe_2(SO_4)_4+24H_2O$.

Not efflorescent. Very easily sol. in H_2O. 361.5 g. anhydrous, or 646 g. hydrated salt are sol. in 1 l. H_2O at 25°, or 0.799 mol. of the anhydrous salt is sol. in 1 l. H_2O at 25°. Melts in crystal H_2O at 37°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Iron (ferrous) zinc sulphate, $FeSO_4$, $ZnSO_4+14H_2O$.

$2FeSO_4$, $2ZnSO_4$, H_2SO_4. (Étard, C. R. **87.** 602.)

Iron (ferric) zinc sulphate, $Fe_2(SO_4)_3$, $ZnSO_4+24H_2O$.

(Bastick.)

Iron (ferrous) sulphate nitric oxide, $FeSO_4$, NO.

The solubility of NO in $FeSO_4+Aq$ is diminished by the presence of H_2SO_4, HCl, phosphoric acid, and by the presence of certain salts. (Manchot, A. 1910, **372.** 157.)

$Fe(NO)SO_4$, $FeSO_4+13H_2O$. Decomp. in the air. Sol. in water. (Manchot.)

Lanthanum sulphate, basic, $2La_2O_3$, $3SO_3+3H_2O$.

Precipitate. (Frerichs and Smith.)

Formula is $3La_2O_3$, SO_3+xH_2O. (Cleve, B. **11.** 910.)

Lanthanum sulphate, $La_2(SO_4)_3$.

Anhydrous. Much less sol. in warm than in cold H_2O. 1 pt. is sol. in less than 6 pts. H_2O, if added in small portions thereto at 2–3°, and the temperature not allowed to rise to 13°; but if heated to 30°, $La_2(SO_4)_3+9H_2O$ separates out until the solution is solid. (Mosander.)

100 pts. H_2O dissolve 2.208 pts. $La_2(SO_4)_3$ at 16.5°; 2.130 pts. at 18°; 1.641 pts. at 34°.

See also under $+9H_2O$.

The solubility of $La_2(SO_4)_3$ in H_2O is diminished by the presence of $(NH_4)_2SO_4$, K_2SO_4 or Na_2SO_4. (Barre, C. R. 1910, **151.** 871.)

Solubility in $(NH_4)_2SO_4+Aq$ at 18°.

Pts. per 100 pts. H_2O		Solid phase
$(NH_4)_2SO_4$	$La_2(SO_4)_3$	
0.00	2.130	$La_2(SO_4)_3+9H_2O$
4.011	0.393	$La_2(SO_4)_3$, $(NH_4)_2SO_4+2H_2O$
8.727	0.279	"
18.241	0.253	"
27.887	0.476	"
36.112	0.277	"
47.486	0.137	$2La_2(SO_4)_3$, $5(NH_4)_2SO_4$
53.823	0.067	$La_2(SO_4)_3$, $5(NH_4)_2SO_4$
65.286	0.0117	"
73.782	0.0033	"

(Barre.)

Solubility in K_2SO_4+Aq at 16.5°.

Pts. per 100 pts. H_2O		Solid phase
K_2SO_4	$La_2(SO_4)_3$	
0.00	2.198	$La_2(SO_4)_3+9H_2O$
0.247	0.727	$La_2(SO_4)_3$, $K_2SO_4+2H_2O$
0.496	0.269	"
0.846	0.185	"
1.029	0.054	$La_2(SO_4)_3$, $5K_2SO_4$
1.516	0.022	"

(Barre.)

Solubility in Na_2SO_4+Aq at 18°.

Pts. per 100 pts. H_2O		Solid phase
Na_2SO_4	$La_2(SO_4)_3$	
0.00	2.130	$La_2(SO_4)_3+9H_2O$
0.395	0.997	$La_2(SO_4)_3$, Na_2SO_4
0.689	0.353	"
0.774	0.299	"
1.136	0.129	"
2.480	0.044	"
3.802	0.019	"
5.548	0.016	"

(Barre.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+9H_2O$. Sol. in 42.5 pts. H_2O, calculated as anhydrous salt, at 23°, and 115 pts. H_2O at 100°. (Mosander.)

Solubility in H_2O.

100 pts. H_2O dissolve pts. $La_2(SO_4)_3$ at t°.

t°	Pts. $La_2(SO_4)_3$
0	3.02
14	2.60
30	1.90
50	1.49
75	0.94
100	0.68

(Muthmann and Rölig, B. 1898, **31.** 1723.)

Solubility in H_2SO_4+Aq at 25°.

Normality H_2SO_4	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	g. sulphate	
0	1.43	2.483	$La_2(SO_4)_3+9H_2O$
0.505	1.69	2.934	"
1.10	1.796	3.118	"
2.16	1.818	3.156	"
3.39	1.42	2.465	"
4.321	1.11	1.927	"
6.685	0.5309	0.9217	"
9.68	0.2659	0.4617	"
12.60	0.2136	0.3709	"
15.15	0.177	0.3073	"

(Wirth, Z. anorg. 1912, **76.** 189.)

Lanthanum hydrogen sulphate, $La(SO_4H)_3$.

(Brauner, Z. anorg. 1904, **38.** 330.)

Lanthanum potassium sulphate, $La_2(SO_4)_3$, $K_2SO_4+2H_2O$.

$La_2(SO_4)_3$, $5K_2SO_4$. (Barre, C. R. 1910, **151.** 872.)

$La_2(SO_4)_3$, $3K_2SO_4$. Sl. sol. in H_2O. Insol. in sat. K_2SO_4+Aq. (Cleve.)

$La_2(SO_4)_3$, $4K_2SO_4$. As above. (Cleve.)

$2La_2(SO_4)_3$, $9K_2SO_4$. As above. (Cleve.)

Lanthanum rubidium sulphate, $La_2(SO_4)_3$, Rb_2SO_4.

(Baskerville, J. Am. Chem. Soc. 1904, **26.** 67.)

$+2H_2O$. (Baskerville.)

$3La_2(SO_4)_3$, $2Rb_2SO_4$. (Baskerville.)

Lanthanum sodium sulphate, $La_2(SO_4)_3$, $Na_2SO_4+2H_2O$.

Sl. sol. in H_2O. (Cleve.) (Barre, C. R. 1910, **151.** 872.)

Lead sulphate, basic, $2PbO$, SO_3.

Not completely insol. in H_2O. Decomp. by acids, even dil. $HC_2H_3O_2$+Aq, with formation of $PbSO_4$. (Barfoed, **1869.**)

0.050 millimole calc. as Pb is sol. in 1 l. H_2O at 18°. (Pleissner, C. C. **1907,** II. 1056.)

$5PbO$, $3SO_3$. (Frankland, Proc. Roy. Soc. **46.** 364.)

Pb_3O_4, $2SO_3$. (Frankland.)

$3PbO$, $PbSO_4+H_2O$. Ppt. (Strömholm, Z. anorg. 1904, 38, 442.)

$Pb_4(SO_4)(OH)_2$. 0.106 millimole calc. as Pb is sol. in 1 liter H_2O at 18°. (Pleissner, C. C. **1907.** II, 1056.)

Lead sulphate, $PbSO_4$.

Sol. in 22,816 pts. H_2O at 11°. (Fresenius, A. **59.** 125.)

Sol. in 31,569 pts. H_2O at 15°. (Rodwell, C. N. **11.** 50.)

Sol. in 13,000 pts. H_2O. (Kremers, Pogg. **85.** 247.)

Calculated from electrical conductivity of $PbSO_4$+Aq, 1 l. H_2O dissolves 46 mg. $PbSO_4$ at 18°. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

4.23×10^{-2} gr. are dissolved in 1 liter of sat. solution at 20°; 4.41×10^{-2} at 25°. (Böttger, Z. phys. Ch. 1903, **46.** 604.)

1 l. H_2O dissolves 41 mg. $PbSO_4$ at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

0.126 millimole Pb is sol. in 1 liter H_2O at 18°. (Pleissner. C. C. **1907,** II. 1056.)

40 mg. are dissolved in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

0.0824 g. $PbSO_4$ is sol. in 1000 cc. H_2O at 18° and also at 100°. The fact that $PbSO_4$ dissolves in H_2O is ascribed to hydrolysis, and in support of this it is shown that the solubility of hydrated oxide of lead, PbO, H_2O, in dil. H_2SO_4 is the same as the solubility of $PbSO_4$ in H_2O. (Sehnal, C. R. 1909, **148.** 1395.)

1 l. H_2O dissolves 26 mg. at 18°; 30 mg. at 25°; 38 mg. at 37°. (Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34.** 447.)

Solubility in H_2O at t°.
(Millimols per l.)

t°	$PbSO_4$
18	0.126
25	0.144
37	0.183

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34.** 446.)

Sol. in hot conc. HCl+Aq. (Fresenius.)

Solubility of $PbSO_4$ in HCl+Aq.

Sp. gr. of HCl+Aq	% HCl in HCl+Aq	Pts. HCl+Aq for 1 pt. $PbSO_4$
1.0519	10.602	681.89
1.0800	16.310	281.73
1.1070	22.010	105.65
1.1359	27.525	47.30
1.1570	31.602	35.03

(Rodwell, Chem. Soc. **15.** 59.)

Solubility of $PbSO_4$ in HCl+Aq at t°.
(Millimols. per l.)

t°	0.1N	0.2N	0.3N	0.4N
18	0.126	1.72	2.67	3.63
25	0.144	2.07	3.14	4.29
37	0.183	2.63	4.06	5.43

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34.** 446.)

Above measurements in HCl+Aq show solubility directly proportional to the hydrogen ions. (Beck and Stegmüller.)

Sol. in HNO_3+Aq, and more sol. in hot or conc. than in cold or dil. HNO_3+Aq.

Sol. in 172 pts. HNO_3+Aq of 1.144 sp. gr. at 12.5°. (Bischof.)

Pptd. from HNO_3 solution by dil. H_2SO_4+Aq and not by H_2O. (Bischof, **1827.**)

Solubility of $PbSO_4$ in HNO_3+Aq.

Sp. gr. of HNO_3+Aq	% HNO_3 in HNO_3+Aq	Pts. HNO_3+Aq for 1 pt. $PbSO_4$
1.079	11.55	303.10
1.123	17.50	173.75
1.250	34.00	127.48
1.420	60.00	10282.78

(Rodwell, Chem. Soc. **15.** 59.)

Solubility in HNO_3 at 18°.
(Millimols per l.)

HNO_3	$PbSO_4$
0.1N	0.506
0.2N	0.844
0.3N	1.13
0.4N	1.44

(Beck and Stegmüller.)

Sol. in 36,504 pts. dil. H_2SO_4+Aq. (Fresenius.) *See also* under solubility in alcohol.

Sl. sol. in conc. H_2SO_4, from which it is partially pptd. by H_2O or completely by alcohol. (Fresenius.)

100 pts. conc. H_2SO_4 dissolve 6 pts. $PbSO_4$. (Schultz, Pogg. **133.** 137.)

Conc. H_2SO_4 dissolves 0.005 pt. $PbSO_4$. (Ure.)

100 pts. H_2SO_4 dissolve 0.13 pt. $PbSO_4$, and 100 pts. fuming H_2SO_4 dissolve 4.19 pts. (Struve, Z. anal. **9.** 31.)

More sol. in commercial H_2SO_4 than in the more conc. acid. (Hayes.)

100 pts. H_2SO_4+Aq of 1.841 sp. gr. dissolve 0.039 pts. $PbSO_4$; of 1.793 sp. gr. dissolve 0.011 pt. $PbSO_4$; of 1.540 sp. gr. dissolve 0.003 pt. $PbSO_4$.

Presence of SO_2 does not increase the solubility; HNO_3 increases the solubility somewhat, *i. e.*, 100 pts. H_2SO_4+Aq of 1.841 sp. gr. with 5 pts. HNO_3 of 1.352 sp. gr. dissolve 0.044 pt. $PbSO_4$; 100 pts. H_2SO_4 of 1.749 sp. gr. with 5 pts. HNO_3 of 1.352 sp. gr. dissolve 0.014 pt. $PbSO_4$; 100 pts. H_2SO_4 of 1.512 sp. gr. with 5 pts. HNO_3 of 1.352 sp. gr. dissolve only a trace.

Nitrous oxides do not increase the action. (Kolb, Dingl. **209.** 268.)

Solubility in dil. H_2SO_4+Aq at 18°.
(G. per l.)

H_2SO_4	$PbSO_4$	H_2SO_4	$PbSO_4$
0	0.0382	0.0245	0.0194
0.0049	0.0333	0.0490	0.0130
0.0098	0.0306	0.4904	0.0052

(Pleissner, Arb. K. Gesund. Amt. 1907, **26.** 384.)

A trace of H_2SO_4 has a considerable effect in reducing the solubility of $PbSO_4$ in H_2O. (Sehnal, C. R. 1909, **148.** 1395.)

Solubility in dil. H_2SO_4+Aq at 20°.
(G. per l.)

H_2SO_4	$PbSO_4$	H_2SO_4	$PbSO_4$
0	0.082	0.0980	0.013
0.0098	0.051	0.4900	0.006
0.0196	0.025	0.9800	0

(Sehnal.)

Pptd. from solution in H_2SO_4 by HCl. (Bolley, A. **91.** 113.)

Not more insol. in dil. $HC_2H_3O_2$+Aq than in H_2O. (Bischof.)

Solubility in other acids is prevented by great excess of H_2SO_4. (Wackenroder.)

Sol. in warm NH_4OH+Aq, separating on cooling. Completely sol. in warm KOH or NaOH+Aq.

Decomp. by boiling with K_2CO_3, Na_2CO_3, and $(NH_4)_2CO_3$+Aq.

Sol. in NH_4 salts +Aq but repptd. by H_2SO_4+Aq. (Fresenius, A. **59.** 125.)

The best solvents of the NH_4 salts are the nitrate, citrate, and tartrate; the two latter should be strongly alkaline with NH_4OH+Aq. (Wackenroder.)

Sol. in NH_4Cl+Aq at 12.5–25°.

Sl. decomp. by NaCl+Aq. (Bley.)

1 l. sat. NaCl+Aq dissolves 0.66 g. $PbSO_4$. (Becquerel.)

Sol. in 100 pts. cold conc. NaCl+Aq, and $PbCl_2$ is deposited after a few hours. (Field.)

Solubility of $PbSO_4$ in NaCl+Aq at 18°. (Millimols per l.)

NaCl	$PbSO_4$
0.1N	0.546
0.2N	0.904
0.3N	1.28
0.4N	1.68

(Beck and Stegmüller, Arb. k. Gesund. Amt. 1910, **34.** 446.)

Sol. in Fe_2Cl_6+Aq. (Fresenius, Z. anal. **19.** 419.)

Sol. in $Na_2S_2O_3$+Aq. (Löwe.)

Sol. in $(NH_4)_2SO_4$+Aq. (Rose.)

Solubility of $PbSO_4$+$PbSO_4$, K_2SO_4 in H_2O.

t°	K_2SO_4 g. in 100 cc. of solution	K_2SO_4 Mol. in 100 cc. of solution	Solid phase
0	0.195	0.0112	K_2SO_4, $PbSO_4$+$PbSO_4$
22	0.396	0.0227	"

(Brönsted, Z. phys. Ch. 1911, **77.** 316.)

Sol. in 47 pts. $NH_4C_2H_3O_2$+Aq (1.036 sp. gr.), and 969 pts. NH_4NO_3+Aq (1.269 sp. gr.); from the solution in $NH_4C_2H_3O_2$ it is pptd. by H_2SO_4 or K_2SO_4; from solution in NH_4NO_3 by K_2SO_4, but not by H_2SO_4. (Bischof.)

Sol. in acetates of NH_4, Na, K, Ca, Al, and Mg. (Mercer.)

Solubility in $NH_4C_2H_3O_2$+Aq. Excess of $PbSO_4$ was boiled with solution of $NH_4C_2H_3O_2$+Aq of varying conc.

G. $NH_4C_2H_3O_2$ in 100 cc.	g. $PbSO_4$ contained in 5 cc. solution: Hot	Cooled	Cooled 24 hrs.
28	0.356	...	...
30	0.418	...	0.224
32	0.494	0.451	0.242
35	0.513	0.452	...
37	0.529	...	0.238
40	0.539	...	0.263
45	0.555	0.488	...

(Dunnington and Long, Am. Ch. J. 1899, **22.** 218.)

Solubility in ammonium acetate+Aq at 25°.

$NH_4C_2H_3O_2$ Millimol. per l.	Solubility of $PbSO_4$: Millimols. per l.	g. per l.
0.0	0.134	0.041
103.5	2.10	0.636
207.1	4.55	1.38
414.1	10.10	3.06

(Noyes and Whitcomb, J. Am. Chem. Soc. 1905, **27.** 756.)

Solubility in $KC_2H_3O_2$+Aq at 25°.
Solid phase, $PbSO_4$+$PbK_2(SO_4)_2$.

Composition of the solutions: % $KC_2H_3O_2$	% $Pb(C_2H_3O_2)_2$	% $KC_2H_3O_2$	% $Pb(C_2H_3O_2)_2$
4.33	2.54	26.58	9.83
9.03	3.55	28.82	11.40
17.81	5.43	28.93	19.41
22.07	5.95		

(Fox, Chem. Soc. 1909, **95.** 887.)

100 pts. H_2O containing a drop of $HC_2H_3O_2$ and 2.05 pts. $NaC_2H_3O_2$ dissolve 0.054 pt. $PbSO_4$; containing 8.2 pts. $NaC_2H_3O_2$ dissolve 0.900 pt. $PbSO_4$; containing 41.0 pts. $NaC_2H_3O_2$ dissolve 11.200 pts. $PbSO_4$. (Dibbits, Z. anal. 1874, **13.** 139.)

Solubility in $NaC_2H_3O_2$+Aq at 25°.

Composition of the solutions: % Na acetate	% Pb acetate	% Na_2SO_4	% H_2O
6.69	0.78	0.34	92.19
11.76	2.73	1.26	84.25
16.90	5.70	2.49	74.91
19.92	8.24	3.60	68.24
21.51	10.75	4.68	63.10
6.95	0.81	0.35	91.90

The proportion of sulphate in solution in each case corresponded with the amount of Pb present, but was calculated to sodium sulphate, since $Na_2SO_4+10H_2O$ cryst. from the solutions on cooling. The solid phase in these solutions was $PbSO_4$.

(Fox, Chem. Soc. 1909, **95.** 887.)

Sol. in $Mn(C_2H_3O_2)_2$, $Zn(C_2H_3O_2)_2$, $Ni(C_2H_3O_2)_2$, and $Cu(C_2H_3O_2)_2$, but not in $Hg(C_2H_3O_2)_2$ or $AgC_2H_3O_2$+Aq.

Solubility in $KC_2H_3O_2$+Aq is not less than that in $NaC_2H_3O_2$+Aq. (Dibbits, Z. anal. **13.** 137.)

Insol. in $Pb(C_2H_3O_2)_2$+Aq. (Smith.)

Sol. in basic lead acetate +Aq, but not in neutral $Pb(C_2H_3O_2)_2$+Aq. (Stammer, Z. anal. **23.** 67.)

12.2 pts. $Ca(C_2H_3O_2)_2$ in very dil. solution dissolve 1 pt. $PbSO_4$. (Städel, Z. anal. **2.** 180.)

Sol. in $Al(C_2H_3O_2)_3$+Aq. (Lennsen.)

Very easily and abundantly sol. in NH_4 tartrate +Aq. (Wöhler, A. **34.** 235.)

Even when native, easily sol. in NH_4 citrate +Aq. (Smith.)

Insol. in alcohol (18%) and H_2SO_4 when NH_4 acetate, K tartrate, or NH_4 succinate are present. Insol. in alcohol (18%) and H_2SO_4 or $(NH_4)_2SO_4$ when Na acetate, Na or NH_4 oxalate are present. Sol. in NH_4 *di*citrate and K *tri*citrate in presence of H_2SO_4; in NH_4 succinate and NH_4 acetate in presence of $(NH_4)_2SO_4$; and in NH_4 citrate in presence of H_2SO_4 or $(NH_4)_2SO_4$. (Storer, C. N. **21.** 17.)

Alcohol (59%) alone, or with ethylsulphuric acid or sugar, does not dissolve Pb by 3 months action. (Storer.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329); methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Min. *Anglesite.* Sol. in cold citric acid+Aq. (Bolton, C. N. **37.** 14.)

Lead hydrogen sulphate, $PbSO_4, H_2SO_4+H_2O$.

Decomp. by H_2O.

Lead *pyro*sulphate, PbS_2O_7.

Decomp. by H_2O. (Schultz.)

Lead potassium sulphate, $PbSO_4, K_2SO_4$.

When $PbSO_4$ is added to potassium acetate +Aq at 25° a double salt, $PbK_2(SO_4)_2$ is formed. This salt is insol. in the solution which contains only potassium acetate and lead acetate. (Fox, Chem. Soc. 1909, **95.** 882.)

Decomp. by H_2O. Stable only in solutions of K_2SO_4, containing at least 0.56% K_2SO_4 at 7°; 0.62% at 17°; 1.09% at 50°; 1.37% at 75°; 1.69% at 100°. (Barre, C. R. 1909, **149.** 294.)

Lead sulphate chloride, $PbSO_4, 2PbCl_2+H_2O$.

Insol. in H_2O or NaCl+Aq. (Becquerel, C. R. **20.** 1523.)

Lead sulphate fluoride, $PbSO_4, 2PbF_2$.

Not decomp. by H_2SO_4. (Lonyet, C. R. **24.** 434.)

Lithium sulphate, Li_2SO_4.

More sol. in cold than in hot H_2O.

100 pts. H_2O dissolve 34.6 pts. Li_2SO_4 at 18°. (Wittstein.)

100 pts. H_2O dissolve pts. Li_2SO_4 at t°

t°	Pts. Li_2SO_4	t°	Pts. Li_2SO_4	t°	Pts. Li_2SO_4
0	35.34	45	32.38	100	29.24
20	34.36	65	30.3	. . .	. . .

(Kremers, Pogg. **95.** 468.)

Sat. Li_2SO_4+Aq contains at:

—20°	—16°	—15°	—12°
18.4	22.5	22.6	24.4 % Li_2SO_4.

—4°	+15°	+90°
25.7	25.3	23.9 % Li_2SO_4.

(Étard, A. ch. 1894, (7) **2.** 547.)

Sat. solution boils at 105°. (Kremers.)

Sp. gr. of Li_2SO_4+Aq at 19.5° containing:

6.5	7.4	12.5	15.3% Li_2SO_4,
1.05	1.06	1.098	1.118

22.6	24.4	29.4 % Li_2SO_4.
1.167	1.178	1.208

(Kremers, Pogg. **114.** 47.)

Sp. gr. of Li_2SO_4+Aq at 15° containing 5% Li_2SO_4=1.0430; 10% Li_2SO_4=1.0877. (Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of Li_2SO_4+Aq at 25°.

Concentration of Li_2SO_4 +Aq	Sp. gr.
1—normal	1.0453
1/2— "	1.0234
1/4— "	1.0115
1/8— "	1.0057

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Sp. gr. of Li_2SO_4+Aq.

½Li_2SO_4 g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
2.9198	1.002589
16.0461	1.014093

(Dijken, Z. phys. Ch. 1897, **24.** 109.)

Sp. gr. of Li_2SO_4+Aq at 20°.

Normality of Li_2SO_4+Aq	% Li_2SO_4	Sp. gr.
2.60	23.48	1.2330
1.96	18.53	1.1650
1.708	16.41	1.1449
1.320	13.01	1.1133
0.747	7.71	1.0678

(Forchheimer, Z. phys. Ch. 1900, **34.** 21.)

Insol. in SO_3. (Weber, B. **17.** 2497.)

10 ccm. of sat. Li_2SO_4 in absolute H_2SO_4 contain approx. 2.719 g. Li_2SO_4. (Bergius, Z. phys. Ch. 1910, **72.** 355.)

Solubility in H_2SO_4+Aq at 30°.

Composition of the solution		Solid phase
% by wt. H_2SO_4	% by wt. Li_2SO_4	
5.05	22.74	Li_2SO_4, H_2O
12.23	20.45	"
15.37	19.11	"
16.60	19.10	"
32.70	13.37	"
36.90	11.90	"
42.98	10.57	"
48.00	10.20	"
52.72	11.44	"
54.54	12.92	"
55.08	13.69	Li_2SO_4
56.30	13.87	"
61.46	17.10	"
61.82	17.00	"
62.14	17.97	"
62.49	18.89	Li_2SO_4, H_2SO_4
65.70	16.55	"
69.40	13.75	"
77.30	11.31	"
78.23	11.64	"
81.20	13.28	"
81.70	13.85	"
82.30	15.50	"
83.43	15.65	"

(Van Dorp, Z. phys. Ch. 1910, **73.** 289.)

Solution in H_2SO_4 contains 17.2% Li_2SO_4 at 30°. (Van Dorp, Z. phys. Ch. 1913, **86.** 112.)

Solubility of Li_2SO_4+$Th(SO_4)_2$ in H_2O at 25°.

Solid phase, $Th(SO_4)_2$.
G. in 100 g. H_2O.

Li_2SO_4	$Th(SO_4)_2$	Li_2SO_4	$Th(SO_4)_2$
0.0	1.722	11.13	11.05
2.57	4.13	13.18	12.54
4.93	6.20	16.12	14.52
6.98	7.95	20.49	16.92
9.23	9.68	16.92	18.87

(Barre, Bull. Soc. 1912, (4) **11.** 647.)

Easily sol. (Kastner), sl. sol. (Berzelius) in alcohol.

Solubility of Li_2SO_4 in alcohol+Aq at 30°.

Solid phase Li_2SO_4, H_2O.

G. per 100 g. sat. solution			
C_2H_5OH	Li_2SO_4	C_2H_5OH	Li_2SO_4
0	25.1	47.28	3.04
11.75	16.16	58.59	1.22
21.19	11.52	69.39	0.4
29.10	8.17	80.74	0
33.21	6.66	94.11	0

(Schreinemakers and van Dorp, Chem. Weekbl. 1906, **3.** 557.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate (Naumann. B. 1904, **37.** 3601); acetone. (Eidmann, C. C, **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

+H_2O. Very sl. efflorescent. (Rammelsberg.)

Aq. solution contains 25.1% Li_2SO_4 at 30°. (Schreinemakers, C. C. **1910,** I. 1801); **24.3** g. at 50°. (Schreinemakers and Cocheret, Chem. Weekbl. 1905, **2.** 771.)

Lithium hydrogen sulphate, $LiHSO_4$.

Decomp. by H_2O.

Cryst. from H_2SO_4. (Gmelin.)

$LiH_3(SO_4)_2$. Cryst. from H_2SO_4. (Schultz, Pogg **133.** 137.)

Li_2SO_4, $7H_2SO_4$. (Bergius, Z. phys. Ch. 1910, **72.** 355.)

Lithium potassium sulphate, Li_2SO_4,K_2SO_4.

This is the only compd. of Li_2SO_4 and K_2SO_4 which exists below 100°. (Spielrein, C. R. 1913, **157.** 48.)

$K_4Li_2(SO_4)_3$. (Knobloch.) Has the formula $K_2Li_8(SO_4)_5$+$8H_2O$, according to Rammelsberg.

Lithium sodium sulphate, $Na_3Li(SO_4)_2$+$6H_2O$.

$Na_4Li_2(SO_4)_3$+$9H_2O$.

$Na_2Li_8(SO_4)_5$+$5H_2O$. (Rammelsberg.)

Do not exist. (Troost.)

Li_2SO_4, Na_2SO_4+$5.5H_2O$. Exists from 0°–16°.

+$3H_2O$. Exists from 32°–100°.

Li_2SO_4, $3Na_2SO_4$+$12H_2O$. Exists from 16°–24°.

$4Li_2SO_4$, Na_2SO_4+$5H_2O$. Exists from 24°–32°.

(Spielrein, C. R. 1913, **157.** 47.)

Lithium thallic sulphate, $LiTl(SO_4)_2$+$3H_2O$.

(Meyer and Goldschmidt, C. C. **1903,** I. 495.)

Lithium titanium sulphate, $Li_2TiO_2(SO_4)_2+7H_2O$.

Less hygroscopic than K compound. (Mazzuchelli and Pontanelli, C. C. **1909, II.** 420.

Lithium uranyl sulphate, Li_2SO_4, $UO_2SO_4+4H_2O$.

(de Coninck, Chem. Soc. 1905, **88.** (2) 530.

Magnesium sulphate basic, $6Mg(OH)_2$, $MgSO_4+3H_2O$.

Sl. sol. in cold or hot H_2O.

Sol. in HCl+Aq. (Thugutt, Z. anorg. 1892, 2. 150.)

Magnesium sulphate, $MgSO_4$.

Anhydrous. Very slowly sol. in H_2O; sol. in hot conc. H_2SO_4, less in HCl, and HNO_3+Aq.

$+H_2O$. Min. *Kieserite.* Easily sol. in warm, but slowly dissolved by cold H_2O.

100 g. sat. solution at 83° contain 40.2 g. $MgSO_4$. (Geiger, Dissert. **1904.**)

$+6H_2O$, and $+7H_2O$. The latter exists in two modifications; (*a*) hexagonal, and (*b*) the ordinary or rhombic salt.

$MgSO_4$+Aq, which on cooling or keeping in closed vessels has deposited $MgSO_4+6H_2O$, always contains for 100 pts. H_2O at:

0°	10°	20°
40.75	42.23	43.87 pts. $MgSO_4$.

If only hexagonal $MgSO_4+7H_2O$ has been deposited, then the mother liquor contains for 100 pts. H_2O at:

0°	10°	20°
34.67	38.71	42.84 pts. $MgSO_4$.

Solutions prepared from rhombic $MgSO_4+7H_2O$ contain for 100 pts. H_2O at:

0°	10°	20°
26.0	30.9	35.6 pts. $MgSO_4$.

(Löwel.)

These results may be given in tabular form as follows:

Temp.	A sat. aqueous solution of $MgSO_4+7H_2O$ (*b*) contains for 100 pts. H_2O	
	Anhydrous $MgSO_4$	$7H_2O$ (*b*) salt
0°	26.0	73.31
10°	30.9	93.75
20°	35.6	116.54

Temp.	A sat. aqueous solution of $MgSO_4+7H_2O$ (*a*) contains for 100 pts. H_2O	
	Anhydrous $MgSO_4$	$7H_2O$ (*a*) sale
0°	34.67	111.74
10°	38.71	133.67
20°	42.84	159.61

Temp.	A sat aqueous solution of $MgSO_4+6H_2O$ contains for 100 pts. H_2O		
	Anhydrous $MgSO_4$	$6H_2O$ salt	$7H_2O$ salt
0°	40.75	122.22	146.02
10°	42.32	129.44	155.53
20°	43.87	137.72	167.97

It is seen from table that at the same temp. the $6H_2O$ salt is more sol. than the $7H_2O$ (*b*) salt, and the latter is more sol. than $7H_2O$ (*a*) salt; that the solubility of the $7H_2O$ (*b*) salt increases rapidly from 0° to 20°; that the $6H_2O$ salt is not much more sol. at 20° than at 0°, and at 20° the $7H_2O$ (*b*) salt is nearly as sol. as the $6H_2O$ salt. (Löwel, A. ch. (3) **43.** 405.)

100 pts. H_2O at t° dissolve pts. $MgSO_4$. G L = according to Gay Lussac (A. ch. (2) **11.** 311); T = according to Tobler (A. **95.** 198).

t°	G L	T	t°	G L	T
0	25.8	24 7	50	49 7	
10	30 5		55	.	52 8
20	35 0		60	55 9	..
25		37 1	70	60 4	
30	39 8		80	65.1	.
40	45 2	..	90	70 3	

100 pts. H_2O at 105.5° dissolve 135.2 pts. $MgSO_4$. (Griffiths.)

$MgSO_4$+Aq sat. at 17.5 has sp. gr. = 1.2932, and contains 55.57 % $MgSO_4+7H_2O$, or 100 pts. H_2O dissolve 125.06 pts. $MgSO_4+7H_2O$, or 60 pts. $MgSO_4$, at 17.5°. (Karsten.)

100 pts. H_2O at 0° dissolve 53.8 pts., and 125 pts. at ord. temp. (Otto-Graham.)

Sol. in 2 pts. cold, and 0.5 pt. boiling H_2O. (Fourcroy.)

The aqueous solution contains for 100 pts. H_2O 92.217 pts. $MgSO_4+7H_2O$ at 15°. (Michel and Krafft.)

I pt. $MgSO_4+7H_2O$ is sol. in 0.933 pt. H_2O at 15° (Gerlach); in 0.92 pt. H_2O at 23° (Schiff).

100 pts. H_2O dissolve 28.067 pts. $MgSO_4$ at 0°. (Pfaff, A. **99.** 224.)

100 pts. H_2O dissolve pts. $MgSO_4$ at t°.

t°	Pts. $MgSO_4$
0	26.37
17.9	33.28
24.1	35.98

(Diacon, J. B. **1886.** 62.)

100 pts. $MgSO_4$+Aq sat. at 18–20° contain 25.67–26.38 pts. $MgSO_4$. (v. Hauer, J. pr. **98.** 137.)

Solubility in 100 pts. H_2O at t°, using $MgSO_4+7H_2O$.

t°	Pts. $MgSO_4$	t°	Pts. $MgSO_4$	t°	Pts. $MgSO_4$
0	26.9	37	44.2	74	61.4
1	27.4	38	44.7	75	61.9
2	27.9	39	45.2	76	62.3
3	28.3	40	45.6	77	62.8
4	28.8	41	46.1	78	63.2
5	29.3	42	46.5	79	63.7
6	29.7	43	47.0	80	64.2
7	30.2	44	47.5	81	64.6
8	30.6	45	48.0	82	65.1
9	31.1	46	48.4	83	65.6
10	31.5	47	48.9	84	66.0
11	32.0	48	49.3	85	66.5
12	32.4	49	49.8	86	67 0
13	32.9	50	50.3	87	67.5
14	33.4	51	50.7	88	68.0
15	33.8	52	51 2	89	68 4
16	34.3	53	51.7	90	68.9
17	34.7	54	52.2	91	69.4
18	35.2	55	52.7	92	69.9
19	35.7	56	53.2	93	70.4
20	36.2	57	53.6	94	70.9
21	36.7	58	54.1	95	71.4
22	37.1	59	54.5	96	71.9
23	37.6	60	55.0	97	72.4
24	38.0	61	55.5	98	72.8
25	38.5	62	55.9	99	73.3
26	39.0	63	56.4	100	73.8
27	39.5	64	56.8	101	74.3
28	39.9	65	57 3	102	74.8
29	40.4	66	57.7	103	75.2
30	40.9	67	58.2	104	75.7
31	41.4	68	58.6	105	76.2
32	41.8	69	59.1	106	76.7
33	42.3	70	59.6	107	77.2
34	42.8	71	60.0	108	77.7
35	43.3	72	60.5	108.4	77.9
36	43.7	73	61.0	..	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. **1864.** 52).

100 pts. H_2O dissolve 72.4 pts. $MgSO_4+7H_2O$ at 0°, 178 pts. at 40°; and 212.6 pts. at 49°. (Tilden, Chem. Soc. **45.** 409.)

Supersat. $MgSO_4$+Aq is brought to crystallisation by addition of crystal of $MgSO_4+7H_2O$, or an isomorphous substance as $ZnSO_4+7H_2O$, $NiSO_4+7H_2O$, $FeSO_4+7H_2O$, or $CoSO_4+7H_2O$. (Thomson, Chem. Soc. **35.** 199.)

Sat. $MgSO_4$+Aq contains at:

2°	7°	23°	67°	81°	
20.9	22.5	26.0	35.6	38.6%	$MgSO_4$,
94°	130°	145°	164°	188°	
41.5	45.3	38.0	29.3	20.4%	$MgSO_4$.

Readily forms supersat. solutions.

(Étard, A. ch. 1894, (7) **2.** 551.)

M.-pt. of $MgSO_4+7H_2O$ is 70°. (Tilden, Chem. Soc. **45.** 409.)

$MgSO_4$+Aq with sp. gr. 1.50 contains 44.4 % $MgSO_4$; sp. gr. 1.42, 39%; sp. gr. 1.30, 30% $MgSO_4$. (Dalton.)

Sp. gr. of $MgSO_4$+Aq sat. at 15° = 1.275 (Michel and Krafft); at 8° = 1.267 (Anthon); at 18.75° = 1.293 (Karsten).

Sp. gr. of $MgSO_4$+Aq at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1.054	30	1.326
10	1.108	35	1.384
15	1.161	40	1.446
20	1.215	45	1.511
25	1.269	50	1.580

(Calculated from Anthon by Schiff, A. **107.** 303.)

Sp. gr. of $MgSO_4$+Aq at 23°.

% $MgSO_4$ $7H_2O$	Sp. gr.	% $MgSO_4$ $+7H_2O$	Sp. gr.
1	1.0048	28	1.1426
2	1.0096	29	1.1481
3	1.0144	30	1.1536
4	1.0193	31	1.1592
5	1.0242	32	1.1648
6	1.0290	33	1.1704
7	1.0339	34	1.1760
8	1.0387	35	1.1817
9	1.0437	36	1.1875
10	1.0487	37	1.1933
11	1.0537	38	1.1991
12	1.0587	39	1.2049
13	1.0637	40	1.2108
14	1.0688	41	1.2168
15	1.0739	42	1.2228
16	1.0790	43	1.2288
17	1.0842	44	1.2349
18	1.0894	45	1.2410
19	1.0945	46	1.2472
20	1.0997	47	1.2534
21	1.1050	48	1.2596
22	1.1103	49	1.2659
23	1.1156	50	1.2722
24	1.2109	51	1.2786
25	1.1261	52	1.2850
26	1.1316	53	1.2915
27	1.1371	54	1.2980

(Schiff, A. **113.** 185.)

Sp. gr. of $MgSO_4$+Aq at 12°.

% $MgSO_4+7H_2O$	Sp. gr.	% $MgSO_4+7H_2O$	Sp. gr.
1	1.0046	21	1.1071
2	1.0096	22	1.1125
3	1.0146	23	1.1179
4	1.0196	24	1.1234
5	1.0246	25	1.1289
6	1.0296	26	1.1344
7	1.0346	27	1.1399
8	1.0396	28	1.1454
9	1.0446	29	1.1510
10	1.0497	30	1.1566
11	1.0548	31	1.1622
12	1.0599	32	1.1679
13	1.0650	33	1.1736
14	1.0702	24	1.1793
15	1.0754	35	1.1850
16	1.0807	36	1.1908
17	1.0859	37	1.1965
18	1.0911	38	1.2023
19	1.0964	39	1.2082
20	1.1018	40	1.2140

(Oudemans, Z. anal. **7.** 419.)

Sp. gr. of $MgSO_4$+Aq at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
1	1.01031	14	1.15083
2	1.02062	15	1.16222
3	1.03092	16	1.17420
4	1.04123	17	1.18618
5	1.05154	18	1.19816
6	1.06229	19	1.21014
7	1.07304	20	1.22212
8	1.08379	21	1.23465
9	1.09454	22	1.24718
10	1.10529	23	1.25972
11	1.11668	24	1.27225
12	1.12806	25	1.28478
13	1.13945	25.248	1.28802

(Gerlach, Z. anal. **8.** 287.)

Sp. gr. of $MgSO_4$+Aq at 23.5°. a = no. of ½ mols. in grms. dissolved in 1000 g. H_2O; b = sp. gr. if a is $MgSO_4+7H_2O$, ½ mol. wt. = 123; c = sp. gr. if a is $MgSO_4$, ½ mol. wt. = 60.

a	b	c	a	b	c
1	1.056	1.059	5	1.203	1.260
2	1.103	1.114	6	1.229	...
3	1.141	1.166	7	1.252	...
4	1.174	1.214	8	1.273	...

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $MgSO_4$+Aq at 15°.

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1.0510	20	1.2200
10	1.1052	25	1.2861
15	1.1602	..	...

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $MgSO_4$+Aq at 0°. S = pts. $MgSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
13.800	1.1586	7.4046	1.0826
11.7458	1.1329	5.0447	1.0557
9.6218	1.1072	2.5907	1.0284

(Charpy, A. ch. (6) **29.** 26.)

Sat. $MgSO_4$+Aq boils at 105° (Griffiths); 108.4° (Mulder).

Crust forms at 103.5° (solution containing 48.4 pts. $MgSO_4$ to 100 pts. H_2O); highest temp. observed, 105°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $MgSO_4$+Aq containing pts. $MgSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $MgSO_4$	B.-pt.	Pts. $MgSO_4$	B.-pt.	Pts. $MgSO_4$
100.5°	8.8	102.5°	34.7	104.5°	51.3
101.0	16.7	103.0	39.5	105	54.6
101.5	23.5	103.5	43.8	108	75(?)
102.0	29.5	104.0	47.7	...	...

(Gerlach, Z. anal. **26.** 432.)

Sp. gr. of $MgSO_4$+Aq at 9.5°.

Mass of salt per unit mass of solution	Density of solution (g. per cc).
0.00191	1.00170
0.00380	1.00346
0.00569	1.00526
0.00758	1.00705
0.01132	1.01060

(McGregor, C. N. 1887, **55.**6.)

Sp. gr. of $MgSO_4$+Aq at 25°.

Concentration of $MgSO_4$ +Aq	Sp. gr.
1—normal	1.0584
1/2— "	1.0297
1/5— "	1.0152
1/8— "	1.0076

(Wagner, Z. phys. Ch. 1890, **5.** 38.)

Sp. gr. at 16°/4° of $MgSO_4$+Aq containing 11.0222% $MgSO_4$ = 1.11471; containing 8.343% $MgSO_4$ = 1.08558. (Schönrock, Z. phys. Ch. 1893, **11.** 782.)

Sp. gr. of $MgSO_4$+Aq.

G.-equivalents $MgSO_4$ per liter	t°	Sp. gr. t°/t°
0.002548	17.989	1.0001625
0.005093	18.020	1.000324
0.01015	17.995	1.000639
0.02023	17.980	1.001274
0.05023	18.047	1.003117
0.09950	18.033	1.006122
0.19773	18.014	1.012035
0.29459	17.997	1.017806
0.48671	17.994	1.029101
0.5022	17.90	1.03000
5.0220	17.95	1.26970
0.002616	14.096	1.0001672
0.005230	14.109	1.0003311
0.01042	14.098	1.000659
0.02077	14.092	1.001306
0.12462	14.199	1.007682
0.24567	14.092	1.014980

(Kohlrausch, W. Ann. 1894, **53.** 27.)

Sp. gr. of $MgSO_4$+Aq.

½ $MgSO_4$ g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.5368	1.000570
1.0917	1.001157
"	1.001141
2.1076	1.002234
4.1367	1.004372
9.0608	1.009523
18.0846	1.018954
37.1342	1.038983
52.1362	1.054867

(Dijken, Z. phys. Ch. 1897, **24.** 108.)

Sp. gr. of $MgSO_4$+Aq at 18.2°, when p = per cent strength of the solution; d = observed density; and w = volume conc. in grams per cc. $\left(\frac{pd}{100} = w.\right)$

p	d	w
26.25	1.2903	1.3374
25.91	1.2860	1.3319
24.53	1.2693	1.3101
21.60	1.2330	1.2650
18.41	1.1950	1.2187
13.79	1.1423	1.1562
12.63	1.1291	1.1413
11.29	1.1147	1.1246
8.08	1.0803	1.0859
2.01	1.0204	1.0191

(Barnes, J. phys. Chem. 1898, **2.** 542.)

Sp. gr. of $MgSO_4$+Aq at 20°.

Normality of $MgSO_4$+Aq	% $MgSO_4$	Sp. gr.
2.73	25.46	1.2879
1.36	18.6	1.2019
0.934	10.[illegible]4	1.1049

(Forchheimer, Z. phys. Ch. 1900, **34.** 24.)

Sp. gr. of dil. $MgSO_4$+Aq at 20.004°.
Conc. = g. equiv. per l. at 20.004°.
Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,006,4
0.0002	1.000,012,9
0.0003	1.000,019,4
0.0004	1.000,025,9
0.0005	1.000,032,4
0.0010	1.000,064,8
0.0020	1.000,129,4
0.0050	1.000,322,4
0.0100	1.000,642,1

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1684.)

More sol. in HCl+Aq than in H_2O. (Richter.)

In sat. HCl+Aq, anhydrous $MgSO_4$ is scarcely sol.; $MgSO_4+7H_2O$ dissolves, but is precipitated by a current of HCl gas. (Hensgen, B. **10.** 259.)

Margueritte (C. R. **43.** 50) denies the precipitation.

For solubility in H_2SO_4, *see* $MgH_2(SO_4)_2$.

Completely pptd. from $MgSO_4$+Aq by conc. $HC_2H_3O_2$+Aq. (Persoz.)

Somewhat sol. in sat. NH_4Cl+Aq with separation of a double sulphate.

Rapidly sol. in KCl+Aq with separation of K_2SO_4.

Sol. in sat. NaCl+Aq without pptn. of the latter.

Easily sol. in sat. KNO_3+Aq without causing any pptn.

Sol. in sat. $NaNO_3$+Aq. (Karsten.)

Rapidly sol. in sat. $CuSO_4$+Aq; when saturation is reached, a double salt separates out. (Karsten.)

100 pts. sat. $MgSO_4+NiSO_4$+Aq at 18–20° contain 30.93 pts. of the two salts; 100 pts. sat. $MgSO_4+ZnSO_4$+Aq at 18–20° contain 35.45 pts.; 100 pts. sat. $MgSO_4+NiSO_4+ZnSO_4$+Aq at 18–20° contain 35.62 pts. (v. Hauer, J. pr. **98.** 137.)

100 pts. H_2O dissolve 14.1 pts. $MgSO_4$ and 9.8 pts. K_2SO_4, if sat. $MgSO_4$+Aq is sat. with K_2SO_4; 32.4 pts. $MgSO_4$ and 8.2 pts. K_2SO_4, if sat. K_2SO_4+Aq is sat. with $MgSO_4$, all at 15°. (Mulder, J. B. **1866.**)

100 pts. H_2O dissolve 25.95 pts. $MgSO_4$ and 5.21 pts. Na_2SO_4 at 0°. (Diacon, J. B. **1866.** 62.)

100 pts. H_2O dissolve 15.306 pts. $MgSO_4$ and 13.086 pts. Na_2SO_4 at 0°. (Pfaff, A. **99.** 224.)

See also under $MgNa_2(SO_4)_2+4H_2O$.

Solubility of mixtures of $MgSO_4$ and $MgNa_2(SO_4)_2+4H_2O$ at t°.

t°	g. per 100 g. H_2O	
	Na_2SO_4	$MgSO_4$
22	23.3	31.4
24.5	27.2	24.2
30	36.1	19.1
35	33.9	18.44

(Roozeboom, 1888, Z. phys. Ch. **2.** 518.)

See also under $MgNa_2(SO_4)_2+4H_2O$.

Slowly sol. in sat. $ZnSO_4$+Aq without pptn. until saturation, when a double salt separates out.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

100 pts. dil. alcohol containing at 15°:

	10	20	40 % alcohol
contain	39.3	21.3	1.62% $MgSO_4+7H_2O$.

(Schiff, A. **118.** 365.)

At higher temp. the solubility increases proportional to the temp. (Gerardin, A. ch. (4) **5.** 145.)

100 pts. absolute methyl alcohol dissolve 1.18 pts. $MgSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. absolute methyl alcohol dissolve 41 pts. $MgSO_4+7H_2O$ at 17°; 100 pts. absolute methyl alcohol dissolve 29 pts. $MgSO_4+7H_2O$ at 3–4°; 100 pts. 93% methyl alcohol dissolve 9.7 pts. $MgSO+7H_2O$ at 17°; 100 pts. 50% methyl alcohol dissolve 4.1 pts. $MgSO_4+7H_2O$ at 3–4°. (de Bruyn, R. t. c. **11.** 112.)

100 pts. absolute ethyl alcohol dissolve 1.3 pts. $MgSO_4+7H_2O$ at 3°. (de Bruyn.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790.); ethyl acetate (Naumann, B. 1910, **43.** 314.); acetone. (Naumann, B. 1904, **37.** 4329.)

100 g. 95% formic acid dissolve 0.34 g. $MgSO_4$ at 19°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

100 g. sat. solution of $MgSO_4$ and sugar in H_2O contains 46.52, g. sugar +14.0 g. $MgSO_4$, or 100 g. H_2O dissolve 119.6 g. sugar +36.0 g. $MgSO_4$. (Köhler, Z. Ver. Zuckerind, 1897, **47.** 447.)

Magnesium hydrogen sulphate, $MgH_2(SO_4)_2$.

Decomp. by H_2O. Sol. in H_2SO_4. Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$MgH_6(SO_4)_4$. Boiling H_2SO_4 dissolves about 2% $MgSO_4$, from which this compound crystallises. (Schultz, Pogg. **133.** 137.)

Magnesium *pyro*sulphate, MgS_2O_7.

Decomp. by H_2O.

Magnesium manganous sulphate, $MgSO_4$, $2MnSO_4+15H_2O$.

Min. *Fauserite.*

Magnesium manganous zinc sulphate, $MgSO_4$, $MnSO_4$, $ZnSO_4+21H_2O$.

Sol. in H_2O. (Vohl, A. **99.** 124.)

Magnesium nickel sulphate, $MgSO_4$, $3NiSO_4+28H_2O$.

Sol. in H_2O. (Schiff.)

Magnesium nickel potassium sulphate, $MgSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Magnesium potassium sulphate, $MgK_2(SO_4)_2+6H_2O$.

100 pts. H_2O dissolve 22.7 pts. anhydrous salt at 16.5°. (Mulder.)

100 pts. H_2O dissolve at:

0°	10°	20°	30°	35°	
14.1	19.6	25.0	30.4	33.3	pts. anhydrous salt,
45°	55°	60°	65°	75°	
40.5	47.0	50.2	53.0	59.8	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

100 g. H_2O dissolve 30.52 g. $MgK_2(SO_4)_2+6H_2O$ at 15°. (Lothian, Pharm. J. 1909, **82.** 292.)

Solubility in H_2O at t°.

t°	Sat. solution contains		Mols. K_2SO_4: mols. $MgSO_4$ in the solution	100 pts. H_2O dissolve	
	% K_2SO_4	% $MgSO_4$		K_2SO_4	$MgSO_4$
10	9.4	9.8	1:1.52	11.63	12.13
20	10.9	10.8	1:1.43	13.92	13.79
30	12.4	11.8	1:1.38	16.36	15.56
40	13.8	13.1	1:1.37	18.88	17.92
50	14.7	14.8	1:1.46	20.85	20.99
60	15.2	16.3	1:1.55	22.19	23.79
70	15.6	16.8	1:1.52	23.07	24.85
80	16.0	17.1	1:1.56	23.91	25.56
80	16.6	18.1	1:1.58	25.42	27.72
90	17.2	18.2	1:1.54	26.62	28.17

(Precht, B. 1882, **15.** 1668.)

Sp. gr. of aqueous solution at 15° containing:

2	4	6	8% hydrous salt,
1.0129	1.0261	1.0394	1.053
10	12	14	16% hydrous salt,
1.0668	1.0808	1.095	1.1094
18	20	22% hydrous salt	
1.124	1.1388	1.1539	

(Schiff, A. **113.** 183, calculated by Gerlach Z. anal. **8.** 287.)

Sp. gr. of $MgK_2(SO_4)_2+Aq$ at 18°.

G-equiv. of salt per l.	Sp. gr.
1.0010	1.0633
0.8345	1.0531
0.6688	1.0427
0.3744	1.0243
0.0998	1.0040
0.02004	1.0015
0.01004	1.0004

These results lead the author to conclude that in dil. solutions the double salt is decomp. into its constituents. (McKay, Elektrochem. Zeit. 1899, **6.** 115.)

Min. *Picromerite.*

$+4H_2O$. (van der Heide, B. **26.** 414.)

$2MgSO_4, K_2SO_4$. Min. *Langbeinite.*

Deliquescent. Absorbs 56.26% H_2O from air to form $K_2SO_4, MgSO_4+6H_2O$. (Mallet, Chem. Soc. 1900, **77.** 220.)

$4MgSO_4, K_2SO_4+5H_2O$. (van't Hoff and Kassatkin, B. A. B. **1889.** 951.)

Magnesium potassium zinc sulphate, $MgSO_4$, $2K_2SO_4, ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 57.)

Magnesium potassium sulphate chloride, $MgSO_4, K_2SO_4, MgCl_2+6H_2O$.

Min. *Kainite.*

Magnesium rubidium sulphate, $MgSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

1 l. H_2O dissolves 202 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

$2MgSO_4, Rb_2SO_4$. Deliquescent. (Mallet, Chem. Soc. 1900, **77.** 223.)

Magnesium sodium sulphate, $MgSO_4, Na_2SO_4$ $+4H_2O$.

Min. *Blödite, Simonyite.*

Blödite is efflorescent; Simonyite, deliquescent.

$+5H_2O$. Min. *Löwite.*

$+6H_2O$. Decomp. on air. Sol. in 3 pts. cold H_2O.

$Na_6Mg(SO_4)_4$. Min. *Vanthoffite.* (van't Hoff, B. A. B. **1902.** 414.)

$MgNa_2(SO_4)_2+4H_2O$. Min. *Astrakanite.*

100 mols. H_2O hold mols. salt in solution at t°.

t°	$MgSO_4$	Na_2SO_4
22	4.70	2.95
24.5	3.6[illegible]	3.45
30	3.60	3.60
35	3.69	3.69
47	3.60	3.60

(Roozeboom, R. t. c. 1887, **6.** 333.)

Solubility of mixtures of $MgNa_2(SO_4)_2+4H_2O$ and Na_2SO_4 at t°.

t°	g per 100 g H_2O	
	Na_2SO_4	$MgSO_4$
18.5	43.0	45.5
22	35.2	48.9
24.5	32.5	50.3
30	25.9	55.0
35	23.5	59.4

(Roozeboom, Z. phys. Ch. 1888, **2.** 518.)

See also under $MgSO_4$.

Magnesium thallous sulphate, $MgSO_4, Tl_2SO_4$ $+6H_2O$.

Sol. in H_2O, but decomp. by repeated recrystallisations. (Werther.)

Magnesium uranyl sulphate, $MgSO_4, (UO_2)SO_4+5HO_2$.

(de Coninck, Chem. Soc. 1905, **88.** (2) 530.)

Magnesium zinc sulphate, $MgSO_4, ZnSO_4+$ $14H_2O$.

Sol. in H_2O. (Pierre, A. ch. (3) **16.** 244.)

$+10H_2O$. (Pierre.)

$3ZnSO_4, 5MgSO_4+56H_2O$. (Schiff.)

There are only two compounds, $2(MgSO_4, 7H_2O), ZnSO_4, 7H_2O$ and $MgSO_4, 7H_2O, ZnSO_4, 7H_2O$. (Hollmann, Z. phys. Ch. 1901, **37.** 212, and 1902, **40.** 577.

Magnesium sulphate potassium chloride, $MgSO_4, KCl+3H_2O$ or $MgSO_4, K_2SO_4, MgCl_2+6H_2O$.

Min. *Kainite.*

100 pts. H_2O dissolve 79.56 pts. at 18°. (Krause, Arch. Pharm. (3) **6.** 326.)

Not sol. in a mixture of abs. alcohol and ether, which dissolves out $MgCl_2$. (Lehmann, J. B. **1867.** 416.)

Alcohol dissolves out $MgCl_2$, also little H_2O. Much H_2O dissolves completely. (Zincken, Miner. Jahrb. **1865.** 310.)

Magnesium sulphate potassium chromate, $2MgSO_4, K_2CrO_4+9H_2O$.

Sol. in H_2O. (Étard, C. R. **85.** 443.)

Manganous sulphate, basic, $3MnO, 2SO_3+3H_2O$.

Insol. in H_2O, but slowly decomp. thereby. (Gorgeu, C. R. **94.** 1425.)

Manganous sulphate, $MnSO_4$.

Anhydrous.

Absorbs H_2O from the air to form $MnSO_4+4H_2O$.

1 pt. $MnSO_4$ is sol. in pts. H_2O at t°.

t°	Pts. H_2O	t°	Pts. H_2O	t°	Pts. H_2O
6.25	1.77	18.75	1.667	75	1.494
10	1 631	37 5	1·457	101 25	2 031

Or—

100 pts. H_2O dissolve pts. $MnSO_4$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
6 25	56.49	18 75	60 00	75	66.95
10	61 29	37.5	68 63	101 25	49 33

(Brandes, Pogg. **20.** 575.)

Sol. in 2.5 pts. H_2O at 18.75°; at 62.5° it is difficult to dissolve 1 pt. $MnSO_4$ in 3 pts. H_2O, but the sat. solution at 62.5° does not become cloudy on heating to 100°. (Jahn.)

100 pts. $MnSO_4$+Aq sat. at 11–14° contain 37.5 pts. $MnSO_4$. (v. Hauer, J. pr. **103.** 114.)

Sat. $MnSO_4$+Aq contains at:

—8°	—5°	+5°	18°	22°	
30.0	31.0	34.1	38.3	38.2%	$MnSO_4$,
23°	32°	45°	52°	70°	
39.1	41.7	44.2	36.4	41.1%	$MnSO_4$,
83°	110°	115°	123°	130°	140°
36.3	18.4	21.5	16.7	13.6	9.4% $MnSO_4$.

(Étard, A. ch. 1894, (7) **2.** 553.)

Solubility in H_2O increases from 0–55°, and decreases from 55–145°. The increasing solubility is that of $MnSO_4+5H_2O$, and $MnSO_4+2H_2O$ separates out at 35°, and is completely insol. at 145°. (Étard.)

If solubility S=pts. anhydrous $MnSO_4$ in 100 pts. solution, S=30.0+0.2828t from −8° to 57°; S=48.0−0.4585t from 57° to 150°.

Practically insol. in H_2O at 180°. (Étard, C. R. **106.** 208.)

Solubility varies according to the hydrate used. Above results of Étard show the solubility of $MnSO_4+7H_2O$ at 0°, and $MnSO_4+3H_2O$ at 57°. Anhydrous $MnSO_4$ is stable only above 117°. (Linebarger.)

100 pts. H_2O dissolve pts. anhydrous $MnSO_4$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
120	67.18	141	41.18	155	26.49
132	63.16	146	38.83	170	16.15

(Linebarger, Am. Ch. J. **15.** 225.)

$+H_2O$. Stable only between 57° and 117°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
48	87.98	78	79.13	115	69.78
53	86.10	90	75.63	117	68.81
65	84.33	100	71.27	...	...
72	82.73	106	70.14	...	...

(Linebarger.)

Min. *Szmikite.*

Solubility of $MnSO_4+H_2O$ in H_2O at t°.

t°	Pts. $MnSO_4$ per 100 pts. H_2O	t°	Pts. $MnSO_4$ per 100 pts. H_2O
41.5	61.06	75	49.45
50.1	58.01	84.8	44.87
67.1	51.37	95	38.71
...	...	99.6	34.27

Av. of varying results.

(Cottrell, J. phys. Ch. 1900, **4.** 652.)

Linebarger's determinations are inaccurate. (Cottrell.)

$+2H_2O$. Stable between 40° and 57°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+2H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
35	68.88	42	77.63	50	83.16
40	75.31	45	80.07	55	86.27

(Linebarger.)

$+3H_2O$. Stable between 30° and 40°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+3H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
5	54.68	25	66.85	68	71.89
12	60.56	30	67.38	53	72.81
16	63.41	35	68.31	57	73.17
19	65.12	40	70.63	..	...

(Linebarger.)

$+4H_2O$. Sl. efflorescent. Less sol. in boiling than in cold H_2O.

100 pts. H_2O at 4.4° dissolve 31 pts. $MnSO_4+4H_2O$. (Jahn.)

100 pts. H_2O at t° dissolve pts. $MnSO_4+4H_2O$.

t°	Pts. $MnSO_4+4H_2O$	t°	Pts $MnSO_4+4H_2O$
6.25	113.22	37.5	149
10	123	75	144
18.75	122	101.25	93

(Brandes, Pogg. **20.** 575.)

Solubility of $MnSO_4$ in 100 pts. H_2O at t°, using $MnSO_4+4H_2O$.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
0	55.4	35	71.9	70	61.5
1	55.9	36	72.2	71	61.5
2	56.5	37	72.4	72	61.5
3	57.1	38	72.7	73	61.5
4	57.7	39	72.9	74	61.5
5	58.2	40	73.1	75	61.5
6	58.8	41	73.3	76	61.5
7	59.4	42	73.5	77	61.5
8	60.0	43	73.7	78	61.5
9	60.5	44	73.9	79	61.5
10	61.1	45	74.0	80	61.5
11	61.7	46	74.2	81	61.5
12	62.2	47	74.4	82	61.5
13	62.7	48	74.6	83	61.5
14	63.3	49	74.7	84	61.4
15	63.8	50	74.8	85	61.3
16	64.3	51	74.9	86	61.2
17	64.8	52	75.1	87	61.0
18	65.3	53	75.2	88	60.8
19	65.8	54	75.3	89	60.6
20	66.3	55	74.7	90	60.3
21	66.7	56	74.0	91	60.0
22	67.2	57	72.9	92	59.6
23	67.6	58	71.5	93	59.2
24	68.1	59	69.5	94	58.6
25	68.5	60	65.9	95	57.9
26	68.9	..	...	96	57.2
27	69.3	63.5	61.3	97	56.3
28	69.7	64	61.5	98	55.4
29	70.0	65	61.5	99	54.3
30	70.4	66	61.5	100	52.9
31	70.7	67	61.5	101	51.2
32	71.0	68	61.5	102	49.3
33	71.3	69	61.5	102.5	47.4
34	71.6	.	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 137.)

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+4H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
2.2	57.88	25	72.23	48	84.33
7.3	61.78	30	74.67	52	86.16
11	64.01	35.5	78.81	56	88.19
15	67.12	40	79.63	..	...
20	69.93	45	83.06	..	...

(Linebarger.)

Stable in aqueous solution between 25° and 31°. (Schieber, M. 1898, **19.** 281.)

Solubility of $MnSO_4+4H_2O$ in H_2O at t°.

t°	Pts. $MnSO_4$ per 100 pts. H_2O	t°	Pts. $MnSO_4$ per 100 pts. H_2O
16.0	63.97	35.0	67.87
17.7	64.16	35.5	68.09
18.5	64.19	39.9	68.81
25.0	65.32	49.9	72.48
30.0	66.43	50.0	72.62
32.2	66.83	..	...

(Cottrell, J. phys. Ch. 1900, **4.** 651.)

Linebarger's determinations are inaccurate. (Cottrell.)

Solubility in H_2O at t°.

t°	g $MnSO_4$ for 100 g. H_2O
30.15	66.38
35	68.22

(Richards and Fraprie, Am. Ch. J. 1901, **26.** 77.)

$+5H_2O$. Sol. in 1 pt. H_2O at 18.75°. (Jahn, A. **28.** 110.)

Stable from 8° to 18°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+5H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	t° $MnSO_4$
0	58.05	20	75.16	40	84.63
2.5	62.41	25	78.63	42	85.27
4	64.22	30	79.16	45	86.16
7	66.83	32	80.38	47.7	86.05
10	68.05	34	82.04	53	88.89
15	72.33	37	83.91	54	89.08

(Linebarger.)

Stable in aqeous solution between 15° and 20°. (Schieber, M. 1898, **19.** 281.)

Solubility of $MnSO_4+5H_2O$ at t°.

t°	Pts. $MnSO_4$ per 100 pts. H_2O	t°	Pts. $MnSO_4$ per 100 pts. H_2O
5	58.06	16	61.59
9	59.23	25	64.78
12	60.19	30	67.76
12.3	60.16	31.1	67.92
15	61.08	35.5	71.61

(Cottrell, J. phys. Ch. 1900, **4.** 651.)

Linebarger's determinations are inaccurate. (Cottrell.)

Solubility in H_2O at 25° = 65.09 g. $MnSO_4$ for 100 g. H_2O. (Richards and Fraprie, Am. Ch. J. 1901, **26.** 77.)

$+6H_2O$. Stable from − 5° to +8°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+6H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
−4	55.87	9	70.88	30	76.24
0	64.21	15	72.45	34	77.02
3	66.87	20	74.35	35	77.23
5	67.49	25	75.38	38	7.481

(Linebarger.)

$+7H_2O$. Efflorescent.

Sol. in less than 0.5 pt. H_2O at 18.75°. (Jahn.)

Stable between − 10° and − 5°.

100 pts. H_2O dissolve pts. $MnSO_4$ from $MnSO_4+7H_2O$ at t°.

t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$	t°	Pts. $MnSO_4$
−10	50.11	0	53.61	10	59.91
−8	50.93	5	54.83	15	64.34
−5	51.53	7	56.62	.	. .

(Linebarger.)

Stable in aqueous solution below 0°. (Schieber, M. 1898, **19.** 281.)

Solubility of $MnSO_4+7H_2O$ in H_2O at t°.

t°	Pts. $MnSO_4$ per 100 pts. H_2O	t°	Pts. $MnSO_4$ per 100 pts. H_2O
−10	47.96	9	59.33
0	56.23	12	61.78
5	56.38	14.3	63.93

(Cottrell, *l. c.*)

M.-pt. of $MnSO_4+7H_2O$ is 54°. (Tilden, Chem. Soc. **45.** 409.)

Sp. gr. of $MnSO_4$+Aq at 15°.

% $MnSO_4+4H_2O$	Sp. gr.	% $MnSO_4+4H_2O$	Sp. gr.
1	1.006	29	1.208
2	1.013	30	1.2150
3	1.020	31	1.224
4	1.025	32	1.231
5	1.0320	33	1.244
6	1.038	34	1.250
7	1.044	35	1.2579
8	1.050	36	1.268
9	1.056	37	1.276
10	1.0650	38	1.285
11	1.072	39	1.295
12	1.079	40	1.3038
13	1.085	41	1.313
14	1.093	42	1.322
15	1.1001	43	1.331
16	1.106	44	1.340
17	1.114	45	1.3495
18	1.121	46	1.360
19	1.129	47	1.370
20	1.1363	48	1.380
21	1.144	49	1.389
22	1.150	50	1.3986
23	1.160	51	1.410
24	1.166	52	1.420
25	1.1751	53	1.430
26	1.183	54	1.440
27	1.190	55	1.4514
28	1.200	. .	. . .

(Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $MnSO_4$+Aq at 23°. a = no. of ½ mols. in grms. dissolved in 1000 g. H_2O; b = sp. gr. if a is $MnSO_4+5H_2O$, ½ mol. wt. = 120.5; c = sp. gr. if a is $MnSO_4$, ½ mol. wt. = 75.5.

a	b	c	a	b	c
1	1.068	1.071	6	1.306	3.576
2	1.128	1.139	7	1.341	1.429
3	1.181	1.202	8	1.371	. . .
4	1.227	1.262	9	1.399	. . .
5	1.269	1.320	10	1.426	. . .

(Favre and Valson, C. R. **79.** 968.)

Above table recalculated by Gerlach (Z. anal. **28.** 475.)

% $MnSO_4+5H_2O$	Sp. gr.	% $MnSO_4+5H_2O$	Sp. gr.
10	1.0630	40	1.2900
20	1.1325	50	1.3800
30	1.2070	. .	. . .

Sp. gr. of $MnSO_4$+Aq at 15°. a=%; b=sp. gr. if a is $MnSO_4$; c=sp. gr. if a is $MnSO_4+4H_2O$; d=sp. gr. if a is $MnSO_4+5H_2O$; e=sp. gr. if a is $MnSO_4+7H_2O$.

a	b	c	d	e
5	1.0500	1.0340	1.0310	1.0270
10	1.1035	1.0690	1.0630	1.0545
15	1.1605	1.1055	1.0965	1.0830
20	1.2215	1.1435	1.1315	1.1130
25	1.2870	1.1835	1.1685	1.1440
30	1.3575	1.2255	1.2070	1.1765
35	...	1.2695	1.2470	1.2105
40	...	1.3155	1.2885	1.2455
45	...	1.3640	1.3315	1.2815
50	...	...	1.3760	1.3185
55	...	..	...	1.3565

(Gerlach, Z. anal. **28.** 475.)

Sp. gr. of $MnSO_4$+Aq at 0°. S=pts. $MnSO_4$ in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
16.7450	1.1834	8.8295	1.0928
14.0462	1.1519	6.0172	1.0622
11.5804	1.1239	3.0865	1.0315

(Charpy, A. ch. (6) **29.** 26.)

Sp. gr. of $MnSO_4$+Aq at room temp. containing:

11.45	18.8	22.08	% $MnSO_4$.
1.1469	1.2513	1.3082	

(Wagner, W. Ann. 1883, **18.** 271.)

Sp. gr. of $MnSO_4$+Aq at 25°.

Concentration of $MnSO_4$ +Aq	Sp. gr.
1—normal	1.0728
1/2— "	1.0365
1/4— "	1.0179
1/8— "	1.0087
1/16— "	1.0041

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

Sp. gr. at 16°/4° of $MnSO_4$+Aq. containing 30.819% $MnSO_4$=1.36267. (Schönrock, Z. phys. Ch. 1893, **11,** 781.)

Sat. $MnSO_4$+Aq boils at 102.4°; crust forms at 101.6°, and solution contains 48.7 pts. $MnSO_4$ to 100 pts. H_2O.

B.-pt. of $MnSO_4$+Aq containing pts. $MnSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $MnSO_4$	B.-pt.	Pts. $MnSO_4$
100.5°	17.1	102.0°	58.9
101.0	32.1	102.4	68.4
101.5	46.2	...	...

(Gerlach, Z. anal. **26.** 434.)

Sol. in about 20 pts. boiling H_2SO_4, and more sol. in boiling H_2SO_4+Aq of 1.6 sp. gr. (Schultz, Pogg. **133.** 137.)

Completely pptd. from solution by $HC_2H_3O_2$. (Persoz.)

For solubility in $(NH_4)_2SO_4$, see under $(NH_4)_2SO_4$.

$MnSO_4$+Aq sat. at 10°, then sat. with K_2SO_4 at same temp. contains for 100 pts. H_2O 16.7 pts. $MnSO_4$ and 44.3 pts. K_2SO_4 (Mulder.)

Solubility of $MnSO_4+Na_2SO_4$ in H_2O at 35°.

g. per 100 g. sat. solution		
$MnSO_4$	Na_2SO_4	Solid phase
39.45	0	$MnSO_4, H_2O$
33.92	5.23	"
33.06	7.97	$MnSO_4, H_2O+9MnSO_4, 10Na_2SO_4$
32.92	7.42	"
31.05	9.20	$9MnSO_4, 10Na_2SO_4$
27.67	10.76	"
22.14	14.28	"
14.58	20.01	"
13.96	21.91	"
12.79	22.49	$9MnSO_4, 10Na_2SO_4+MnSO_4, 3Na_2SO_4$
10.45	23.41	$MnSO_4, 3Na_2SO_4$
7.43	26.58	"
5.69	29.31	"
5.11	30.52	$MnSO_4, 3Na_2SO_4+Na_2SO_4$
2.96	31.33	Na_2SO_4
0	33	"

(Schreinemakers and Provije, Proc. Ak. Wet. Amsterdam, 1913, **15.** 326.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Anhydrous $MnSO_4$ in insol. in absolute alcohol.

1000 pts. alcohol of 0.872 sp. gr. dissolve 6.3 pts. $MnSO_4$.

Sol. in 50 pts. of 50% alcohol. Insol. in absolute alcohol. (Brandes, Pogg. **20.** 556.)

100 pts. solution saturated at 15° in dil. alcohol containing:

0	10	50	**60 % alcohol, contain**
56.25	**51.4**	**2.0**	**0.66 pts. $MnSO_4+5H_2O$.**

(Schiff, A. **118.** 365.)

When $MnSO_4+7H_2O$ is boiled with absolute alcohol none is dissolved, but $MnSO_4+3H_2O$ is formed.

When $MnSO_4+7H_2O$ is dissolved in 15–50% alcohol, the liquid separates into two layers, the lower containing less (12–14%) alcohol and more (47–49%) salt; the upper containing

more (50–55%) alcohol and less (1.3–2.2%) salt. If the alcohol has the above strength (15–50%) the separation takes place at ordinary temp., but with 13–14% or 60% or more alcohol, warming is necessary to effect the separation. (Schiff, A. **118.** 363.)

Solubility of $MnSO_4+H_2O$ in alcohol+Aq at t°.

Composition of two layers sat. with the solid salt at t°.

t°	Alcohol layer		Water layer	
	% alcohol	% $MnSO_4$	% alcohol	% $MnSO_4$
30	45.20	2.49	8.69	30.15
31	43.90	2.74	8.47	30.10
35	41.71	3.44	9.24	28.61
37	38.26	4.84	11.03	26.47
41	34.01	5.86	11.93	24.97
42	32.37	6.89	13.57	23.09
43	31.42	8.51	14.33	22.01

(Schreinemakers and Deuss, Z. phys. Ch. 1912, **79.** 559.)

Composition of alcohol solutions sat. with $MnSO_4+H_2O$ at t°.

t°	% H_2O	% alcohol	% $MnSO_4$
50	63.74	0	36.26
	65.21	6.67	28.12
	65.23	16.02	18.75
	64.83	22.63	12.54
	59.41	36.47	4.12
35	61.4	0	38.6
	62.13	5.50	32.37
	62.06	6.46	31.48
	62.01	7.48	30.51
	*62.15	9.24	28.61
	*54.85	41.71	3.44
	50.69	47.73	1.58
	50.16	48.27	1.57
30	61.4	0	38.6
	61.43	2.26	36.31
	61.25	5.09	33.66
	60.78	5.96	*33.26
	*61.16	8.69	30.15
	*52.31	45.20	2.49
	44.83	54.19	0.98
	30.95	68.97	0.08
	9.19	90.80	0.01

*The solutions also sat. with respect to one another.

(Schreinemakers and Deuss.)

Composition of the solutions sat. with respect to one another.

t°	water layer		alcohol layer	
	% alcohol	% $MnSO_4$	% alcohol	% $MnSO_4$
50	†5.68	34.95	†53.64	0.97
	†7.69	30.99	†45.83	2.19
	†8.70	29.20	†41.93	3.11
	†11.85	24.84	†35.15	5.95
35	†8.38	29.52	†42.38	3.07
	*9.24	28.61	*41.71	3.44
	10.75	26.33	36.89	5.19
	13.09	21.85	30.06	9.03
30	†7.60	32.40	†50.97	1.74
	*8.69	30.15	*45.20	2.49
	10.46	27.58	40.71	3.93
	11.86	25.75	37.54	5.20
	16.18	20.86	29.89	9.64

(Schreinemakers and Deuss.)

†Metastable solutions.

*Solutions also sat. with respect to $MnSO_4$, H_2O.

Solubility of $MnSO_4+4H_2O$ in alcohol+Aq.

g. H_2O	g. alcohol	$MnSO_4$, $4H_2O$
55.86	30.03	14.11
52.25	43.59	4.16
49.41	47.66	2.94
45.34	53.00	1.66
42.56	56.24	1.20

(Linebarger, Am. Ch. J. 1892, **14.** 380.)

Solubility of $MnSO_4+5H_2O$ in alcohol+Aq.

Composition of the solution sat. with $MnSO_4+5H_2O$.

t°	alcohol layer		water layer	
	% alcohol	% $MnSO_4$	% alcohol	% $MnSO_4$
10	37.06	5.44	13.78	25.25
15	44.56	2.79	9.25	29.79
17.6	47.11	2.22	8.53	30.88
21	53.55	1.10	6.10	35.05
25	53.09	1.23	6.81	33.72

Composition of solution sat. with solid substance at 25°.

% H_2O	% alcohol	% $MnSO_4$	Solid phase
60.7	0	39.3	$MnSO_4+5H_2O$
*59.47	6.81	33.72	"
*45.68	53.09	1.23	"
42.05	57.39	0.56	"
23.30	76.70	0.0	$MnSO_4+H_2O$

*The two liquids are sat. with respect to one another.

Composition of the two solutions sat. with respect to one another at 25°.

Water layer		Alcohol layer	
% alcohol	% $MnSO_4$	% alcohol	% $MnSO_4$
*6.81	*33.72	*53.09	1.22
8.48	31.51	49.76	1.83
15.02	22.61	32.75	8.01

*Also sat. with $MnSO_4$, $5H_2O$.
(Schreinemakers and Deuss.)

Insol. in absolute ether between 5° and 7°, and no crystal H_2O is removed thereby. Insol. in boiling oil of turpentine, but 1 mol. crystal H_2O is removed from $MnSO_4+4H_2O$ (Brandes, Pogg. **20.** 568.)
Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.); ethyl acetate. Naumann, B. 1910, **43.** 314); acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C.C. **1899,** II. 1014.)
100 g. sat. solution in glycol contain 0.5 g. $MnSO_4$ (de Coninck, Bull. Ac roy. Belg. **1905.** 359.)
$MnSO_4+7H_2O$ occurs as the min. *Mallardite.*

Manganomanganic sulphate, MnO, MnO_2, $4SO_3+9H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in little dil. H_2SO_4+Aq. (Fremy, C. R. **82.** 475.)

Manganic sulphate, $Mn_2(SO_4)_3$.

Extremely deliquescent. Sol. in H_2O with evolution of heat, and decomposition into a basic sulphate. Behaves similarly with dilute acids. Sol. in traces in cold conc. H_2SO_4. Insol. in cold conc. HNO_3+Aq. Sol. in conc. HCl+Aq. Decomp. by absolute alcohol. (Carius, A. **98.** 53.)

Manganyl sulphate, MnO_2, SO_3.

Sol. in H_2SO_4 but solution decomp. if below 40–60° Baumé. Solubility in 40° Baumé acid = 15%: 55°, 4–5%. Solution can be heated to 60–80° without decomp. (Bad. Anilin u. Sodafabrik, C. C. **1905,** II. 1398.)

Manganous hydrogen sulphate.

$MnSO_4$ is sol. in 20 pts. boiling conc. H_2SO_4; more sol. in boiling H_2SO_4+Aq of 1.6 sp. gr. (Schultz.)
$MnH_2(SO_4)_2$, and $+H_2O$. Sol. in H_2O with decomp. (Schultz.)
$MnH_6(SO_4)_4$. Sol. in H_2O with decomp. (Schultz.)

Manganic hydrogen sulphate, $Mn_2H_2(SO_4)_4+8H_2O$.

Deliquescent. Decomp. by H_2O. Sol. in dil. H_2SO_4+Aq. (Francke, J. pr. (2) **36.** 251.)

Manganous hydrazine sulphate, $MnH_2(SO_4)_2$, $2N_2H_4$.

1 pt. is sol. in 60 pts. H_2O at 18°.
Stable in the air at 100°. (Curtius, J. pr. 1894, (2) **50.** 331.)

Manganous nickel potassium sulphate,

$MnSO_4$, $NiSO_4$, $2K_2SO_4+12H_2O$. Sol. in H_2O. (Vohl, A. **94.** 57.)

Manganous potassium sulphate, K_2SO_4, $MnSO_4+2H_2O$.

$+4H_2O$. Efflorescent. (Pierre, A. ch. (3) **16.** 239.)
$2MnSO_4$, K_2SO_4. (Mallet, C. N. 1899, **80.** 301.)

Manganic potassium sulphate, $K_2Mn_2(SO_4)_4+24H_2O$.

Decomp. by dissolving in H_2O. (Mitscherlich.)

Manganomanganic potassium sulphate, $Mn_5(SO_4)_8$, $5K_2SO_4$ = $3Mn(SO_4)_2$, $2MnSO_4$, $5K_2SO_4$.

Decomp. by much H_2O. Sol. in dil. or conc. H_2SO_4. Insol. in alcohol or ether. (Francke, J. pr. (2) **36.** 166.)

Manganous potassium zinc sulphate, $MnSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl.)

Manganous rubidium sulphate, $MnSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)
1 l. H_2O dissolves 357 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27,** 459.)
$+2H_2O$. (Wyrouboff, Bull. Soc. Min. 1891, **14.** 242.)
$2MnSO_4$, Rb_2SO_4. (Wyrouboff.)

Manganic rubidium sulphate, $Mn_2(SO_4)_3$, $Rb_2SO_4+24H_2O$.

Deliquescent. (Christensen, Z. anorg. 1901, **27.** 333.)

Manganous sodium sulphate, $MnSO_4$, Na_2SO_4.

$+2H_2O$. Deliquescent in moist air. (Geiger.)
$+4H_2O$. Sol. in 1.2 pts. boiling H_2O. (Geiger.)

Manganous sulphate ammonia, $MnSO_4$, $4NH_3$.

Decomp. by H_2O. (Rose, Pogg. **20.** 148.)

Manganous sulphate cupric oxide, $MnSO_4$, $2CuO+3H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 392.)
$MnSO_4$, $3CuO+xH_2O$. (Recoura, C. R. 1901, **132.** 1415.)
$MnSO_4$, $24CuO+xH_2O$. (Recoura.)

Manganous sulphate hydrazine, $MnSO_4$, $2N_2H_4$.

Very unstable.

Somewhat sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 285.)

Manganous sulphate hydroxylamine, $MnSO_4$, NH_2OH+2H_2O.

Insol. in H_2O. (Feldt, B. 1894, **27.** 405.)

Mercurous sulphate, basic, $2Hg_2O$, SO_3+H_2O.

Sol. in 25,000 pts. H_2O at 20°. (Gouy, C. R. 1900, **130.** 1401.)

Mercurous sulphate, Hg_2SO_4.

Sol. in 500 pts. cold, and 300 pts. hot H_2O. (Wackenroder, A. **41.** 319.)

Solubility in H_2O at 18° = 7.8×10^{-4} g. mol. per liter. (Wilsmore, Z. phys. Ch. 1900, **35.** 305.)

1 l. H_2O dissolves 11.71×10^{-4} g.-mol. Hg_2SO_4 at 25°. (Drucker, Z. anorg. 1901, **28.** 362.)

Solubility in H_2O at t°.

t°	In 100 pts. of the solution	
	Hg_2SO_4	H_2SO_4
16.5	0.055	0.008
33	0.060	0.018
50	0.065	0.037
75	0.074	0.063
91	0.084	0.071
100	0.092	0.071

(Barre, A. ch. 1911, (8) **24.** 203.)

Solubility in H_2O at 25° is 20% greater than at 18° and = 11.71×10^{-4} g. mol. per l. By addition of increasing amts. of H_2SO_4 the solubility is somewhat, but not regularly, decreased, K_2SO_4 lowers solubility less than H_2SO_4. (Drucker, Z. anorg. 1901, **28.** 362.)

Easily sol. in dil. HNO_3+Aq, from which solution it is separated by dil. H_2SO_4+Aq. (Wackenroder, A. **41.** 319.)

Abundantly sol. in hot, less sol. in cold dil. H_2SO_4+Aq. (Berzelius.)

Solubility in H_2SO_4+Aq at 25°.

H_2SO_4 normality	g.-mol. Hg_2SO_4 per litre
0.0400	8.31×10^{-4}
0.1000	8.78×10^{-4}
0.2000	8.04×10^{-4}

(Drucker, Z. anorg. 1901, **28.** 362.)

Partially decomp. by hot NH_4 salts+Aq. (Miahle, A. ch. (3) **5.** 179.)

5 times more sol. in sat. $CdSO_4$+Aq than in H_2O. (Hulett, Phys. Rev. 1907, **25.** 16.)

Sat. $ZnSO_4$ or $CdSO_4$+Aq attack much less than pure H_2O, yet the solubility of Hg_2SO_4 in these solutions is greater, *i. e.*, 0.8 g. in 1 l. $ZnSO_4$+Aq and 1.1 g. in 1 l. $CdSO_4$+Aq at 20°. (Gouy, C. R. 1900, **130.** 1402.)

Solubility in 0.2N K_2SO_4+Aq = 9.05×10^{-4} g. mol. per l. at 25°. (Drucker, Z. anorg. 1901, **28.** 362.)

Solubility of Hg_2SO_4 in K_2SO_4+Aq.

t°	g. per 100 g. sat. solution		
	K_2SO_4	Hg_2SO_4	free H_2SO_4
15	2.90	0.0475	0.0080
	5.70	0.0703	0.0093
	8.22	0.0912	0.0098
	8.77	0.0994	....
	9.44	0.1080	0.0110
33	2.94	0.0677	0.0250
	5.68	0.1015	0.0350
	8.30	0.1364	0.0441
	10.70	0.1724	0.0438
	11.90	0.1902	0.0420
75	3.10	0.1344	0.1681
	5.75	0.2120	0.2135
	8.50	0.2951	0.2514
	13.20	0.4610	0.2503
	17.30	0.6440	0.2225

(Barre, A. ch. 1911, (8) **24.** 202.)

About 3 times as sol. in sat. $ZnSO_4$+Aq as in distilled H_2O. (Wright, Phil. Mag. (5) 1885, **19.** 29.)

Mercuric sulphate, basic, $2HgO$, SO_3.

(Mailhe, A. ch. 1902, (7) **27.** 394.)

$3HgO$, SO_3. (*Mineral turpeth.*)

Sol. in 2000 pts. cold and 600 pts. boiling H_2O. (Fourcroy, A. ch. **10.** 307.)

Sol. in 43,478 pts. H_2O at 16° when pptd. cold, and in 32,258 pts. at 16° when pptd. at 100°. (Cameron, Z. anal. **19.** 144.)

Sl. sol. in warm dil. H_2SO_4+Aq. (Rose.)

Solubility in H_2O is increased by addition of H_2SO_4 up to an acid content of 4.3 mol. SO_3 to 93.7 mols. H_2O. (Hoitsema, Z. phys. Ch. 1895, **17.** 665.)

Sol. in warm conc. HCl or HBr+Aq. (Ditte.)

Sol. in alkali chlorides+Aq. (Miahle.)

Sol. in dil. HNO_3 or in HCl+Aq. More easily sol. in the warm acids. (Rây, Chem. Soc. 1897, **71.** 1099.)

$3HgO$, $2SO_3+2H_2O$. (Hoitsema, Z. phys. Ch. 1895, **17.** 659.)

$4HgO$, $3SO_3$. (Hopkins, Sill. Am. J. **18.** 364.)

Mercuric sulphate, $HgSO_4$.

Decomp. by H_2O into $3HgO$, SO_3, and a sol. acid salt. Sol. in dil. H_2SO_4+Aq. Decomp. by all acids. (Berzelius.)

Sol. in warm conc. HCl or HBr+Aq; very sl. sol. in boiling conc. HI+Aq. (Ditte, A. ch. (5) **17.** 124.)

Very sl. sol. in hot conc. HF. (Ditte, A. ch. 1879, (5) **17.** 125.)

Sol. in HCN+Aq. (Mohr.)

Sol. with decomp. in NaCl+Aq. (Miahle.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.

Insol. in conc. alcohol.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.); methyl acetate. (Naumann, B. 1909, **42.** 3790.); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

Insol. in pyridine. (Schroeder, Dissert. **1901.**)

$+H_2O$. Decomp. by H_2O. (Eisfeldt, Pharm. Centr. **1853.** 812.)

Mercuromercuric sulphate, Hg_2O, $2HgO$, SO_3.

Insol. in cold H_2O; not decomp. by boiling H_2O. Decomp. by HCl+Aq. (Brooke, Pogg. **66.** 63.)

Hg_2SO_4, $HgSO_4$. (Baskerville, J. Am. Chem. Soc. 1897, **19.** 875.)

Mercuric hydrogen sulphate, $HgH_2(SO_4)_2$.

(Braham, C. N. **42.** 163.)

Mercuric potassium sulphate, $3HgSO_4$, $K_2SO_4+2H_2O$.

Sol. in H_2O. (Hirzel, J. B. **1850.** 332.)

Mercuric sulphate chloride ammonium chloride, $2HgSO_4$, $HgCl_2$, $2NH_4Cl$.

Decomp. with H_2O. Ether dissolves out $HgCl_2$. (Kosmann, A. ch. (3) **27.** 238.)

Mercuric sulphate cyanide, $HgSO_4$, $Hg(CN)_2$ $+5H_2O$.

Decomp. by conc. or warm acids. (Rupp, Arch. Pharm. 1912, **250.** 280.)

Mercuric sulphate hydrazine, $HgSO_4$, N_2H_4.

Ppt. (Hofmann and Marburg, A. 1899, **305.** 216.)

Mercuric sulphate hydrobromide, $HgSO_4$, $2HBr$.

Sol. in H_2O without separation of basic sulphate. (Ditte, A. ch. (5) **17.** 122.)

$3HgO$, SO_3, $6HBr$. Sol. in H_2O. (Ditte.)

Mercuric sulphate hydrochloride, $HgSO_4$, HCl.

Not attacked by HCl. Sl. sol. in HNO_3. (Baskerville, J. Am. Chem. Soc. 1901, **23.** 895.)

$HgSO_4$, 2HCl. Sol. in H_2O without separation of a basic salt. Very sol. in warm H_2SO_4, solidifying on cooling if very conc., or crystallising if dil. (Ditte.)

Very deliquescent.

Very sol. in H_2O. (Baskerville, J. Am. Chem. Soc. 1901, **23.** 895.)

$+H_2O$. (Baskerville, J. Am. Chem. Soc. 1901, **23.** 895.)

$3HgO$, SO_3, 6HCl. Sol. in H_2O. (Ditte.)

Mercuric sulphate hydroxylamine, $HgSO_4$, $2NH_2OH+H_2O$.

Decomp. by cold H_2O. (Adams, Am. Ch. J. 1902, **28.** 209.)

Mercuric sulphate iodate iodide, $6(3HgO, 2SO_3)$, $6HgI_2$, $Hg(IO_3)_2$.

Decomp. by H_2O and acids. (Brückner, M. 1907, **28.** 961.)

Mercuric sulphate iodide, basic, $3HgO$, $2SO_3$, HgI_2.

$3(3HgO, 2SO_3)$, $2HgI_2+10H_2O$.

$2(3HgO, 2SO_3)$, HgI_2+10H_2O. Very sol. in hot conc. HNO_3.

$3HgO$, $2SO_3$, $HgSO_4$, HgI_2+10H_2O. (Ditte, C. R. 1905, **140.** 1167.)

Mercuric sulphate iodide, $HgSO_4$, HgI_2.

Decomp. by H_2O, not by alcohol or ether. (Riegel, J. B. pr. Pharm. **11.** 396.)

$3HgSO_4$, HgI_2. Decomp. by cold or hot H_2O. Sol. in H_2SO_4+Aq. (Ditte, C. R. 1905, **140.** 1165.)

$4HgSO_4$, HgI_2+15H_2O, and $+18H_2O$. Decomp. by cold or hot H_2O.

Sol. in H_2SO_4. (Ditte.)

Mercuric sulphate phosphide.

*See Di*mercuriphosphonium mercuric sulphate.

Mercuric sulphate sulphide, basic, $2HgO$, SO_3, HgS.

Somewhat sol. in HCl, H_2SO_4 and HNO_3. (Jacobson, Pogg. 1846, **68.** 412.

$4HgO$, $3SO_3$, $2HgS+4H_2O$. Sl. sol. in H_2SO_4. (Estrup, Z. anorg. 1909, **62.** 169.)

Mercuric sulphate sulphide, $2HgSO_4$, HgS.

Sl. sol. in hot HCl, H_2SO_4, or HNO_3+Aq. Easily sol. in hot aqua regia. (Jacobson, Pogg. **68.** 410.)

$2HgSO_4$, HgS. (Palm, C. C. **1863.** **122.**)

$HgSO_4$, 2HgS. (Barfoed, J. B. **1864.** 282.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) **17.** 355.)

$HgSO_4$, 3HgS. Insol. in H_2O. Easily sol. in aqua regia; decomp. by HNO_3 into—

$3HgSO_4$, HgS. Insol. in all acids except aqua regia. (Spring, A. **199.** 116.)

Molybdenum ***sesqui*****sulphate** (?).

Basic. Insol. in H_2O.

Neutral. Decomp. by H_2O into acid and basic salts.

Acid. Sol. in H_2O. (Berzelius.)

Molybdenum *di*sulphate (?).
Sol. in H_2O.

Molybdenum sulphate, $Mo_2O_5, 2SO_3$.
Very slowly sol. in cold, more quickly sol. in hot H_2O. (Bailhache, C. R. 1901, **132.** 476.)
$7MoO_3, 2MoO_2, 7SO_3+Aq$. (Péchard, C. R. 1901, **132.** 630.

Molybdic sulphate, MoO_3, SO_3.
Deliquescent. Sol. in H_2O. (Schultz-Sellack, B. **4.** 14.)
$MoO_3, 3SO_3+2H_2O$. Deliquescent. Partially sol. in H_2O. (Anderson, Berz. J. B. **22.** 161.)
Does not exist. (Schultz-Sellack.)

Molybdenum sulphate ammonia,
$5NH_3, MoO_2SO_3, 7MoO_3+8H_2O$.
$3NH_3, MoO_2SO_3, 7MoO_3+10H_2O$.
Both very sol. in water but less sol. in H_2O containing ammonium salts. (Péchard, C. R. 1901, **132.** 630.)

Neodymium sulphate, basic, Nd_2O_3, SO_3.
Insol. in H_2O.
Nearly insol. in dil. acids. (Wöhler, B. 1913, **46.** 1730.)
Insol. in H_2O. (Matignon, C. R .1902, **134.** 658.)

Neodymium sulphate, $Nd_2(SO_4)_3+8H_2O$.
Solubility in 100 pts. H_2O at t°.

t°	pts. $Nd_2(SO_4)_3$
0	9.50
16	7.05
30	5.04
50	3.72
80	2.70
100	2.21

(Muthmann and Rolig, B. 1898, **31.** 1728.)

Neodymium hydrogen sulphate, $Nd(SO_4H)_3$.
(Brauner, Z. anorg. 1904, **38.** 331.)

Neodymium potassium sulphate.
Cryst. modification more sol. in cold than in hot H_2O. (Boudouard, C. R. 1898, **126.** 901.)

Nickel sulphate, basic.
Very sl. sol. in H_2O. (Berzelius.)
$6NiO, 5SO_3+4H_2O$. (Athanasesco, C. R. **103.** 271.)
$7NiO, 7H_2O, SO_3+3H_2O$. Nearly insol. in H_2O. (Habermann, M. **5.** 432.)
$5NiO, SO_3$; $5NiO, 2SO_3$; and $5NiO, 3SO_3$. (Pickering, Chem. Soc. 1907, **91.** 1985.)
$6NiO, SO_3$. (Strömholm. C.C. **1906,** 1. 1222.)

Nickel sulphate, $NiSO_4$.
100 pts. H_2O dissolve pts. $NiSO_4$ at t°:

2°	16°	20°	23°	31°	
30.4	37.4	39.7	41	45.3	pts. $NiSO_4$,
41°	50°	53°	60°	70°	
49.1	52	54.4	57.2	61.9	pts. $NiSO_4$.

(Tobler, A. **95.** 193.)

100 pts. of sat. solution contain: at 11-14°, 28.84; at 18 20°, 30.77 pts. anhydrous salt. (v. Hauer, W. A. B. **53, 2.** 221.)
100 pts. H_2O at 112.5° dissolve 185.71 pts. $NiSO_4$. (Griffiths.)
$NiSO_4+7H_2O$ is sol. in 3 pts. H_2O at 12.5°. (Tupputi.)
100 pts. H_2O at 15.5° dissolve 75.6 pts. $NiSO_4+7H_2O$.

Sat. $NiSO_4+Aq$ contains at:

—3°	+2°	5°	11°	17°	54°		
21.7	22.7	23.1	25.2	26.6	33.6% $NiSO_4$.		
68°	74°	92°	97°	110°	117°	119°	
38.2	38.7	42.4	44.2	46.5	48.8	49.4%	$NiSO_4$.

(Étard, A. ch. 1894, (7) **2.** 552.)

See also below under hydrated salts.
Sp. gr. of $NiSO_4+Aq$ containing g. $NiSO_4+7H_2O$ in 1000 g. H_2O at 23.5°.

140.5 g. (=½ mol.)	281	421.5	562
1.073	1.136	1.190	1.238
602.5	843	983.5	1124
1.280	1.317	1.349	1.378

Containing $NiSO_4$ (anhydrous):

77.5 g.(=1/2mol.)	155	232.5	310	387.5	465
1.079	1.153	1.224	1.292	1.358	1.421

(Gerlach, Z. anal. **28.** 468.)

Sp. gr. of $NiSO_4+Aq$ at 0°. S=pts. $NiSO_4$ in 100 pts. solution; S_1=mols. $NiSO_4$ in 100 mols. solution.

S	S_1	Sp. gr.
4.2930	0.581	1.0522
3.9591	0.476	1.0431
3.2845	0.392	1.0357
2.5043	0.297	1.0271
1.6131	0.189	1.0173
0.8327	0.097	1.0089

(Charpy, A. ch. (6) **29.** 26.)

Sp. gr. of $NiSO_4+Aq$ at room temp. containing:

10.62	18.19	25.35% $NiSO_4$.
1.0925	1.1977	1.3137

(Wagner, W. Ann. 1883, **18.** 272.)

Sp. gr. of $NiSO_4+Aq$ at 25°.

Concentration of $NiSO_4$ +Aq	Sp. gr
1–normal	1.0773
1/2– "	1.0391
1/4– "	1.0198
1/8– "	1.0017

(Wagner, Z. phys. Ch. 1890, **5.** 39.)

For solubility of $NiSO_4+Na_2SO_4$ in H_2O, see under $NiSO_4+7H_2O$ and $NiNa_2(SO_4)_2$.

100 pts. sat. $NiSO_4+ZnSO_4+Aq$ at 18–20° contain 35.45 pts. of the two salts. (v. Hauer.)

Insol. in liquid NH_3. (Franklin. Am. Ch. J. 1898, **20.** 828.)

$HC_2H_3O_2$ precipitates it completely from aqueous solution. (Persoz.)

100 pts. absolute methyl alcohol dissolve 0.5 pt. $NiSO_4$ at 18°. (de Bruyn, Z phys. Ch. **10.** 783.)

Solubility of $NiSO_4$, $3CH_4O+3H_2O$ in methyl alcohol at 14°.

P = % anhydrous $NiSO_4$ in the sat. solutions.

Alcohol % by wt.	P	In 1000 mol. of the solution: Mol. $NiSO_4$	Mol. CH_4O	Mol. H_2O
100	3.72	7.75	969	23.2
97.5	0.77	1.65	950	48.5
95	0.455	0.96	908	91
92.5	0.50	1.0	871	128
90	0.70	1.6	830	168
89	1.01	2.0	814	184
88	1.25	2.4	800	198
87	1.48	2.9	781	216
86	1.73	3.2	767	230
85	1.93	3.6	755	241

(de Bruyn, R. t. c. 1903, **22.** 418.)

This salt is more sol. in ethyl alcohol than in methyl alcohol.

See also under hydrated salts.

For solubility of $NiSO_4$ in ethyl alcohol, see under hydrated salts.

100 g. sat. solution in glycol contain 9.7 g. $NiSO_4$ at ord temp. (de Coninck, Bull. Ac. Roy. Belg. **1905.** 359.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate, (Naumann, B. 1904, **37,** 3602.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014).

$+H_2O$. Very sl. sol. in abs. methyl alcohol. After standing in contact with it for 8–9 months, the solution contains 1.34% $NiSO_4$. (de Bruyn. R. t. c. 1903, **22.** 414.)

$+2H_2O$. Cryst. from sat. $NiSO_4+Aq$ at 131°. (Steele and Johnson.)

$+4H_2O$. Solubility in methyl alcohol+Aq at 10°. Time=24 hrs. P=% anhydrous salt in the sat. solutions.

Alcohol of	100%	80%	50%	20%	water
P	7.38	0.66	1.43	14.8	25.1

(de Bruyn, R. t. c. 1903, **22.** 414.)

$+6H_2O$. Two modifications. α-blue, tetragonal; β-green, monoclinic.

Solubility of α- $NiSO_4$, $6H_2O$ in H_2O at t°.

Salt used	t°	g. $NiSO_4$ in 100 g. H_2O	Salt remaining
$NiSO_4+6H_2O$ (blue)	32.5	43.57	$NiSO_4+6H_2O$ (blue)
"	33.0	43.35	"
$NiSO_4+7H_2O$	34.0	43.84	"
"	35.[illegible]	43.79	"
$NiSO_4+6H_2O$	44.7	48.05	"
$NiSO_4+7H_2O$	44.7	47.97	"
$NiSO_4+6H_2O$ (blue)	50.0	50.15	"
"	51.0	50.66	"
"	52.0	52.34	"
"	53.0	52.34	"

(Steele and Johnson.)

Solubility of β- $NiSO_4$, $6H_2O$ in H_2O at t°.

Salt used	t°	g. $NiSO_4$ per 100 g. H_2O	Salt remaining
$NiSO_4+6H_2O$(blue)	54.5	52.50	$NiSO_4+6H_2O$ (green)
$NiSO_4+6H_2O$(blue) $NiSO_4+7H_2O$	57.0	53.40	"
$NiSO_4+6H_2O$(blue) $NiSO_4+7H_2O$	60.0	54.84	"
$NiSO_4+7H_2O$	69.0	58.38	"
	70.0	59.44	"
$NiSO_4+6H_2O$(blue)	73.0	60.72	"
$NiSO_4+6H_2O$(blue) $NiSO_4+7H_2O$	80.0	63.17	"
$NiSO_4+7H_2O$	89.0	67.90	"
"	99.0	76.71	"

(Steele and Johnson, Chem. Soc. 1904, **85.** 118.)

Tr. point from α- to β- salt=53.3°. (Steele and Johnson.)

100 pts. absolute methyl alcohol dissolve 31.6 pts. $NiSO_4+6H_2O$ at 17°; 100 pts. 93.5% methyl alcohol dissolve 7.8 pts. $NiSO_4+6H_2O$ at 18°; 100 pts. 50% methyl alcohol dissolve 1.9 pts. $NiSO_4+6H_2O$ at 18°. (de Bruyn, Z. phys. Ch. **10.** 786.)

α-Salt. Solubility in methyl alcohol+Aq at 14°. Time=5 to 6 hrs.

Alcohol % by wt.	% $NiSO_4$	In 1000 mol. of the solution: Mol. $NiSO_4$	Mol. CH_4O	Mol. H_2O
100	12.4	26	794	180
97.5	10.6	22.3	808	170
95	6.5	14	817	169
92.5	3.06	5.9	838	156
90	1.18	2.3	821	177
85	0.315	0.57	757	242
80	0.25	0.4	688	312
60	0.46	0.8	453	546
40	2.43	3.5	265	732
20	14.7	21	105	874
0 (water)	26.0	39	0	961

(de Bruyn, R. t. c. 1903, **22.** 412.)

β-salt. Solubility in methyl alcohol+Aq at 14°. Time = 24 hrs.

Alcohol % by wt.	% $NiSO_4$	In 1000 mol. of the solution		
		Mol. $NiSO_4$	Mol. CH_4O	Mol. H_2O
100	15.7	33.8	763	203
97.5	12.4	26	781	193
95	10.0	20.3	784	196
92.5	5.61	11.1	800	189
90	2.35	4.5	810	185
89	1.79	...	...	...
88	1.29	...	...	...
87	0.97	...	...	...
86	0.735	...	...	...
85	0.61	1.3	755	244
80	0.415	0.7	682	317
60	0.75	1.3	453	546
40	3.11	4.0	264	732
20	14.1	21.0	105	874
0 (water)	27.2	40.0	0	960

(de Bruyn.)

+$7H_2O$.
Solubility in 100 pts. H_2O at t°, using $NiSO_4+7H_2O$.

t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$
0	29.3	33	45.5	66	63.6
1	29.7	34	46.0	67	64.1
2	30.1	35	46.5	68	64.7
3	30.5	36	47.0	69	65.3
4	31.0	37	47.5	70	65.9
5	31.5	38	48.0	71	66.5
6	32.0	39	48.5	73	67.0
7	32.5	40	49.0	72	67.6
8	33.0	41	49.6	74	68.2
9	33.5	42	50.1	75	68.8
10	34.0	43	50.6	76	69.3
11	34.5	44	51.2	77	69.9
12	35.0	45	51.7	78	70.5
13	35.5	46	52.3	79	71.1
14	36.0	47	52.8	80	71.7
15	36.5	48	53.4	81	72.3
16	37.0	49	53.9	82	72.9
17	37.5	50	54.5	83	73.5
18	38.0	51	55.0	84	74.1
19	38.5	52	55.6	85	74.6
20	39.0	53	56.1	86	75.2
21	39.5	54	56.7	87	75.8
22	40.0	55	57.3	88	76.4
23	40.5	56	57.9	89	77.0
24	41.0	57	58.4	90	77.6
25	41.5	58	59.0	91	78.2
26	42.0	59	59.6	92	78.8
27	42.5	60	60.2	93	79.4
28	43.0	61	60.7	94	80.1
29	43.5	62	61.3	95	80.7
30	44.0	63	61.9	96	81.3
31	44.5	64	62.4	97	81.9
32	45.0	65	63.0	98	82.5

Solubility in 100 pts. H_2O at t°.—*Continued.*

t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$	t°	Pts. $NiSO_4$
99	83.1	103	85.6	107	88.1
100	83.7	104	86.2	108	88.7
101	84.3	105	86.8	108.4	88.7
102	84.9	106	87.5	...	...

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. **1864.** 70.)

Solubility in H_2O at t°.

Salt used	t°	g. $NiSO_4$ in 100 g H_2O	Salt remaining
$NiSO_4+7H_2O$	−5	25.74	$NiSO_4+7H_2O$
"	0	27.22	"
"	9	31.55	"
"	15	34.19	"
"	22.6	37.90	"
"	22.8	38.88	"
"	30.0	42.46	"
$NiSO_4+6H_2O$	30.0	42.47	"
$NiSO_4+7H_2O$	32.3	44.02	"
"	33.0	45.74	"
"	34.0	45.5	"

(Steele and Johnson, Chem. Soc. 1904, **85.** 116.)

M.-pt. of $NiSO_4+7H_2O$ = 98–100°. (Tilden, Chem. Soc. **45.** 409.)

Tr. point from α-$6H_2O$ salt to $7H_2O$ salt = 31.5°. (Steele and Johnson.)

Exists also in an unstable, more soluble modification. (Fedorow, C. C. **1903,** II. 95.)

Solubility of $NiSO_4.7H_2O+Na_2SO_4.10H_2O$ in 100 g. H_2O at t°.

t°	grams $NiSO_4$	grams Na_2SO_4
0	22.46	10.09
5	25.28	15.245
10	28.26	20.64

(Koppel, Z. phys. Ch. 1905, **52.** 401.)
See also under $NiNa_2(SO_4)_4$.

100 pts. absolute methyl alcohol dissolve 46 pts. $NiSO_4+7H_2O$ at 17°; 100 pts. absolute methyl alcohol dissolve 24.7 pts. $NiSO_4+7H_2O$ at 4°; 100 pts. 93.5% methyl alcohol dissolve 10.1 pts. $NiSO_4+7H_2O$ at 4°; 100 pts. 50% methyl alcohol dissolve 2 pts. $NiSO_4+7H_2O$ at 4°. (de Bruyn, Z. phys. Ch. **10.** 786.)

Solubility in methyl alcohol+Aq at 14°. Time, 5 to 6 hrs.

Alcohol % by wt.	% $NiSO_4$	In 1000 mol. of solution Mol. $NiSO_4$	Mol. CH_4O	Mol. H_2O
100	16.8	35.7	714	250
97.5	13.9	29	734	237
95	11.6	23.6	742	234.5
92.5	8.12	16.2	760	224
90	5.78	11.2	758	231
85	1.52	3	744	253
84	1.06	.	...	...
83	0.985	. .	...	. .
82	0.83	. .	. .	. .
81	0.665	. .	...	...
80	0.653	1.2	687	312
60	0.805	1.3	453	546
45	1.73	...	...	...
40	2.78	4	264	732
35	4.55	. .	...	...
30	6.33	. .	. .	...
20	13.7	20	105	875
0 (water)	26.4	39.5	0	960.5

(de Bruyn, R. t. c. 1903, **22.** 411.)

100 g. absolute ethyl alcohol dissolve 1.3 g. $NiSO_4+7H_2O$ at 4°, and 2.2 g. at 17°. (de Bruyn, Z. phys. Ch. **10.** 786.)
Min. *Morenosite.*

Nickel hydrazine sulphate, $NiH_2(SO_4)_2$, $2N_2H_4$.

1 pt. is sol. in 275.5 pts. H_2O at 18°. Sl. sol. in hot H_2O. Sol. in HNO_3 with decomp.; insol. in HCl. Sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 331.)

Nickel potassium sulphate, $NiSO_4$, $K_2SO_4+6H_2O$.

Sol. in 8-9 pts. H_2O. (Tupputi.)

100 pts. H_2O dissolve at:

0°	10°	14°	20°	30°	
5.3	8.9	10.5	13.8	18.6	pts. anhydrous salt,

36°	49°	55°	60°	75°	
20.4	27.7	32.4	35.4	45.6	pts. anhydrous salt.

(Tobler, A. **95.** 193.)

Saturated solution contains at:

20°	40°	60°	80°	
8.7	12.3	17.6	22.0%	anhydrous salt.

(v. Hauer, J. pr. **74.** 433.)

1 l. H_2O dissolves 68.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Nickel potassium zinc sulphate, $NiSO_4$, $2K_2SO_4$, $ZnSO_4+12H_2O$.

Sol. in H_2O. (Vohl, A. **94.** 51.)

Nickel rubidium sulphate, $NiSO_4$, $Rb_2SO_4+6H_2O$.

Sol. in H_2O. (Tutton, Chem. Soc. **63.** 337.)

1 l. H_2O dissolves 59.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Nickel sodium sulphate, $NiNa_2(SO_4)_2+4H_2O$.

Solubility of $NiNa_2(SO_4)_2.4H_2O$ in 100 g. H_2O at t°.

t°	grams $NiSO_4$	grams Na_2SO_4
20	29.31	26.87
25	27.33	25.33
30	24.64	22.58
35	23.66	21.67
40	21.88	20.65

(Koppel, Z. phys. Ch. 1905, **52.** 401.)

Solubility of $NiNa_2(SO_4)_2.4H_2O+NiSO_4.7H_2O$ in 100 g. H_2O at t°.

t°	grams $NiSO_4$	grams $NaSO_4$	t°	grams $NiSO_4$	grams Na_2SO_4
18.5	30.70	25.805	30	34.98	19.825
20	31.59	25.355	35	36.01	16.435
25	33.11	23.07	40	37.935	14.295

(Koppel.)

Solubility of $NiNa_2(SO_4)_2.4H_2O+Na_2SO_4.10H_2O$ in 100 g. H_2O at t°.

t°	grams $NiSO_4$	grams $NaSO_4$
18.5	26.14	29.455
20	24.07	31.365
25	18.81	37.13
30	9.87	44.25

(Koppel.)

Solubility of $NiNa_2(SO_4)_2.4H_2O+Na_2SO_4$ (anhydrous) in 100 g. H_2O at t°.

t°	grams $NiSO_4$	grams Na_2SO_4
35	7.13	49.595
40	7.245	49.03

(Koppel.)

Nickel thallium sulphate, $NiSO_4$, $Tl_2SO_4+6H_2O$.

Easily sol. in H_2O. Can be recryst. from little H_2O without decomp. (Werther, J. pr. **92.** 132.)

1 l. H_2O dissolves 46.1 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27,** 459.)

Nickel zinc sulphate, $NiSO_4$, $ZnSO_4+13H_2O$.

Sol. in 3-4 pts. cold H_2O. Insol. in alcohol. (Tupputi, **1811.**)

Completely sol. in NH_4OH+Aq.

$2NiSO_4$, $2ZnSO_4$, H_2SO_4. (Étard, C. R., **87.** 602.)

Nickel sulphate ammonia, $NiSO_4$, $6NH_3$.

Sol. in H_2O with separation of hydroxide. (Rose, Pogg. **20.** 151.)

$NiSO_4$, $5NH_3+3\frac{1}{2}H_2O$. Deliquescent. (André, C. R. **106.** 936.)

$NiSO_4$, $4NH_3+2H_2O$. Easily sol. in H_2O. Can be recrystallized out of little H_2O. Insol. even in dil. alcohol. (Erdmann.)

Nickel sulphate cupric oxide, $NiSO_4$, $2CuO+6H_2O$.

(Mailhe, Bull. Soc. 1902, (3) **27.** 172.)

$2NiSO_4$, $3CuO+10H_2O$, and $+12H_2O$. (Mailhe.)

$5NiSO_4$, $16CuO+xH_2O$. (Recoura, C. R. 1901, **132.** 1415.)

$NiSO_4$, $20CuO+xH_2O$. (Recoura.)

Nickel sulphate, hydrazine, $NiSO_4$, $3N_2H_4$.

Ppt. (Curtius, J. pr. 1894, (2) **50.** 343.)

Nickel sulphate hydroxylamine, $NiSO_4$, $6NH_2OH$.

Decomp. by H_2O. (Uhlenhut, A. 1899, **307.** 334.)

Nitrosyl sulphate, $H(NO)SO_4$.

See **Nitrosulphonic acid.**

Osmious sulphate.

Easily sol. in H_2O and alcohol.

Osmic sulphate.

Sol. in H_2O. (Berzelius.)

Palladous sulphate, basic, $PdSO_4$, $7PdO+6H_2O$, and $10H_2O$.

Insol. in H_2O. Easily sol. in $HCl+Aq$. (Kane.)

Palladous sulphate, $PdSO_4+2H_2O$.

Deliquescent in moist air; very sol. in H_2O, but decomp. by much H_2O, with separation of a basic salt. (Kane.)

Phosphoryl sulphate, $(PO)_2(SO_4)_3$ (?).

Possible composition of Weber's (B. **20.** 86) P_2O_5, $3SO_3$ (?).

$3P_2O_4$, $2SO_3$. Immediately decomp. by H_2O. (Adie, C. N. 1891, **63.** 102.)

Platinic sulphate, $Pt(SO_4)_2$.

Deliquescent. Sol. in H_2O, alcohol, or ether; also in H_3PO_4, HCl, and HNO_3+Aq. (Berzelius.)

$H_2PtO_2SO_4$. Sol. in H_2O. (Blondel, A. ch. 1905, (8) **6.** 109.)

PtO_2, SO_3+4H_2O. Ppt. Decomp. by H_2O. Sol. in H_2SO_4.

$PtSO_4(OH)_2$, $4Pt(OH)_4+3H_2O$. Ppt. (Prost, Bull. Soc. (2) **46.** 156.)

$Pt_8SO_4O_{13}+16H_2O$. As above. (Prost.)

Platinum hydroxylamine sulphate, $Pt(NH_2OH)_4SO_4$.

Only sl. sol. in H_2O; sol. in dil H_2SO_4+Aq. (Uhlenhut, A. 1900, **311.** 123.)

Platinic potassium sulphate, basic.

Insol. in boiling H_2O, HNO_3, H_2SO_4, H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. Easily sol. in boiling $HCl+Aq$. Sl. decomp. by aqua regia. (E. Davy.)

$Pt_{10}(SO_4)_2O_{10}$, $3K_2SO_4+34H_2O$. Insol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

$Pt_{18}(SO_4)O_{22}$, $5K_2SO_4+34H_2O$. As above. (Prost.)

Platinum rubidium sulphate, $Pt_6Rb_6(SO_4)_4+17H_2O$.

Sol. in H_2O. (Prost, Bull. Soc. (2) **46.** 156.)

Platinum sulphate sulphocarbamide, $PtSO_4$, $4CS(NH_2)_2$.

Insol. in H_2O. Sol. in conc. H_2SO_4 without decomp. (Kurnakow. J. pr. 1894, (2) 50, 489.)

Potassium sulphate, K_2SO_4.

Not hygroscopic in the ordinary sense of the word. 100 pts. K_2SO_4 over H_2O at 14–20° absorb 58 pts. H_2O in 22 days, and finally deliquesce completely. (Mulder.)

12 pts. K_2SO_4 mixed with 100 pts. H_2O lower the temp. 3.3°. (Rüdorff, B. **2.** 68.)

100 pts. H_2O dissolve with absorption of heat at 0°:

8.36	pts. K_2SO_4.	(Gay-Lussac.)
8.46	"	(Mulder.)
8.5	"	(Gerardin.)
7.31	"	(Möller, Pogg. **117.** 386.)
7.3–7.9	"	(Nordenskiöld, Pogg. **136.** 314.)

100 pts. H_2O at 0° dissolve 8.36 pts. K_2SO_4; at 12.72°, 10.57 pts.; at 49.08°, 16.91 pts.; at 63.90°, 19.29 pts.; at 101.50°, 26.33 pts. (Gay Lussac, A. ch. (2) **11.** 311.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
0	7.8	47.0	16 0
15 65	10 3	70 2	20.3
28 1	12 8	98.0	23.9

(Nordenskiöld, Pogg. **136.** 341.)

100 pts. sat. K_2SO_4 at 101.7° contain 17.5 pts. K_2SO_4, or 100 pts. H_2O at 101.25° dissolve 21.212 pts. K_2SO_4. (Griffiths.)

100 pts. H_2O at 102.8° dissolve 29 pts. K_2SO_4 (Penny); at 15°, 7.3-6.25 pts. (Ure's Dict.); at 100°, 20 pts. (Ure's Dict.); at 100°, 24.2 pts. (Wenzel).

Sol. in 9.081 pts. H_2O at 15° (Gerlach); in 16 pts. at 15°, and 5 pts. at 100° (Bergmann); in 18 pts. cold, and 5 pts. boiling H_2O (Fourcroy); in 15 pts. cold, and 5 pts. boiling H_2O (Reid); in 12 pts. H_2O at 0°, and 4 pts. boiling H_2O (M. R. and P.); in 12 pts. H_2O at 18.75° (Abl).

K_2SO_4 sat. at 15° has sp. gr. =1.0774, and contains 10.055 pts. K_2SO_4 in 100 pts. H_2O. (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve 9.26 pts. K_2SO_4 at 15.6°, and sat. solution has sp. gr. =1.177. (Page and Keightley, Chem. Soc. (2) **10.** 566.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
0	8.5	35	13.1	70	19.8
1	8.6	36	13.3	71	20.0
2	8.7	37	13.4	72	20.2
3	8.8	38	13.6	73	20.4
4	9.0	39	13.8	74	20.6
5	9.1	40	14.0	75	20.8
6	9.2	41	14.2	76	21.0
7	9.3	42	14.3	77	21.2
8	9.4	43	14.5	78	21.4
9	9.5	44	14.7	79	21.6
10	9.7	45	14.9	80	21.8
11	9.8	46	15.1	81	22.0
12	9.9	47	15.3	82	22.2
13	10.0	48	15.5	83	22.4
14	10.2	49	15.6	84	22.6
15	10.3	50	15.8	85	22.8
16	10.4	51	16.0	86	23.0
17	10.5	52	16.2	87	23.2
18	10.7	53	16.4	88	23.4
19	10.8	54	16.6	89	23.6
20	10.9	55	16.8	90	23.9
21	11.1	56	17.0	91	24.1
22	11.2	57	17.2	92	24.3
23	11.3	58	17.4	93	24.5
24	11.5	59	17.6	94	24.7
25	11.6	60	17.8	95	25.0
26	11.7	61	18.0	96	25.2
27	11.9	62	18.2	97	25.5
28	12.0	63	18.4	98	25.7
29	12.2	64	18.6	99	25.9
30	12.3	65	18.8	100	26.2
31	12.5	66	19.0	101	26.4
32	12.6	67	19.2	102	26.6
33	12.8	68	19.4	102.25	26.75
34	13.0	69	19.6	...	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. **1864.** 50.)

If solubility S = pts. anhydrous salt in 100 pts. of solution, $S = 7.5 + 0.1070t$ from 0° to 163°. Solubility from 163° to 220° is constant at 25. (Étard, C. R. **106.** 208.)

Solubility of K_2SO_4 in 100 pts. H_2O at t°.

t°	Pts. K_2SO_4	t°	Pts. K_2SO_4	t°	Pts. K_2SO_4
16	9.76	39	14.21	120	26.5
20	10.30	54	17.39	143	28.8
28	12.59	98	23.91	170	32.9
36	13.28	..	...	...	...

(Tilden and Shenstone, Phil. Trans. **1884.** 23.)

Solubility of K_2SO_4 in H_2O. 100 pts. H_2O dissolve at:

4.3°	18.4°	69.9°
8.16	10.8	19.7 pts. K_2SO_4.

(Andreae, J. pr. (2) **29.** 456.)

100 ccm. H_2O dissolve 12.04 g. K_2SO_4 at 25°. (Trevor, Z. phys. Ch. **7.** 468.)

Sat. K_2SO_4+Aq contains at:

21°	23°	60°	99°	130°
10.1	10.3	14.5	19.1	21.1% K_2SO_4,
130°	152°	175°	195°	220°
21.3	22.8	24.5	23.8	24.6% K_2SO_4.

(Étard, A. ch. 1894, (7) **2.** 549.)

Solubility of K_2SO_4 in H_2O at t°.
G. K_2SO_4 per 100 g. H_2O

t°	K_2SO_4	Sp. gr.	t°	K_2SO_4	Sp. gr.
0.40	7.47	1.0589	58.95	18.01	1.1089
15.70	10.37	1.0770	74.85	20.64	1.1157
31.45	13.34	1.0921	89.70	22.80	1.1194
42.75	15.51	1.1010	101.1*	24.21	1.1207

* = b.-pt.

(Berkeley, Phil. Trans. Roy. Soc. 1904, **203.** A, 189.)

100 g. H_2O dissolve 0.133 gram-equivalent K_2SO_4 at 25° (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, **49.** 315.)

1 l. sat K_2SO_4+Aq at 25° contains 0.617 mols. K_2SO_4. (Herz, Z. anorg. 1911, **73.** 274.)

Solubility of K_2SO_4 in H_2O at t°.

t°	% K_2SO_4
4.78	7.82
30.05	11.43
54.20	14.77
68.90	16.40

(Le Blanc and Schmandt, Z. phys. Ch. 1911, **77.** 614.)

100 g. H_2O dissolve 12.10 g. K_2SO_4 at 25°. (Amadori, Rend. Acc. Linc. 1912, (5) **21. II.** 667.)

Solubility of K_2SO_4 in H_2O at various pressures. Figures denote pts. K_2SO_4 contained in 100 pts. sat. K_2SO_4+Aq at t° and A pressure in atmospheres.

A	0°	15°	15.5°	16.2°
1	6.81	9.14	9.24	9.35
20	7.14	...	9.44	9.54
30	7.14	...	...	...

(Möller, Pogg. **117.** 386.)

Sat. K_2SO_4+Aq boils at 101.5°, and contains 26.33 pts. K_2SO_4 to 100 pts. H_2O (Gay-Lussac); at 101.7°, and contains 21.2 pts. K_2SO_4 to 100 pts. H_2O (Griffiths); at 102.25°, and contains 26.75 pts. K_2SO_4 to 100 pts. H_2O (Mulder); boils at 103° (Kremers).

Crust forms at 101.7°, and solution contains 25.3 pts. K_2SO_4 to 100 pts. H_2O; highest

temp. observed, 102.1°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of K_2SO_4+Aq containing pts. K_2SO_4 to 100 pts. H_2O.

B.-pt.	Pts. K_2SO_4	B.-pt.	Pts. K_2SO_4
100.5°	7	102°	30.0
101.0	14.5	102.1	31.6
101.5	22.1	...	...

(Gerlach, Z. anal. **26.** 430.)

Sp. gr. of K_2SO_4 at 19.5°.

% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.
2.401	1.0193	9.264	1 0763
4.744	1.0385	10.945	1 0909
6.968	1.0568	..	..

(Kremers, Pogg. **95.** 120.)

Sp. gr. and B-pt. of K_2SO_4+Aq at 12.5°.

Pts. K_2SO to 100 pts. H_2O	Sp. gr.	B.-pt.	Pts. K_2SO to 100 pts. H_2O	Sp. gr.	B.-pt.
1	1.0079	100.38°	6	1.0456	101.12°
2	1 0151	100.63°	7	1.0524	101.25°
3	1.0231	100.75°	8	1.0599	101.25°
4	1.0305	100 88°	9	1 0676	101.38°
5	1.0391	101°	10	1.0735	101.5°

(Brandes and Gruner, **1827.**)

K_2SO_4+Aq sat. at 8° has 1.072 sp. gr. (Anthon, A. **24.** 211.)

K_2SO_4+Aq saturated at 12° contains 10.38% K_2SO_4 and has sp. gr. 1.0716 (Struve, Zeit. Ch. (2) **5.** 323); saturated at 15° contains 11.01% K_2SO_4 and has sp. gr. 1.0831 (Gerlach); saturated at 18.75° contains 10.74% K_2SO_4 and has sp. gr. 1.0798 (Karsten).

Sp. gr. of K_2SO_4+Aq at 15°.

% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.	% K_2SO_4	Sp. gr.
1	1.0082	5	1.0410	8	1.0664
2	1.0163	6	1.0495	9	1.0750
3	1.0245	7	1.0579	9.92	1.0830
4	1.0328	.	...	...	...

(Gerlach, Z. anal. **8.** 287.)

Sp. gr. of K_2SO_4+Aq at 18°.

% K_2SO_4	Sp. gr.
5	1.0395
10	1.0815

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of K_2SO_4+Aq at 15°/15°. a = pts. K_2SO_4 in 100 pts. of the solution; b = pts. K_2SO_4 in 100 pts. H_2O.

a	b	Sp. gr.
1	1.010	1.00808
3	3.093	1.02447
5	5.263	1.04091
7	7.527	1.05776
9	9.890	1.07499
9.92	11.013	1.08305

(Gerlach, Z. anal. **28.** 493.)

Sp. gr. of K_2SO_4+Aq at 20° containing 0.5 mol. K_2SO_4 to 100 mols. H_2O = 1.03758; containing 1 mol. K_2SO_4 to 100 mols. H_2O = 1.06744. (Nicol, Phil. Mag. (5) **16.** 122.)

Sp. gr. of K_2SO_4+Aq. at 25°.

Concentration of K_2SO_4 +Aq	Sp. gr.
1–normal	1.0664
1/2– "	1.0338
1/4– "	1.0170
1/8– "	1.0084

(Wagner, Z. phys. Ch. 1890, **5.** 37.)

K_2SO_4+Aq. containing 6.7% K_2SO_4 has sp. gr. 20°/20° = 1.0549. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19.** 278.)

Sp. gr. of K_2SO_4+Aq at 20.1°, when p = per cent strength of solution; d = observed density; w = volume conc. in gr. per cc. $\left(\frac{pd}{100}=w.\right)$

p.	d.	w.
9.83	1.0800	0.10615
8.172	1.0657	0.08708
6.779	1.0539	0.07144
5.021	1.0394	0.05218
3.127	1.0238	0.03202
2.508	1.0186	0.02554
1.448	1.0100	0.01463
1.079	1.0070	0.01087
1.047	1.0066	0.01053
0.455	1.0018	0.00456

(Barnes, J. phys. Chem. 1898, **2.** 543.)

Sp. gr. of K_2SO_4+Aq at 18°.

½ K_2SO_4 g.-equiv. per l.	Sp. gr. at 18°
0.8327	1.0567
0.7975	1.0539
0.6688	1.0456
0.5029	1.0344
0.5016	1.0340
0.2508	1.0173
0.01001	1.0006

(McKay, Elektrochem. Zeit. 1899, **6.** 115.)

Sp. gr. of sat. K_2SO_4+Aq at t°.

t°	g. K_2SO_4 sol. in 100 g. H_2O	Sp. gr.
0	7.35	1.058
10	9.22	1.069
20	11.11	1.081
30	12.97	1.089
40	14.76	1.097
50	16.50	1.106
60	18.17	1.114
70	19.75	1.121

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, **44.** 1565.)

Sol. in conc. acids; not pptd. by glacial $HC_2H_3O_2$. Insol. in KOH+Aq of 1.35 sp. gr. (Liebig, A. **11.** 262.)

Solubility of K_2SO_4 in H_2SO_4+Aq at 18°.

Mols. per 100 mols. solution		Solid phase
K_2SO_4	H_2SO_4	
1.10	0	K_2SO_4
1.59	0.95	"
2.49	2.70	"
2.75	3.17	K_2SO_4, $KHSO_4$
2.75	3.74	"
2.83	5.08	"
2.80	5.79	K_2SO_4, $3KHSO_4$
2.61	5.61	K_2SO_4, $6KHSO_4$
2.25	6.19	" $+KHSO_4$
1.08	7.94	$KHSO_4$
0.77	9.2	"
0.44	22.7	"

(Stortenbecker, R. t. c. 1902, **21.** 407.)

Solubility in H_2SO_4+Aq at 0°.

1000 g. of the solution contain		Solid phase
Mols H_2SO_4	Mols K_2SO_4	
...	0.393	K_2SO_4
0.37	0.53	"
0.75	0.64	"
1.08	0.74	$K_2SO_4+K_3H(SO_4)_2$
1.13	0.73	$K_3H(SO_4)_2$
1.44	0.71	"
1.66	0.69	"
1.89	0.66	$K_3H(SO_4)_2$+Ka
1.88	0.69	"
2.15	0.59	Ka+Kb
2.12	0.61	"
2.29	0.54	Kb
2.30	0.53	Kb+$KHSO_4$
2.33	...	"
2.48	0.43	$KHSO_4$
3.08	0.28	"
4.43	0.12	"
5.27	0.09	"

These results show that at 0° there exist between $K_3H(SO_4)_2$ and $KHSO_4$, two acid sulphates, Ka and Kb. Ka is probably K_2SO_4, $3KHSO_4$ and Kb is probably K_2SO_4, $6KHSO_4$.

(D'Ans, Z. anorg. 1909, **63.** 228.)

3.1 mols. K_2SO_4 are sol. in absolute H_2SO_4 at 25°. (Bergius, Z. phys. Ch. 1910, **73.** 353.)

Solubility in H_2SO_4+Aq at 25°.

Millimols H_2SO_4 in 10 ccm.	Millimols K_2SO_4 in 10 ccm.
...	6.17
3.97	8.92
7.57	10.82
1[illegible].35	14.86

(Herz, Z. anorg. 1912, **73.** 276.)

Solubility in H_2SO_4+Aq at 25°.

In 1000 g. of the solution		Solid phase
Mols SO_3	Mols K_2SO_4	
6.42	0.171	$KHSO_4$
6.60	0.190	"
6.91	0.266	$KHSO_4+KH_3(SO_4)_2$, H_2O
7.26	0.182	"
7.62	0.157	"
7.88	0.167	"
8.00	0.201	"
8.10	0.250	$KH_3(SO_4)_2$, H_2O
8.15	0.352	"
8.16	0.364	$KH_3(SO_4)_2$, $H_2O+KH_3(SO_4)_2$
8.29	0.341	"
8.33	0.322	"
8.45	0.325	"
8.62	0.346	"
8.57	0.384	$KH_3(SO_4)_2$
8.71	0.412	"
8.82	0.583	$KH_3(SO_4)_2$
8.65	0.880	$KH_3(SO_4)_2+KHS_2O_7$
8.63	0.899	KHS_2O_7(metastable solution)
8.70	0.882	"
8.96	0.561	"
9.80	0.365	"
9.78	0.430	"
9.80	0.665	KHS_2O_7
9.66	0.904	"
9.66	0.937	"

(D'Ans, Z. anorg. 1913, **80.** 239.)

Pptd. from K_2SO_4+Aq by NH_4OH+Aq. (Sullivan.)

Solubility of K_2SO_4 in NH_4OH+Aq at 20°.

G. NH_3 in 100 ccm. H_2O	G. K_2SO_4 in 100 ccm. H_2O
0	10.804
6.08	4.100
15.37	0.828
24.69	0.140
31.02	0.042

(Girard, Bull. Soc. (2) **43.** 522.)

1 l. sat. solution in H_2O contains 105.7 g. K_2SO_4 at 20°; in NH_4OH+Aq (5.2% NH_3), 45.2 g. (Konowalow, J. Russ. Phys. Chem. Soc. **1894, 31.** 985.)

Solubility of K_2SO_4 in KOH+Aq at 25°.

In 1000 g. of the solution	
Mols K_2SO_4	Mols $(KOH)_2$
0.617	0.0
0.433	0.258
0.280	0.433
0.137	1.13
0.035	2.86
0.009	3.42
0.0	4.809

(D'Ans and Schreiner, Z. anorg. 1910, **67.** 438.)

Sol. in sat. NH_4Cl+Aq without pptn. (*See* NH_4Cl.)

Sl. sol. in sat. KCl+Aq without pptn.

100 g. sat KCl+Aq. at 25° dissolve 0.0167 g. equiv. K_2SO_4 at 25°. (Van't Hoff and Meyerhoffer Z. phys. Ch. 1904. **49.** 315.)

Sl. sol. in sat. KNO_3+Aq without causing pptn.

1 l. of the solution contains 50.7 g. K_2SO_4+ 216.5 g. KNO_3=267.2 g. mixed salts at 15°. Sp. gr. K_2SO_4+KNO_3+Aq=1.165.

1 l. of the solution contains 47.66 g. K_2SO_4 +308.5 g. KNO_3=356.2 g. mixed salts at 25°. Sp. gr. of K_2SO_4+KNO_3+Aq=1.210. (Euler, Z. phys. Ch. 1904, 49. 313.)

***See also* under KNO_3.**

Sol. in sat. $NaNO_3$+Aq without causing pptn. at first, but soon KNO_3 is pptd. (Karsten.) (*See* $NaNO_3$.)

Sol. in $(NH_4)_2SO_4$+Aq with pptn. of $(NH_4)_2SO_4$. (Rüdorff, B. **6.** 485.) (*See* $(NH_4)_2SO_4$.)

More sol. in aqueous solutions of other salts, as Na_2SO_4, $MgSO_4$, $CuSO_4$, etc., than in pure H_2O. (Pfaff, A. **99.** 227.)

Sol. in sat. Na_2SO_4+Aq, $MgSO_4$+Aq, NaCl+Aq. (*See* $MgSO_4$ and NaCl.)

Solubility of K_2SO_4 in Na_2SO_4+Aq.

Temp. =34°		Temp. =60°	
% Na_2SO_4	% K_2SO_4	% Na_2SO_4	% K_2SO_4
0	11.9	0	15.3
7.1	10.7	6.6	13.9
31.4	4.3	27.1	8.2
33.1	0	31.3	0

(Nacken, B. A. B. **1910.** 1016.)

100 g. H_2O sat. with both K_2SO_4 and Tl_2SO_4 dissolve:

4.74 g. Tl_2SO_4+10.3 g. K_2SO_4 at 15°.
11.5 g. " +16.4 g. " " 62°.
18.52 g. " +26.2 g. " " 100°.

(Rabe, Z. anorg. 1902, **31.** 156.)

Sl. sol. in sat. $ZnSO_4$ or $CuSO_4$+Aq with separation of double salt.

100 pts. H_2O dissolve 8.5+0.12t pts. K_2SO_4. On addition of a K salt, K_2SO_4 is pptd. The amount of K_2SO_4 remaining in solution plus the amt. of K in the salt added is a constant. (Blarez, C. R. **112.** 939.)

Solubility of K_2SO_4+$Th(SO_4)_2$ at 16°.
Solid phase, $Th(SO_4)_2$.

Pts. per 100 pts H_2O		Pts. per 100 pts. H_2O	
K_2SO_4	$Th(SO_4)_2$	K_2SO_4	$Th(SO_4)_2$
0.000	1.390	1.487	0.870
0.424	1.667	1.633	0.635
1.004	2.193	1.844	0.370
1.152	3.191	2.512	0.128
1.224	2.514	3.092	0.070
1.283	2.222	4.050	0.027
1.348	1.706	4.825	0.003
1.378	1.637	...	...

(Barre, C. R. 1911, **150.** 1555.)

Difficultly sol. in 20% $KC_2H_3O_2$+Aq. (Stromeyer.)

Solubility in K acetate+Aq at 25°.

Composition of the solutions		
% K acetate	% K_2SO_4	% H_2O
6.11	6.65	87.24
8.68	5.09	86.23
11.29	3.99	84.72
15.59	2.35	82.06
20.12	1.23	78.65
29.95	0.39	69.66

The solid phase in these solutions is K_2SO_4.
(Fox, Chem. Soc. 1909, **95.** 885.)

100 g. hydroxylamine dissolve 3.5 g. K_2SO_4 at 17–18°. (de Bruyn, Z. phys. Ch. 1892, 10. 782.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905. **46.** 2)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Neither dissolved nor attacked by liquid NO_2. (Frankland, Chem. Soc. 1901, **79.** 1361.)

Insol. in absolute alcohol.

Insol. in alcohol, the sp. gr. of which is 0.905. (Anthon.)

Solubility in dil. alcohol increases with the temp.

100 pts. alcohol of 0.939 sp. gr. (53% by vol., 45% by weight) dissolve at:

4°	8°	60°	
0.16	0.21	0.92	pts. K_2SO_4.

(Gerardin, A. ch. (4) **5.** 147.)

100 pts. of the sat. solution at 15° in alcohol of:

	10	20	30	40% by weight,
contain	3.9	1.46	0.56	0.21 pts. K_2SO_4.

(Schiff, A. **118.** 362.)

Solubility in acetic acid+Aq at 25°.

Concentration of the acetic acid Mol./Liter	Solubility of K_2SO_4 Mol./Liter
0.000	0.6714
0.070	0.6619
0.137	0.6559
0.328	0.6350
0.578	0.6097
1.151	0.5556
2.183	0.4743

(Rothmund and Wilsmore, Z. phys. Ch. 1902, **40.** 620.)

Solubility in phenol+Aq at 25°.

Concentration of the phenol Mol/Liter	Solubility of K_2SO_4 Mol/Liter
0.000	0.6714
0.016	0.6650
0.021	0.6614
0.032	0.6598
0.040	0.6555
0.047	0.6522
0.064	0.6502
0.076	0.6494
0.127	0.6310
0.152	0.6251
0.236	0.6042
0.252	0.5956
0.308	0.5834
0.409	0.5572
0.464	0.5480
0.486	0.5425
0.495	0.5389
0.498 (saturated)	0.5377

(Rothmund and Wilsmore, Z. phys. Ch. 1902, **40.** 619.)

100 g. 95% formic acid dissolve 36.5 g. K_2SO_4 at 21°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Solubility in organic substances+Aq at 25°.

Organic substance	Composition of the solutions		
	% organic substance	% K_2SO_4	% H_2O
Alcohol	1.35	9.17	89.48
	4.80	6.90	88.30
	7.80	4.96	87.24
	9.70	4.32	85.98
	12.34	3.57	84.09
	14.51	2.71	82.78
	15.26	2.66	82.08
	20.50	1.83	77.67
	26.91	0.97	72.12
	35.97	0.41	63.62
	43.90	0.22	55.88
	69.26	0.016	30.72
Pyridine	4.23	7.95	87.82
	13.90	4.77	81.33
	24.51	2.75	72.74
	34.19	1.47	64.34
	46.29	0.45	53.26
	55.93	0.12	43.95
	75.90	0.006	24.09
Ethylene glycol	3.16	9.67	87.17
	9.89	7.69	82.53
	18.47	5.74	75.79
	32.11	3.57	64.32
	49.03	1.83	49.14
Chloral hydrate	6.44	9.13	84.43
	9.09	8.41	82.50
	12.38	7.79	79.83
	13.20	7.31	79.49
	22.07	5.88	72.05
	33.15	4.54	62.31
	44.40	3.36	52.24
	47.30	2.92	49.78
	62.82	2.00	35.18
	70.28	1.75	27.97
	80.36	1.40	18.24
	85.26	1.08	13.66
Glycerol	8.96	8.87	82.17
	13.36	7.69	78.95
	20.34	6.47	73.19
	24.15	5.83	70.02
	33.73	4.44	61.83
	40.40	3.65	55.95
	43.52	3.38	53.10
	50.18	2.69	47.13
	57.22	2.07	40.71
	67.94	1.53	30.53
	78.18	0.98	20.84
	98.28	0.73	0.99
Mannitol	3.20	10.32	86.48
	5.82	10.07	84.11
	8.35	9.61	82.04
	11.26	9.19	79.55
	14.30	8.66	77.04
	17.22	8.35	74.43

Solubility in organic substances+Aq at 25°.—*Continued.*

Organic substance	Composition of the solutions		
	% organic substance	% K_2SO_4	% H_2O
Sucrose	9.56	9.65	80.79
	18.55	8.65	72.80
	28.16	7.42	64.42
	37.24	6.35	56.41
	47.55	5.21	47.24
	57.00	4.24	38.76
Acetone	4.92	7.20	87.88
	10.06	5.02	84.92
	16.23	2.96	80.81
	24.31	1.50	74.19
	37.19	0.47	62.34
	46.29	0.20	53.51
	62.40	0.03	37.57

(Fox and Gage, Chem. Soc. 1910, **97.** 381.)

Sol. in 76 pts. glycerine of 1.225 sp. gr. at ordinary temp. (Vogel, N. Repert. **16.** 557.)

Insol. in acetone. (Krug and M'Elroy; Eidman, C. C. **1899,** II. 1014.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257); benzonitrile. (Naumann, B. 1914, **47.** 1370); methyl acetate. (Naumann, B. 1909, **42,** 3790); ethyl acetate. (Naumann. B. 1904, **37,** 3602.)

100 g. H_2O dissolve 104 g. K_2SO_4+219.0 g. sugar at 31.25°, or 100 g. sat. solution contain 3.8 g. K_2SO_4+66.74 g. sugar. (Köhler, Z. Ver. Zuckerind. 1897, **47.** 447.)

Min. *Glaserite.*

$+\frac{1}{2}H_2O$. 100 pts. H_2O dissolve 9.82 pts. (Ogier, C. R. **82.** 1055.)

***Tri*potassium hydrogen sulphate, $K_3H(SO_4)_2$.**

Sol. in H_2O.

Potassium hydrogen sulphate, $KHSO_4$.

1.07 pts. $KHSO_4$ (=1 pt. $K_2S_2O_7$) dissolve:

at 0° in 2.95 pts. H_2O.
" 20° " 2.08 "
" 40° " 1.59 "
" 100° " 0.88 "

(Kremers, Pogg. **92.** 497.)

Sp. gr. of $KHSO_4$+Aq at 15° containing:

5	10	15 % $KHSO_4$,
1.0354	1.0726	1.1116
20	25	27% $KHSO_4$.
1.1516	1.1920	1.2110

(Kohlrausch, W. Ann. **1879.** 1.)

Sat. solution boils at 105.5° (Griffiths); 108° (Kremers).

Alcohol dissolves out H_2SO_4.

K_2SO_4 crystallises from dilute solutions.

100 g. 95% formic acid dissolve 14.6 g. $KHSO_4$ at 19.3°. (Aschan, Ch. Ztg. 1913, **37.** 1117.)

Insol. in methyl acetate. (Naumann B. 1909, **42,** 3790.)

Min. *Misinite.*

$+5\frac{1}{2}H_2O$. Deliquescent. (Senderens, Bull. Soc. (3) **2.** 278.)

Potassium *di*hydrogen sulphate, $K_4H_2(SO_4)_3$.

Sol. in H_2O. (Phillips, Phil. Mag. **1.** 429.)

Composition is $4K_2O$, $7SO_3+3H_2O$, according to Berthelot (A. ch. (4) **30.** 442).

Potassium *tri*hydrogen sulphate, $KH_3(SO_4)_2$.

Sol. in H_2O with rise of temperature. (Schultz, Pogg. **133.** 137.)

$+1\frac{1}{2}H_2O$. (Lescœur, C. R. **78.** 1044.)

Potassium *di*sulphate (*pyro*sulphate), $K_2S_2O_7$.

When dissolved in exactly the necessary amount of hot H_2O for solution, it crystallises on cooling without decomp. Decomp. by excess of H_2O. (Jacquelain, A. ch. **70.** 311.)

Insol. in methyl acetate. (Naumann, B. 1909. **42.** 3790.)

Potassium hydrogen *di*sulphate, KHS_2O_7.

Sol. in fuming H_2SO_4 without decomposition.

Potassium *octo*sulphate, $K_2S_8O_{25}$.

Decomp. by H_2O. (Weber.)

Potassium praseodymium sulphate, $3K_2SO_4$, $Pr_2(SO_4)_3+H_2O$.

Sl. sol. in H_2O.

Sol. in conc. HCl and HNO_3. (Von Scheele Z. anorg. 1898, **18.** 358.)

Potassium rhodium sulphate, $3K_2SO_4$, $Rh_2(SO_4)_3$.

Does not exist. (Leidié, C. R. **107.** 234.)

K_2SO_4, $Rh_2(SO_4)_3+24H_2O$. Very sol. in H_2O. (Piccini, Z. anorg. 1901, **27.** 66.)

Potassium samarium sulphate, $9K_2SO_4$, $2Sm_2(SO_4)_3+3H_2O$.

Sl. sol. in H_2O.

Sl. sol. in sat. K_2SO_4+Aq.

1 l. sat. K_2SO_4+Aq dissolves 0.5 g. Sm_2O_3. (Cleve, Bull. Soc. (2) **43.** 166.)

Potassium scandium sulphate, $3K_2SO_4$, $Sc_2(SO_4)_3$.

Very slowly sol. in cold, more easily sol. in warm H_2O. Insol. in sat. K_2SO_4+Aq.

Sol. in H_2O and in dil. K_2SO_4+Aq. (Meyer, Z. anorg. 1914, **86.** 279.)

$2K_2SO_4$, $Sc_2(SO_4)_3$. Sol. in K_2SO_4+Aq. (Cleve.)

Does not exist. (Nilson.)

Potassium sodium sulphate, $3K_2SO_4$, Na_2SO_4.

100 pts. H_2O dissolve 40.8 pts. at 103.5°: (Penny, Phil. Mag. (4) **10.** 401.)

$5K_2SO_4$, Na_2SO_4. 100 pts. H_2O at 100° dissolve 25 pts.; at 12.7°, 10.1 pts.; at 4.4°, 9.2 pts. (Gladstone, Chem. Soc. **6.** 111.)

Potassium strontium sulphate, $K_2Sr_2(SO_4)_3$.

Decomp. by $(NH_4)_2CO_3$+Aq. (Rose. Pogg. **93.** 604.)

K_2SO_4, $SrSO_4$. This is the only double salt formed from these two components between 0° and 100°.

100 pts of the sat. solution in equilibrium with $SrSO_4$ and the double salt contain at:

17.5°	50°	75°	100°
1.27	1.88	2.71	3.9 pts. K_2SO_4.

(Barre, C. R. 1909, **149.** 292.)

Potassium tellurium sulphate, $KHSO_4$, $2TeO_2$, SO_3+2H_2O.

(Metzner, A. ch. 1898, (7) **15.** 203.)

Potassium terbium sulphate.

Easily sol. in H_2O. Sl. sol. in K_2SO_4+Aq. (Delafontaine, Zeit. Chem. (2) **2.** 230.)

Potassium thallic sulphate, $KTl(SO_4)_2+4H_2O$.

Decomp. by H_2O. (Fortini, Gazz. ch. it. 1905, **35.** (2) 453.)

$2K_2O$, Tl_2O_3, $4SO_3$. Insol. in H_2O. Very difficultly sol. in warm dil. H_2SO_4+Aq. (Strecker, A. **135.** 207.)

Potassium thorium sulphate, K_2SO_4, $Th(SO_4)_2+4H_2O$.

Sol. in hot H_2O containing a few drops HCl. (Barre, A ch. 1911, (8) **24.** 227.)

$2K_2SO_4$, $Th(SO_4)_2+2H_2O$. Slowly sol. in cold, easily and abundantly in hot H_2O, and is gradually decomp. by boiling. Easily sol. in acids. Insol. in alcohol. (Berzelius.)

$3.5K_2SO_4$, $Th(SO_4)_2$. Insol. in K_2SO_4+Aq of concentrations above 4.5%. (Barre.)

$4K_2SO_4$, $Th(SO_4)_2+2H_2O$. (Chydenius.)

Potassium tin (stannous) sulphate, K_2SO_4, $SnSO_4$.

(Marignac.)

Potassium tin (stannic) sulphate, $K_2Sn(SO_4)_3$.

Easily sol. in H_2O with decomp.

Sol. in HCl. (Weinland, Z. anorg. 1907, **54.** 250.)

Potassium tin (stannous) sulphate chloride, $4K_2SO_4$, $4SnSO_4$, $SnCl_2$.

Can be recrystallised from H_2O. (Marignac, Ann. Min. (5) **12.** 62.)

Potassium titanium sulphate, K_2SO_4, $Ti(SO_4)_2+3H_2O$.

Difficultly sol. in H_2O or HCl+Aq. Decomp. by much H_2O. (Wallace, Pogg. **102.** 453.)

Potassium titanyl sulphate, $2K_2SO_4$, $3TiO$, SO_4+10H_2O.

Very sol. in H_2O with decomp. Insol. in conc. H_2SO_4. (Rosenheim, Z. anorg. 1901, **26.** 251.

K_2SO_4, $TiOSO_4+7H_2O$. Very hygroscopic and sol. in H_2O. (Mazzuchelli and Pontanelli, C. C. **1909**, II. 420.)

K_2SO_4, $(TiO)SO_4$. (Spence, C. C. **1901**, II. 747.)

Potassium uranous sulphate, K_2SO_4, $U(SO_4)_2+H_2O$.

Very sl. sol. in H_2O. (Rammelsberg.)

Potassium uranyl sulphate, K_2SO_4, $(UO_2)SO_4+2H_2O$.

Sol. in 9 pts. H_2O at 22° and in 0.51 pt. at 100°. Insol in alcohol. (Ebelmen, A. ch. (3) **5.** 211.)

100 pts. of aqueous solution sat. at 25° contain 10.5 pts. salt; at 70.5° contain 23.93 pts. salt. (Rimbach, B. 1904, **37.** 478.)

$+3H_2O$. (de Coninck, Chem. Soc. 1905, **88.** (2) 39.)

$2K_2SO_4$, $(UO_2)SO_4+2H_2O$. Decomp. by H_2O.

Cannot be cryst. from rather conc. H_2SO_4, as it is completely decomp. by it. (Rimbach, B. 1905, **38.** 1572.)

K_2O, $2UO_3$, $3SO_3$. Ppt. Identical with UO_2, OK, SO_3H of Scheller, (A. 1867, **144.** 238.) (Kohlschütter, A., 1900, **311.** 11.)

$2K_2SO_4$, $3(UO_2)SO_4+H_2O$. Sol. in H_2O. Insol. in alcohol. (Berzelius.)

Does not exist. (Ebelmen.)

Potassium vanadium sulphate, K_2O, V_2O_5, $2SO_3+6H_2O=K(VO_2)SO_4+3H_2O$.

(Friedheim, B. **24.** 1183.)

$=KVO_3$, K_2SO_4, V_2O_5, $2SO_3+9H_2O$ of Münzing (Berlin, Dissert. **1889**).

K_2SO_4, VSO_4+6H_2O. Sol. in H_2O. (Piccini, Z. anorg. 1902, **32.** 61.)

$K_2V_2(SO_4)_4+24H_2O$. 100 pts. H_2O dissolve 198.4 pts. salt. at 10°. Sp. gr. of sat. solution at 4°/20°=1.782. (Piccini, Z. anorg. 1897, **13.** 446.)

Potassium vanadyl sulphate, K_2SO_4, $(VO)_2(SO_4)_3$.

Very slowly sol. in H_2O, still less sol. in dil. alcohol. (Gerland.)

K_2SO_4, $VOSO_4+3H_2O$. Easily sol. in H_2O. Sol. in alcohol+conc. H_2SO_4. (Koppel, Z. anorg. 1903, **35**, 178.)

K_2SO_4, $2VOSO_4$. Very hygroscopic. Very sol. in H_2O but goes into solution slowly. (Koppel and Behrendt, B. 1901, **34.** 3935.)

Easily sol. in H_2O. (Koppel, Z. anorg. 1903, **35.** 174.)

Potassium yttrium sulphate, $4K_2SO_4$, $Y_2(SO_4)_3$.

Sol. in 16 pts. cold H_2O, and in 10 pts. sat. K_2SO_4+Aq, and more abundantly if the latter solution contains ammonium salts or free acid. (Berlin.)

$3K_2SO_4$, $2Y_2(SO_4)_3$. 100 ccm. cold sat.

K_2SO_4+Aq dissolve an amount of this salt corresponding to 4.685 g. Y_2O_3. (Cleve.)

Potassium zinc sulphate, K_2SO_4, $ZnSO_4$+ $6H_2O$.

Sol. in 5 pts. cold H_2O. (Bucholz, N. J. Pharm. **9.** 2. 26.)

100 pts. H_2O dissolve at:

0°	10°	15°	25°	36°	
12.6	18.7	22.5	28.8	39.9	pts. hydrous salt,

45°	50°	58°	65°	70°	
51.2	54.0	67.6	81.3	87.9	pts. hydrous salt.

(Tobler, A. **95.** 193.)

100 pts. H_2O at 15° dissolve 14.8 pts. K_2SO_4, $ZnSO_4+6H_2O$; sp. gr. of sat. H_2O solution at 15°=1.0939. (Schiff, A. **109.** 326.)

1 l. H_2O dissolves 131.9 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Potassium zirconium sulphate, $2K_2O$, $6ZrO_2$, $7SO_3+9H_2O$.

Decomp. by H_2O.

$3K_2O$, $3ZrO_2$, $7SO_3+9H_2O$. Insol. in H_2O.

$Zr_2O_3(KSO_4)_2+8H_2O$. Ppt. (Rosenheim, B. 1905, **38.** 815.)

Potassium sulphate vanadate.

Very difficultly sol. in H_2O. Insol. in alcohol. (Berzelius.)

Potassium sulphate antimony *tri*fluoride.

See **Antimony *tri*fluoride potassium sulphate.**

Praseodymium sulphate, basic, $(PrO)_2SO_4$.

Insol. in H_2O. (Matignon, C. R. 1902, **134.** 660.)

Insol. in H_2O. Nearly insol. in dil. acids. (Wöhler, B. 1913, **46.** 1730.)

Praseodymium sulphate, $Pr_2(SO_4)_3$.

Sol. in H_2O; very hydroscopic. 23.64 pts. are sol. in 100 pts. H_2O at 0° and 17.7 pts. at 20°. (von Scheele, Z. anorg. 1898, **18.** 357–358.)

$+5H_2O$. Sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 357.)

Difficultly sol. in H_2O. (Kraus, Zeit. Kryst. 1901, **34.** 400.)

1.50 pts. $Pr_2(SO_4)_3$ are sol. in 100 pts. H_2O at 85°; 1.45 pts. at 90°; and 1.02 pts. at 95°. (Muthmann and Rölig, B. 1898, **31.** 1729.)

$+8H_2O$. (Kraus, Zeit. Kryst. 1901, **34.** 406.)

Sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 357.)

Solubility in H_2O at t°.

t°	Pts. $Pr_2(SO_4)_3$
0	19.79
18	14.10
35	10.31
55	7.09
75	4.13

(Muthmann and Rölig, B. 1898, **31.** 1727.)

$+15\frac{1}{2}H_2O$. Sol. in H_2O. (von Scheele, Z. anorg. 1898, **18.** 357.)

Praseodymium hydrogen sulphate, $Pr(SO_4H)_3$.

(Brauner, Z. anorg. 1904, **38.** 330.)

Solubility in boiling conc. H_2SO_4. 100 g. of the solution contain 1.02 g. of the acid sulphate. (Matignon, C. R. 1902, **134.** 659.)

Radium sulphate.

Less sol. in H_2O than corresponding Ba comp. (Curie, Dissert. **1903.**)

Rhodium sulphate, $Rh_2(SO_4)_3+12H_2O$.

Easily sol. in H_2O. (Berzelius.)

Sl. sol. in, but not decomp. by H_2O when not more than 16 pts. H_2O are present to 1 pt. salt. Decomp. by hot H_2O to—

$Rh_2(SO_4)_3$, Rh_2O_3. Insol. in H_2O. (Leidié, C. R. **107.** 234.)

Rhodium rubidium sulphate, $Rh_2(SO_4)_3$, $Rb_2SO_4+24H_2O$.

Sol. in H_2O; m.-pt., 108–109°. (Piccini, Z. anorg. 1901, **37.** 65.)

Rhodium thallium sulphate, $Rh_2(SO_4)_3$, Tl_2SO_4 $+24H_2O$.

Very sol. H_2O. (Piccini, Z. anorg. 1901, **37.** 69.)

Rhodium sodium sulphate, $Rh_2Na_2(SO_4)_4$.

Insol. in H_2SO_4 or aqua regia. (Seubert and Kobbe, B. **23.** 2560.)

Rubidium sulphate, Rb_2SO_4.

100 pts. H_2O dissolve 42.4 pts. at 10°. (Bunsen.)

100 cc. H_2O at 17–18° dissolve 44.7 g. Rb_2SO_4. (Tutton, Chem. Soc. 1894, **65.** 632.)

Sat. Rb_2SO_4+Aq contains at:

3°	20°	
27.4	32.5% Rb_2SO_4,	

37°	97°	170°
37.3	43.9	49.2% Rb_2SO_4.

(Étard, A. ch. 1894, (7) **2.** 550.)

Solubility of Rb_2SO_4 in H_2O at t°.

t°	g. Rb_2SO_4 per 100 g		t°	g. Rb_2SO_4 per 100 g.	
	H_2O	solution		H_2O	solution
0	36.4	27.3	60	67.4	40.3
10	42.6	29.9	70	71.4	41.7
20	48.2	32.5	80	75.0	42.9
30	53.5	34.9	90	78.7	44.0
40	58.5	36.9	100	81.8	45.0
50	63.1	38.7	102.4*	82.6	45.2

* B.-pt. at 742.4 mm.

(Berkeley, calc. by Seidell, Solubilities, 2nd Ed., p. 587.)

Sp. gr. of Rb_2SO_4+Aq sat. at 10° = 1.2978 (Erdmann, Arch. Pharm. 1894, **232.** 16.)

G.-equiv. salt per l. at 18° =	0.501	1.01
Sp. gr. 6°/6°	1.05587	1.11047
" 18°/18°	1.05496	1.10896
" 30°/30°	1.05433	1.10810
G.-equiv. salt per l. at 18° =	2.043	3.168
Sp. gr. 6°/6°	1.21888	1.33276
" 18°/18°	1.21613	1.32912
" 30°/30°	1.21443	1.32750

(Clausen, W. Ann. 1914, (4) **44.** 1071.)

10 ccm. of sat. Rb_2SO_4+absolute H_2SO_4 contain approx. 5.881 g. Rb_2SO_4. (Bergius, Z. phys. Ch. 1910, **72.** 355.)

Insol. in methyl acetate (Naumann, B. 1909, **42.** 3790); acetone (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Rubidium *pyro*sulphate, $Rb_2S_2O_7$.

Decomp. by H_2O.

Rubidium *octo*sulphate, $Rb_2S_8O_{25}$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Rubidium hydrogen sulphate, $RbHSO_4$.

Sol. in H_2O.

Rubidium tin (stannic) sulphate, $Rb_2Sn(SO_4)_3$.

Decomp. by H_2O. Sol. in HCl. (Weinland, Z. anorg. 1907, **54.** 250.)

Rubidium thallic sulphate, $RbTl(SO_4)_2$.

(Marshall, C. C. **1902,** II. 1089.)

$+4H_2O$. (Fortini, Gazz. ch. it. 1905, **35.** (2) 455.)

Rubidium thorium sulphate, Rb_2SO_4, $Th(S_4O)_2$ $+2H_2O$.

Sl. sol. in H_2O. (Manuelli, Gazz. ch. it. 1903, **32.** (2) 523.)

Rubidium titanium sulphate, Rb_2SO_4, $Ti_2(SO_4)_3+24H_2O$.

Sol. in H_2O acidified with H_2SO_4. Decomp. in neutral aq. solution. (Piccini, Z. anorg. 1898, **17.** 359.)

Insol. in H_2O. Sol. in HCl. Insol. in H_2SO_4. Decomp. by boiling with conc. H_2SO_4. (Stähler, B. 1905, **38.** 2623.)

Rubidium uranyl sulphate, $Rb_2(UO_2)(SO_4)_2+2H_2O$.

Somewhat less sol. in H_2O than K salt. (Rimbach, B. 1904, **37.** 479.)

Rubidium vanadium sulphate, $Rb_2V_2(SO_4)_4+24H_2O$.

0.177 gram mols. of anhydrous salt are sol. in 1 l. H_2O. (Locke, Am. Ch. J. 1901, **26.** 175.)

Insol. in H_2O.

Insol. in H_2SO_4. Decomp. by boiling with conc. H_2SO_4.

Sol. in HCl. (Stähler, B. 1905, **38.** 3980.)

100 pts. H_2O dissolve 2.56 pts. salt at 10°. Sp. gr. of solution at 4°/20° = 1.915. (Piccini, Z. anorg. 1897, **13.** 446.)

Rubidium zinc sulphate, Rb_2SO_4, $ZnSO_4+6H_2O$.

Sol. in H_2O. (Bunsen and Kopp, Pogg. **113.** 337.)

1 l. H_2O dissolves 101 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Rubidium zirconium sulphate, Zr_2O_3, $(RbSO_4)_2+15H_2O$.

Ppt. (Rosenheim, B. 1905, **38.** 815.)

Ruthenic sulphate, $Ru(SO_4)_2$.

Deliquescent, and easily sol. in H_2O. (Claus, A. **59.** 246.)

Samarium sulphate, basic, $(SmO)_2SO_4$.

Insol. in H_2O and in cold dil. H_2SO_4. (Matignon, C. R. 1905, **141.** 1231.)

Samarium sulphate, $Sm_2(SO_4)_3+8H_2O$.

Difficultly sol. in H_2O.

Much less sol. than $Di_2(SO_4)_3+8H_2O$. (Cleve.)

2.05 pts. anhydrous salt are sol. in 100 pts. H_2O at 25°. (Keyes and James, J. Am. Chem. Soc. 1914, **36.** 635.)

100 g. $Sm_2(SO_4)_3$+Aq sat. at 25° contain 3.426 g. anhyd. $Sm_2(SO_4)_3$. (Wirth, Z. anorg. 1912, **76.** 174.)

Solubility in H_2SO_4+Aq at 25°.

n = equiv. g. of H_2SO_4 in 1 l. of solvent.
c = g Sm_2O_3 in 100 g. of solution.
c_1 = g. $Sm_2(SO_4)_3$ in 100 g. of solution.

n	c	c_1	n	c	c_1
0	2.029	3.426	2.16	1.43	2.416
0.1	2.038	3.441	6.175	0.416	0.7025
0.505	1.985	3.352	12.6	0.0656	0.1107
1.1	1.821	3.075	...	...	...

(Wirth, Z. anorg. 1912, **76.** 174.)

Solubility in $(NH_4)_2SO_4$+Aq at 25°.

Pts. $Sm_2(SO_4)_3$ per 100 pts. H_2O	Pts. $(NH_4)_2SO_4$ per 100pts. H_2O	Solid phase
2.1	0.3	$Sm_2(SO_4)_3$
2.0	0.8	
2.8	1.1	
1.5	1.9	$Sm_2(SO_4)_3$, $(NH_4)_2SO_4$, $7H_2O$
1.2	2.7	
0.8	7.4	
0.8	9.5	
0.8	8.7	
0.8	18.8	
0.8	12.2	
0.8	12.3	
0.9	32.5	
1.0	46.3	
0.9	40.3	
1.3	77.5	$(NH_4)_2SO_4$
0.2	77.2	
0.3	77.3	
0.6	76.8	

(Keyes and James, J. Am. Chem. Soc. 1914, **36.** 637.)

Solubility in Na_2SO_4+Aq at 25°.

Pts. Na_2SO_4 per 100 pts. H_2O	Pts. $Sm_2(SO_4)_3$ per 100 pts. H_2O	Solid phase
0.1	2.0	$Sm_2(SO_4)_3$
0.5	0.11	"
1.9	0.03	$2Sm_2(SO_4)_3$, $3Na_2SO_4+6H_2O$
6.44	0.016	"
7.00	0.008	"
9.02	0.016	"
10.51	0.012	"
11.48	0.012	"
13.58	0.010	"
14.71	0.010	"
14.47	0.009	"
20.02	0.012	"
23.42	0.012	"
23.68	0.018	"
25.93	0.015	"
27.40	0.011	"

These results seem to indicate that there is only one double salt formed by the union of $Sm_2(SO_4)_3$ with Na_2SO_4. Formula of this salt is $2Sm_2(SO_4)_3$, $3Na_2SO_4$, $6H_2O$.

(Keyes and James, J. Am. Chem. Soc. 1914, **36.** 635.)

Samarium hydrogen sulphate, $Sm(HSO_4)_3$.

Sl. sol. in H_2O. (Matignon, C. R. 1905, **141.** 1230.)

Ppt. (Brauner, Z. anorg. 1904, **38.** 331.)

Samarium sodium sulphate, $Sm_2(SO_4)_3$, $Na_2SO_4+2H_2O$.

Sl. sol. in sat. Na_2SO_4+Aq. (Cleve, Bull. Soc. (2) **43.** 166.)

$2Sm_2(SO_4)_3$, $3Na_2SO_4+6H_2O$. Only double salt formed at 25°. (Keyes and James, J. Am. Chem. Soc. 1914, **36.** 365.)

Scandium sulphate, basic, $Sc_2O(SO_4)_2$.

(Crookes, Roy. Soc. Proc. 1908, **80.** A, 518.)

Scandium sulphate, $Sc_2(SO_4)_3$.

Anhydrous. Easily sol. in H_2O.

$+2H_2O$.

$+5H_2O$; 54.61 g. of pentahydrate are sol. in 100 cc. H_2O at 25°. (Wirth, Z. anorg. 1914, **87.** 10.)

Solubility in H_2SO_4+Aq at 25°.

H_2SO_4+Aq.	g. $Sc_2(SO_4)_3$ in 100 g. of the solution
0.00	28.52
0.5-n	29.29
1.0-n	19.87
4.86-n	8.363
9.73-n	1.315

In 22.35-n H_2SO_4 the solid phase is $Sc_2(SO_4)_3$, $3H_2SO_4$ and 100 g. sat. solution contain 0.484 g. $Sc_2(SO_4)_3$.

(Wirth, Z. anorg. 1914, **87.** 10.)

$+6H_2O$. Extremely sol. in H_2O, but not deliquescent.

Scandium hydrogen sulphate, $Sc_2(SO_4)_3+3H_2O$.

(Wirth.)

Scandium sodium sulphate, $Sc_2(SO_4)_3$, $3Na_2SO_4+12H_2O$.

Sol. in H_2O. (Cleve.)

$+10H_2O$. Sol. in H_2O and in excess of Na_2SO_4+Aq. (Meyers, Z. anorg. 1914, **86.** 279.)

Silver (argentoargentic) sulphate, Ag_4SO_4, $Ag_2SO_4+H_2O$.

Gradually sol. in conc., but not attacked by dil., HNO_3+Aq. Not attacked by hot conc. H_2SO_4. (Lea, Sill. Am. J. **144.** 322.)

Silver sulphate, Ag_2SO_4.

Sol. in 200 pts. cold, and less than 100 pts. boiling H_2O. (Wittstein.)

Sol. in 88 pts. boiling H_2O (Schnaubart); in 87.25 pts. boiling H_2O (Wenzel); in 68.85 pts. H_2O at 100° (Kremers).

100 pts. H_2O at 15.5° dissolve 1.15 pts. Ag_2SO_4. (Ure's Dict.)

Sol. in 160 pts. H_2O at 18.75°. (Abl.)

1 l. H_2O dissolves 2.57×10^{-2} g.-mol. Ag_2SO_4 at 25°. (Drucker, Z. anorg. 1901, **28.** 362.)

1 l. H_2O dissolves 7.707 g. Ag_2SO_4 at 17°. (Euler, Z. phys. Ch. 1904, **49.** 314.)

1 l. H_2O dissolves 0.0267 mol. Ag_2SO_4 at 25°. (Rothmund, Z. phys. Ch. 1909, **69.** 539.)

1 l. H_2O dissolves 8.35 g. Ag_2SO_4 at 25°.

(Hill and Simmons, Z. phys. Ch. 1909, 67. 603.)

1 l. H_2O dissolves 8.344 g. Ag_2SO_4 at 25°. Sp. gr. of solution = 1.0052. (Harkins J. Am. Chem. Soc. 1911, **33.** 1812.)

Solubility in H_2O at t°.

t°	Pts. Ag_2SO_4 in 100 pts. of the solution.
14.5	0.730
33	0.909
51.5	1.062
75	1.237
100	1.393

(Barre, A. ch. 1911, (8) **24.** 211.)

More sol. in H_2SO_4+Aq than in pure H_2O. Still more sol. in HNO_3+Aq and still more in conc. H_2SO_4, from which it is pptd. by H_2O (Schnaubart.)

Solubility in H_2SO_4+Aq at 25°.

½H_2SO_4+Aq. Normality	Solubility of Ag_2SO_4 g.-mol. per litre
0.02	2.60×10^{-2}
0.04	2.64×10^{-2}
0.10	2.71×10^{-2}
0.20	2.75×10^{-2}

(Drucker, Z. anorg. 1901, **28.** 362.)

Solubility of Ag_2SO_4 in acids+Aq at 25°.

C = concentration of acid in acid+Aq in milliequivalents per l.

S = Solubility of Ag_2SO_4 in acid+Aq in milliequivalents per l.

Acid	C	S
HNO_3	0.0	53.98
	15.89	59.86
	31.78	65.32
	63.57	75.90
H_2SO_4	0.0	53.98
	29.02	54.88
	58.02	55.64
	105.26	56.82

(Swan, J. Am. Chem. Soc. 1911, **33.** 1814.)

Solubility in HNO_3+Aq at 25°.

Normality HNO_3	Sp. gr. of the solution	g. Ag_2SO_4 dissolved per l.
0.000	1.0054	8.350
1.0046	1.061	34.086
2.0452	1.1069	49.010
4.017	1.1871	71.166
4.209	1.1956	73.212
5.564	1.2456	84.609
8.487	1.3326	94.671
10.034	1.3676	90.806

(Hill and Simmons, Z. phys. Ch. 1909, **67.** 603.

Sol. in NH_4OH, and $(NH_4)_2CO_3$+Aq.

100 pts. H_2O dissolve 0.58 pt. at 18°. 100 pts. $(NH_4)_2SO_4$+Aq (15%) dissolve 0.85 pt. Ag_2SO_4 at 18°. Other sulphates have little effect. (Eder, J. pr. (2) **17.** 44.)

Determinations of the solubility of Ag_2SO_4 in $(NH_4)_2SO_4$ at temp between 16.5° and 100° show that no double salt is formed by these two sulphates. (Étard, A. ch. 1911, (8) **24.** 221.)

Solubility of Ag_2SO_4 in $(NH_4)_2SO_4$+Aq.

G. per 100 g. H_2O.

$(NH_4)_2SO_4$	Ag_2SO_4	$(NH_4)_2SO_4$	Ag_2SO_4
Temp. = 33°		Temp. = 51°	
8.85	1.101	8.90	1.362
15.90	1.331	16.27	1.680
22.22	1.500	22.43	1.887
27.25	1.585	32.10	2.061
30.80	1.619	35.38	2.095
35.88	1.627	39.03	2.082
39.46	1.600	42.37	2.055
43.22	1.557	45.05	2.026
Temp. = 75°		Temp. = 100°	
8.80	1.758	9.23	2.221
15.23	2.155	15.00	2.626
22.30	2.490	22.01	3.075
28.25	2.734	27.00	3.325
32.00	2.823	34.90	3.663
35.82	2.889	38.70	3.772
41.16	2.929	44.15	3.854
46.46	2.902	47.63	3.867

(Barre, A. ch. 1911, (8) **24.** 149, 202, 210.)

Solubility of Ag_2SO_4 in K_2SO_4+Aq.

G. per 100 g. H_2O.

K_2SO_4	Ag_2SO_4	K_2SO_4	Ag_2SO_4
Temp. = 33°		Temp. = 51°	
3.22	0.863	3.20	1.023
5.62	0.940	5.61	1.127
8.37	1.046	8.40	1.247
10.41	1.117	10.55	1.340
11.80	1.177	13.16	1.450
...	...	14.37	1.524
Temp. = 75°		Temp. = 100°	
3.12	1.273	3.23	1.488
5.73	1.406	5.60	1.675
8.43	1.554	8.45	1.890
10.55	1.665	11.30	2.115
13.17	1.806	15.07	2.410
17.06	2.021	18.58	2.677

(Barre, A. ch. 1911, (8) **24.** 149, 202, 210.)

Solubility in K_2SO_4+Aq at 25°.

½K_2SO_4+Aq Normality	Solubility of Ag_2SO_4 g.-mol. per litre
0.02	2.46×10^{-2}
0.04	2.36×10^{-2}
0.10	2.31×10^{-2}
0.20	2.32×10^{-2}

(Drucker, Z. anorg. 1901, **28.** 362.)

Solubility in Na_2SO_4+Aq at t°.

t°	Ag_2SO_4 in 100 pts. H_2O	Na_2SO_4 in 100 pts. H_2O
14.5	0.741	5.278
	0.904	10.103
	1.003	13.045
33	0.972	5.345
	1.150	10.056
	1.320	15.185
	1.448	20.093
	1.548	25.412
	1.570	29.556
	1.549	34.732
	1.462	39.447
	1.199	44.693
	0.932	46.976
51	1.173	5.407
	1.377	10.116
	1.572	15.146
	1.705	20.247
	1.787	25.196
	1.802	29.230
	1.727	34.625
	1.540	39.302
	1.188	42.914
	0.882	44.464
75	1.458	5.368
	1.697	9.813
	1.934	15.260
	2.075	19.978
	2.161	25.556
	2.138	29.662
	1.910	35.278
	1.603	38.944
	1.156	41.365
100	1.651	5.336
	2.012	10.153
	2.312	15.532
	2.351	25.451
	2.260	29.714
	2.012	34.718
	1.687	38.635
	1.158	40.160

Up to 33°, the solubility of Ag_2SO_4 in Na_2SO_4+Aq increases with the concentration of Na_2SO_4; above 33° the solubility of Ag_2SO_4 rises to a maximum at a certain concentration of $NaSO_4$ dependent on the temp. The solubility curves for various temp. all end at a concentration of 40% Na_2SO_4, that is, the mixed crystals formed at this concentration are equally sol. at all temp.

(Barre, C. R. 1910, **150.** 1323.)

Solubility in Na_2SO_4+Aq at t°.

t°	100 pts. H_2O dissolve	
	Na_2SO_4	Ag_2SO_4
18	0.0	0.766
	0.25	0.712
	0.51	0.682
	0.74	0.675
	1.00	0.665
	1.48	0.670
	2.01	0.673
	2.50	0.689
	3.04	0.703
	4.00	0.736
	4.99	0.768
	10.10	0.932
	13.04	1.028
33	0.0	0.917
	0.25	0.861
	0.51	0.835
	0.75	0.825
	0.98	0.816
	1.50	0.820
	2.01	0.832
	2.48	0.849
	3.00	0.867
51	0.00	1.081
	0.25	1.032
	0.49	1.010
	0.68	0.000
	1.02	0.995
	1.51	1.002
	1.90	1.017
	2.46	1.034
	2.92	1.053
	3.95	1.103
75	0.00	1.267
	0.20	1.215
	0.47	1.208
	0.80	1.206
	0.98	1.210
	1.52	1.222
	1.96	1.238
	2.50	1.269
	2.98	1.296
	4.08	1.366
100	0.00	1.404
	0.50	1.341
	1.01	1.363
	1.44	1.382
	1.94	1.418
	3.02	1.494

(Barre, A. ch. 1911, (8) **24.** 215.)

Solubility in salts+Aq at 25°.

C = concentration of salt in salt+Aq in milliequivalents per l.
d_1 = sp. gr. 25°/4° of salt+Aq.
S = solubility of Ag_2SO_4 in salt+Aq expressed in milliequivalents per l.
d_2 = sp. gr. 25°/4° of Ag_2SO_4+salt+Aq.

Salt	C	d_1	S	d_2
none	...	...	53.52	..
KNO_3	24.914	0.9986	57.70	1.0072
	49.774	1.0002	61.13	1.0092
	99.870	1.0034	67.93	1.0034
$Mg(NO_3)_2$	24.764	0.9985	59.44	1.0073
	49.595	0.9999	64.32	1.0094
	99.460	1.0026	72.70	1.0133
$AgNO_3$	24.961	1.0007	39.09	1.0065
	49.86	1.0044	28.45	1.0084
	99.61	1.0112	16.96	1.0137
K_2SO_4	25.024	0.9989	50.66	1.0064
	50.044	1.0006	49.35	1.0079
	100.0	1 0041	48.04	1 0112
	200.03	1.0110	48.30	1.0180
$MgSO_4$	20.22	0.9984	52.21	1.0061
	50.069	1.0002	50.93	1.0079
	100.04	1 0032	49.95	1.0105
	200.05	1.0092	49.60	1.0164

(Harkins, J. Am. Chem. Soc. 1911, **33.** 1813.)

Solubility of Ag_2SO_4 in salts+Aq at 25°.

C = concentration of salt in salt+Aq in milliequivalents per l.
S = solubility of Ag_2SO_4 in salt+Aq in milliequivalents per l.

Salt	C	S
$KHSO_4$	0.0	53.98
	52.64	52.18
	105.26	51.76
K_2SO_4	0.0	53.98
	27.18	50.90
	54.34	49.30

(Swan, J. Am. Chem. Soc. 1911, **33.** 1814.)

Decomp. by alkali thiosulphates+Aq. (Herschell.)

100 ccm. $Ag_2SO_4+AgC_2H_3O_2$+Aq sat. at 17° contain 3.95 g. Ag_2SO_4 and 8.30 g. $AgC_2H_3O_2$ and solution has sp. gr. = 1.0094. (Euler, C. C. **1904,** I. 1316.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898 **20.** 829.)

Solubility in organic compds.+Aq at 25°.

Solvent	Mol. Ag_2SO_4 sol. in 1 litre
Water	0.0267
0.5-N Methyl alcohol	0.0249
" Ethyl alcohol	0.0228
" Propyl alcohol	0.0218
" Tert. amyl alcohol	0.0204
" Acetone	0.0220
" Ether	0.0206
" Formaldehyde	0.0227
" Glycol	0.0259
" Glycerine	0.0263
" Mannitol	0.0297
" Glucose	0.0283
" Sucrose	0.0270
" Urea	0.0303
" Dimethylpyrone	0.0216
" Urethane	0.0227
" Formamide	0.0270
" Acetamide	0.0253
" Acetonitrile	0.0525
" Glycocoll	0.0433
" Acetic acid	0.0252
" Phenol	0.0379
" Chloral	0.0233
" Methylal	0.0205
" Methyl acetate	0.0212

(Rothmund, Z. phys. Ch. 1909, **69.** 539.)

Insol. in methyl acetate (Bezold, Dissert. **1906**; Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601); liquid methylamine. (Franklin, J. Am. Chem. Soc. 1906, **28.** 1420); acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899, II.** 1014.)

Very sol. in a hot mixture of H_2SO_4 and monobrombenzene, less sol. in cold. (Couper, A. ch. (3) **52.** 311.)

Silver hydrogen sulphate, $AgHSO_4$.

Decomp. by H_2O; sol. in H_2SO_4. (Stas.)

Ag_2O, $3H_2O$, $4SO_3+2H_2O = AgH_3(SO_4)_2+H_2O$. As above. (Schultz, Pogg. **133.** 137.)

$2Ag_2O$, $3H_2O$, $5SO_3+2H_2O = Ag_4H_6(SO_4)_5+2H_2O$. As above. (Schultz.)

Silver *pyro*sulphate, $Ag_2S_2O_7$.

Decomp. by H_2O. (Weber, B. **17.** 2497.)

Silver thallic sulphate, $AgTl(SO_4)_2$.

(Lepsius, Chem. Ztg. **1890.** 1327.)

Silver tin (stannic) sulphate, $Ag_2Sn(SO_4)_3+3H_2O$.

Ppt. Decomp. by H_2O. Sol. in HCl. (Weinland, Z. anorg. 1907, **54.** 250.)

Silver sulphate acetylide, Ag_2SO_4, $2Ag_2C_2$.

(Plimpton, Proc. Chem. Soc. 1892, **8.** 109.)

Silver sulphate ammonia, Ag_2SO_4, $2NH_3$.

Completely sol. in H_2O. (Rose, Pogg. **20.** 153.)

Ag_2SO_4, $4NH_3$. Easily sol. in H_2O or NH_4OH+Aq without decomp. (Mitscherlich.)

Silver sulphate mercuric oxide, Ag_2SO_4, HgO.

Insol. in H_2O, but decomp. even in the cold. Sol. in HNO_3 and H_2SO_4. (Finci, Gazz. ch. it. 1911, **41.** (2) 548.)

Silver sulphate sulphide, Ag_2SO_4, Ag_2S.

Decomp. by hot H_2O or cold HCl+Aq. Sol. in boiling HNO_3+Aq. (Poleck and Thümmel, B. **16.** 2435.)

Sodium sulphate, Na_2SO_4.

Anhydrous.

1 pt. Na_2SO_4 is sol. in 7.367 pts. H_2O at 15° (Gerlach); in 8.52 pts. H_2O at 13.3° (Poggendorf); in 10 pts. H_2O at 13°, and in 3.3 pts. H_2O at 62.2° (Wenzel).

100 pts. H_2O at 0° dissolve 5.155 pts. Na_2SO_4(Pfaff, A. **99.** 226); at 100.6° dissolve 45.985 pts. Na_2SO_4 (Griffiths).

See below for further data.

$+7H_2O$. Efflorescent. Insol. in alcohol. *See* below for further data.

$+10H_2O$.

$Na_2SO_4+10H_2O$ is sol. in H_2O with absorption of heat; 20 pts. $Na_2SO_4+10H_2O$ mixed with 100 pts. H_2O at 12.5° lower the temperature 6.8°. (Rüdorff, B. **2.** 68.)

Sol. in 2.33 pts. H_2O at 19°, or 100 pts. H_2O at 19° dissolve 42.8 pts. $Na_2SO_4+10H_2O$. (Schiff, A. **109.** 326.)

100 pts. H_2O dissolve a pts. Na_2SO_4 and b pts. $Na_2SO_4+10H_2O$ at t°.

t°	a	b	t°	a	b
0	5.02	12.17	33.88	50.04	312.11
11.67	10.12	26.38	40.15	48.78	291.44
13.30	11.74	31.33	45.04	47.81	276.91
17.91	16.73	48.28	50.40	46.82	262.35
25.05	28.11	99.48	59.79	45.42	..
28.76	37.35	161.53	70.61	44.35	..
30.75	43.05	215.77	84.42	42.96	..
31.84	47.37	270.22	103.17	42.65	..
32.73	50.65	322.12	..	..	..

(Gay-Lussac, A. ch. (2) **11.** 312.)

Maximum solubility is at 33° from experiment and theoretical considerations. At this temp. $Na_2SO_4+10H_2O$ is converted into Na_2SO_4. (Kopp, A. **34.** 271.)

100 pts. H_2O at t° dissolve pts. $Na_2SO_4+10H_2O$.

t°	Pts. $Na_2SO_4+10H_2O$	t°	Pts. $Na_2SO_4+10H_2O$	t°	Pts. $Na_2SO_4+10H_2O$
2.5	11.39	37.50	294.04	75	241.68
7.5	16.38	43.75	261.04	81.25	217.20
12.5	29.03	50	285.06	87.50	220.65
18.75	70.78	56.25	248.11	93.75	225.46
25	143.38	62.5	222.22	100	241.69
31.25	479.97	68.75	242.88	..	..

(Brandes and Firnhaber, 1824.)

1 pt. $Na_2SO_4+10H_2O$ is sol. in 6.1 pts. H_2O at 7.5°; 3.44 pts. at 12.5°; 2.41 pts. at 18.75°; and 1.724 pts. at 20°. (Karsten.)

1 pt. $Na_2SO_4+10H_2O$ is sol. in 2.86 pts. cold, and 0.8 pt. boiling H_2O (Bergmann); in 3 pts. cold, and 0.5 pt. boiling H_2O (Wittstein); in 4 pts. cold, and 1 pt. boiling H_2O (Fourcroy); in 3 pts. H_2O at 18.75° (Abl).

100 pts. H_2O dissolve 12.494 pts. Na_2SO_4 or 35.492 pts. $Na_2SO_4+10H_2O$ at 15°, and sp. gr. of solution = 1.10847 (Michel and Krafft, A. ch. (3) **41.** 478.)

100 pts. H_2O dissolve 39.4 pts. cryst. salt at 15.5°; 80 pts. cryst salt at 100°. (Ure's Dict.)

100 pts. H_2O dissolve pts. Na_2SO_4 at t°.

t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4
0	4.53	24.1	25.92
17.9	16.28	33	50.81

(Diacon, J. B. **1866.** 61.)

Solubility of Na_2SO_4 in H_2O at various pressures and temp. Pts. Na_2SO_4 contained in 100 pts. sat. Na_2SO_4+Aq at A pressure in atmos. and t° are given.

A	0°	15°	15.4°	A	15°
1	4.40	11.32	11.4	30	10.05
20	4.53	10.78	10.74	40	10.33

(Möller, Pogg. **117.** 386.)

The solubility of $Na_2SO_4+10H_2O$ increases with the temperature from 0 to 34°. At 34° and above, it is converted into the anhydrous salt, the solubility of which is least at 103.17°, which is the boiling point of the saturated solution, and increases by cooling from that temp. down to 18–17°. Below the latter temperature the anhydrous salt cannot exist in the presence of H_2O, but is converted into $Na_2SO_4+7H_2O$, or $Na_2SO_4+10H_2O$. The solubility of $Na_2SO_4+7H_2O$ increases with the temperature from 0–26°, and at 27° it is converted into the anhydrous salt.

Thus there are two different rates of solubility for Na_2SO_4 for temperatures from 0–18°, three different rates from 18–26°, two from 26–34°, and only one above 34°.

1. By heating $Na_2SO_4+10H_2O$ to fusion and raising the heat until the liquid boils, placing in a closed vessel and cooling, the greater part of the anhydrous salt, which separates out on heating, redissolves on cooling, and the amount increases as the temp. falls until 18° is reached. Below 18° $Na_2SO_4+7H_2O$ is formed. Saturated Na_2SO_4+Aq thus obtained contains for 100 pts. HO at:

18°	20°	25°	26°	
53.25	**52.76**	**51.53**	**51.31**	**pts. Na_2SO_4,**
30°	**33°**	**34°**	**36°**	
50.37	**49.71**	**49.53**	**49.27**	**pts. Na_2SO_4.**

2. By allowing the boiling saturated solution free from undissolved salt to cool to 0°

with exclusion of air until crystals of $Na_2SO_4 + 7H_2O$ are formed, then removing the greater part of the mother liquor with a warm pipette, and warming the rest of the mother liquor with the excess of crystals, the crystals dissolve in increasing quantity between 0° and 26–27°, so that at 27° the solution contains 56 pts. Na_2SO_4 to 100 pts. H_2O. The remaining undissolved crystals of $Na_2SO_4+7H_2O$ begin to melt very slowly at 27°, more quickly at higher temperatures, and cause the separation of anhydrous crusts, and thus the strength of the solution is gradually lowered to the normal. Saturated solutions prepared in this way contain for 100 pts. H_2O at:

0°	10°	13°
19.62	30.49	34.27 pts. Na_2SO_4,
or 44.89	78.9	92.9 pts. $Na_2SO_4+7H_2O$.
15°	16°	17°
37.43	38.73	39.99 pts. Na_2SO_4,
or 105.8	117.4	111.0 pts. $Na_2SO_4+7H_2O$,
18°	19°	20°
41.63	43.35	44.73 pts. Na_2SO_4,
or 124.6	133.0	140.0 pts. $Na_2SO_4+7H_2O$,
25°	26°	
52.94	54.97 pts. Na_2SO_4.	
or 188.5	202.6 pts. $Na_2SO_4+7H_2O$.	

3. Solutions obtained by shaking H_2O with $Na_2SO_4+10H_2O$ contain for 100 pts. H_2O at:

0°	10°	15°
5.02	9.00	13.20 pts. Na_2SO_4,
or 12.16	23.04	35.96 pts. $Na_2SO_4+10H_2O$,
18°	20°	25°
16.80	19.40	28.00 pts. Na_2SO_4,
or 48.41	58.85	98.48 pts. $Na_2SO_4+10H_2O$,
26°	30°	
30.00	40.00 pts. Na_2SO_4,	
or 109.81	184.1 pts. $Na_2SO_4+10H_2O$,	
33°	34°	
50.76	55.0 pts. Na_2SO_4.	
or 323.1	412.2 pts. $Na_2SO_4+10H_2O$.	

At 34°, $Na_2SO_4+10H_2O$ begins to melt in its crystal H_2O. As long as there is a considerable quantity of unchanged crystals present, the solution contains 55 pts. Na_2SO_4 for 100 pts. H_2O, but as the hydrous salt decreases in amount and becomes converted into the anhydrous salt, the solution becomes weaker and contains only 49.53 pts. Na_2SO_4 for 100 pts. H_2O after warming for 6 or 8 hours at 34°. In the same way temporary solutions can be obtained at 36–40° with 55–56 pts. Na_2SO_4 to 100 pts. H_2O, but this amount sinks to the normal even more quickly than at 34°.

Na_2SO_4 dehydrated at 100–150°, after the addition of 1²/₃–1½ pts. H_2O, gives a solution between 0° and 32° of the same strength as $Na_2SO_4+10H_2O$, but at 34° a solution with 55 pts. Na_2SO_4 to 100 pts. H_2O cannot be obtained, but one with 49.53 pts. is formed. (Löwel, A. ch. (3) **49.** 32.)

4. Solubility of anhydrous salt. Above 34°, 100 pts. H_2O dissolve at:

35°	40°	45°	50°	55°
50.2	48.8	47.7	46.7	45.9 pts. Na_2SO_4,
60°	65°	70°	75°	80°
45.3	44.8	44.4	44.0	43.7 pts. Na_2SO_4,
85°	90°	95°	100°	103.5°
43.3	43.1	42.8	42.5	42.2 pts. Na_2SO_4.

(Mulder.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4	t°	Pts. Na_2SO_4
0	4.8	35	50.2	70	44.4
1	5.1	36	49.9	71	44.3
2	5.4	37	49.6	72	44.2
3	5.7	38	49.3	73	44.2
4	6.0	39	49.1	74	44.1
5	6.4	40	48.8	75	44.0
6	6.8	41	48.5	76	44.0
7	7.3	42	48.3	77	43.9
8	7.8	43	48.1	78	43.8
9	8.4	44	47.9	79	43.7
10	9.0	45	47.7	80	43.7
11	9.7	46	47.5	81	43.6
12	10.5	47	47.3	82	43.5
13	11.4	48	47.1	83	43.5
14	12.4	49	46.9	84	43.4
15	13.4	50	46.7	85	43.3
16	14.5	51	46.6	86	43.3
17	15.7	52	46.4	87	43.2
18	16.9	53	46.2	88	43.2
19	18.2	54	46.1	89	43.1
20	19.5	55	45.9	90	43.1
21	20.9	56	45.8	91	43.0
22	22.5	57	45.7	92	43.0
23	24.1	58	45.6	93	42.9
24	25.9	59	45.4	94	42.9
25	27.9	60	45.3	95	42.8
26	30.1	61	45.2	96	42.7
27	32.4	62	45.1	97	42.6
28	35.0	63	45.0	98	42.6
29	37.8	64	44.9	99	42.5
30	40.9	65	44.8	100	42.5
31	44.2	66	44.7	101	42.4
32	47.8	67	44.6	102	42.3
32.75	50.65	68	44.5	103	42.2
33	50.6	69	44.5	103.5	42.2
34	50.4	..	...	...	...

(Mulder, Scheik. Verhandel. **1864.** 123.)

100 pts. dissolve at:

0°	34°	100°	120°
5	78.8(?)	42.7	41.95 pts. Na_2SO_4,
140°	160°	180°	230°
42.0	42.9	44.25	46.4 pts. Na_2SO_4.

(Tilden and Shenstone, Lond. R. Soc. Proc. **35.** 345.)

Solubility decreases above 230°. (Étard, C. R. 113. 854.)

Sat. Na_2SO_4+Aq contains at:

0°	7°	13°	24°	28°	30°	
4.1	6.2	9.9	19.3	25.2	29.5%	Na_2SO_4,
49°	62°	83°	99°	134°	150°	
32.8	31.3	30.0	29.7	29.4	29.8%	Na_2SO_4,
190°	240°	279°	320°			
29.9	30.0	24.5	17.8% Na_2SO_4.			

(Étard, A. ch. 1894, (7) 2. 548.)

Solubility of Na_2SO_4 in H_2O at t°.
G. per 100 g. H_2O.

t°	Na_2SO_4	Sp. gr.	t°	Na_2SO_4	Sp. gr.
0.70	4.71	1.0432	33.5	49.39	1.3307
10.25	9.21	1.0802	38.15	48.47	1.3229
15.65	14.07	1.1150	44.85	47.49	1.3136
24.90	27.67	1.2067	60.10	45.22	1.2918
27.65	34.05	1.2459	75.05	43.59	1.2728
30.20	41.78	1.2894	89.85	42.67	1.2571
31.95	47.98	1.3230	101.9*	42.18	1.2450

* B.-pt.

(Berkeley, Phil. Trans. Roy. Soc. 1904, **203.** A, 189.)

Transition point from $Na_2SO_4+10H_2O$ to Na_2SO_4=32.5° (Berkeley); 32.383°. (Richards and Churchill, Z. phys. Ch. 1899, **28.** 314.)

100 g. Na_2SO_4+Aq sat. at 15° contain 11.5 g. anhydrous Na_2SO_4; 21.9 g. at 25°. (Schreinemakers, Arch. Néer. Sc. 1910, (2) **15.** 81.)

1 l. Na_2SO_4+Aq sat. at 25° contains 1.881 mols. Na_2SO_4. (Herz, Z. anorg. 1911, **70.** 127.)

Solubility in H_2O at t°.

t°	Mol. % Na_2SO_4
62	5.39
70	5.27
72	5.25
80	5.18
120	5.04
190	5.25
192	5.27
208	5.39
241	5.39
250	5.04
279	4.12
319	2.56
252	4.9
310	3.2
340	1.8
365	0.0

(Wuite, Z. phys. Ch. 1913, **86.** 364.)

Supersaturated solutions of $NaSO_4$ are easily formed; when Na_2SO_4+Aq sat. at its b.-pt. is hermetically sealed, no crystals are deposited on cooling (Löwel). Supersat. Na_2SO_4+Aq may also be obtained by cooling hot sat. Na_2SO_4+Aq in flasks loosely stoppered with cotton wool (Schroeder, A. **109.** 45), or by covering the containing vessel with a glass plate, watch-glass, card, etc., or by covering the liquid itself with a layer of oil, and then allowing to cool.

Hot Na_2SO_4+Aq containing 1 pt. H_2O to 1 pt. $Na_2SO_4+10H_2O$ does not crystallise on slowly cooling or on being quickly cooled by immersion in cold water, if it is contained in a barometer tube freed from air by boiling, or in an exhausted well-closed vessel, or in an open vessel with a layer of oil of turpentine on it (Gay-Lussac); or in a vessel containing air, either well stoppered or furnished with a loose cover (Schweigger); or in an open vessel under a bell jar full of air and closed at the bottom with a water joint; or in open bottles placed in a quiet situation; or in an open glass enclosed in a stoppered vessel, containing air and some KOH for drying; in this case $Na_2SO_4+10H_2O$ effloresces from the solution, and when washed down again does not cause instant crystallisation, but redissolves.

The crystallisation of a solution cooled in this way may often be brought about instantaneously, or often again after a short time; (1) by agitation, when the solution has been cooled in an open vessel; (2) by access of air caused by opening the vessel, the crystallisation taking place the more rapidly the larger the opening. In this case the crystallisation begins at the top, where the solution, the vessel, and the air come in contact; when a particle of dust falls in the liquid the crystallisation begins a little under the surface. When the solution has been cooled in vacuo, a bubble of air, hydrogen, carbonic acid, or nitrous oxide is sufficient to set up the crystallisation; (3) by contact with a solid body. The latter do not cause crystallisation when cooled in contact with the liquid, nor (excepting a crystal of $Na_2SO_4+10H_2O$) when they are moistened or warmed before contact with the solution.

Supersat. Na_2SO_4+Aq is brought to crystallisation by addition of a crystal of $Na_2SO_4+10H_2O$, or an isomorphous substance as $Na_2SeO_4+10H_2O$, or $Na_2CrO_4+10H_2O$. Other crystals, as $MgSO_4+7H_2O$, etc., have no action. (Thomson, Chem. Soc. **35.** 199.)

See also Hartley, Jones and Hutchinson, Chem. Soc. 1908, **93.** 825, on "Spontaneous crystallisation of sodium sulphate solutions," and de Coppet (A. ch. 1907, (8) **10.** 457) on same subject.

A more extended discussion of the phenomena and causes of supersaturation is not considered to the within the scope of this work.

Na_2SO_4+Aq sat. at 15° has sp. gr. 1.10847 (Michel and Krafft); at 15° has sp. gr. 1.119 (Stolba); at 16°

has sp. gr. 1.1162 (Stolba); at 10° contains 29 pts. Na_2SO_4 to 100 pts. H_2O (supersaturated?), and has sp. gr. 1.1259 (Karsten).

Sp. gr. of Na_2SO_4+Aq at 19.5°.

% Na_2SO_4	Sp. gr.	% Na_2SO_4	Sp. gr
2.894	1.0262	10.538	1.0977
5.589	1.0509	12.473	1.1162
7.995	1.0733	..	.

(Kremers, Pogg. **95**. 120.)

Sp. gr. of Na_2SO_4+Aq.

% Na_2SO_4 +$10H_2O$	Sp. gr.	% Na_2SO_4 +$10H_2O$	Sp. gr.
1.262	1.005	13.744	1.055
2.522	1.010	14.975	1.060
3.780	1.015	16.203	1.065
5.035	1.020	17.426	1.070
6.288	1.025	18.645	1.075
7.538	1.030	19.860	1.080
8.786	1.035	21.071	1.085
10.030	1.040	22.277	1.090
11.272	1.045	23.478	1.095
12.510	1.050	24.674	1.100

(Schmidt, Pogg. **132**. 132.)

Sp. gr. of Na_2SO_4+Aq at 19°.

% Na_2SO_4 +$10H_2O$	Sp. gr.	% Na_2SO_4 +$10H_2O$	Sp. gr.
1	1.0040	16	1.0642
2	1.0079	17	1.0683
3	1.0118	18	1.0725
4	1.0158	19	1.0766
5	1.0198	20	1.0807
6	1.0232	21	1.0849
7	1.0278	22	1.0890
8	1.0318	23	1.0931
9	1.0358	24	1.0973
10	1.0398	25	1.1015
11	1.0439	26	1.1057
12	1.0479	27	1.1100
13	1.0520	28	1.1142
14	1.0560	29	1.1184
15	1.0601	30	1.1226

(Schiff, A. **110**. 70.)

Sp. gr. of Na_2SO_4+Aq at 15°.

%	Sp. gr. if Na_2SO_4	Sp. gr. if Na_2SO_4 +$10H_2O$	%	Sp. gr. if Na_2SO_4 +$10H_2O$	%	Sp. gr. if Na_2SO_4 +$10H_2O$
1	1.0091	1.004	11	1.044	21	1.086
2	1.0182	1.008	12	1.047	22	1.090
3	1.0274	1.013	13	1.052	23	1.094
4	1.0365	1.016	14	1.056	24	1.098
5	1.0457	1.020	15	1.060	25	1.103
6	1.0550	1.024	16	1.064	26	1.107
7	1.0644	1.028	17	1.069	27	1.111
8	1.0737	1.032	18	1.073	28	1.116
9	1.0832	1.036	19	1.077	29	1.120
10	1.0927	1.040	20	1.082	30	1.125

(Gerlach, Z. anal. **8**. 287.)

Sp. gr. of Na_2SO+Aq at 24.8°. a = no. of g., equivalent to ½ mol. wt., dissolved in 1000 g. H_2O; b = sp. gr. if a is Na_2SO_4+$10H_2O$, ½ mol. wt. = 161; c = sp. gr. if a is Na_2SO_4, ½ mol. wt. = 71.

a	b	c	a	b	c
1	1.054	1.059	4	1.163	1.213
2	1.098	1.111	5	1.188	...
3	1.134	1.165	6	1.209	...

(Favre and Valson, C. R. **79**. 968.)

Sp. gr. of Na_2SO_4+Aq at 18°.

% Na_2SO_4	Sp. gr.	% Na_2SO_4	Sp. gr.
5	1.0450	15	1.1426
10	1.0915	..	...

(Kohlrausch, W. Ann. **1879**. 1.)

Sp. gr. of Na_2SO_4+Aq at 20° containing 0.5 mol Na_2SO_4 to 100 mols. H_2O = 1.03466; 1.0 mol. Na_2SO_4 to 100 mols. H_2O = 1.06744. (Nicol, Phil. Mag. (5) **16**. 122.)

Sp. gr. of Na_2SO_4+Aq at 25°.

Concentration of Na_2SO_4 +Aq	Sp. gr.
1-normal	1.0606
1/2– "	1.0309
1/4– "	1.0156
1/8 "	1.0079

(Wagner, Z. phys. Ch. 1890, **5**. 39.)

Sp. gr. at 16°/4° of Na_2SO_4+Aq containing 9.4043% Na_2SO_4 = 1.08655. (Schönrock, Z. phys. Ch. 1893, **11**. 781.)

Na_2SO_4+Aq containing 25.51% Na_2SO_4 has sp. gr. 20°/20° = 1.2527. Na_2SO_4+Aq containing 10.14% Na_2SO_4 has sp. gr. 20°/20° = 1.0938. (Le Blanc and Rohland, Z. phys. Ch. 1896, **19**. 278.)

Sp. gr. of Na_2SO_4+Aq at 17.5°, when p = per cent strength of solution; d = observed density; and w = volume conc. in grs. per cc. $\left(\frac{pd}{100}=w\right)$

p.	d.	w.
13.06	1.1226	0.14662
11.75	1.1094	0.13043
10.68	1.0990	0.11737
8.544	1.0784	0.09214
6.762	1.0615	0.07178
4.015	1.0358	0.04159
2.599	1.0225	0.02658
2.375	1.0204	0.02423
1.818	1.0154	0.01846
1.349	1.0109	0.01364
0.5204	1.0037	0.00522
0.2921	1.0014	0.00293

(Barnes, J. phys. Chem. 1898, **2**. 543.)

Sp. gr. of Na_2SO_4+Aq at 20°.

Normality of Na_2SO_4+Aq	% Na_2SO_4	Sp. gr.
0.97	12.36	1.1138
0.48	6.41	1.0570

(Forchheimer, Z. phys. Ch. 1900, **34.** 23.)

Sp. gr. of sat. Na_2SO_4, $10H_2O$+Aq at t°.

t°	wt. of 1 ccm. of the solution	100 g. H_2O dissolve g. $Na_2SO_4+10H_2O$
0	1.040	12.16
5	1.058	...
10	1.078	21.04
15	1.109	35.96
18	1.137	48.41
20	1.156	58.35
25	1.209	98.48
26	1.222	109.81
30	1.287	184.1
33	1.312	323.1
34	1.317	413.2
35	1.317	...

(Tschernaj, J. Russ. Phys. Chem. Soc. 1914, **46.** 8.)

Sp. gr. and b.-pt. of Na_2SO_4+Aq. Na_2SO_4+Aq containing P pts. $Na_2SO_4+10H_2O$ for every 100 pts. H_2O has given sp. gr. and b.pt.

P	Sp. gr.	B.-pt.	P	Sp. gr.	B.-pt.
1	1.005	100.5°	16	1.064	101.25°
2	1.008	100.62	17	1.067	101.25
3	1.014	100.62	18	1.070	101.37
4	1.020	100.75	19	1.072	101.37
5	1.021	100.75	20	1.074	101.37
6	1.028	100.87	21	1.076	101.37
7	1.030	100.87	22	1 078	101.5
8	1.032	101.0	23	1.080	101.5
9	1.036	101.0	24	1.082	101.5
10	1.040	101.0	25	1.084	101.5
11	1.043	101.12	26	1.090	101.5
12	1.050	101.12	27	1.092	101.63
13	1.055	101.25	28	1.095	101.63
14	1.060	101.25	29	1.098	101.63
15	1.062	101.25	30	1.100	101.75

(Brandes and Gruner, 1827.)

Saturated solution boils at 103.17° (Löwel), 103.5° (Mulder), 105° (Kremers), 100.5° (Griffiths), 100.8° (Gerlach).

Crust forms at 102.9°; highest temp., 103.2°, and solution contains 43.9 pts. Na_2SO_4 to 100 pts. H_2O. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of Na_2SO_4+Aq containing pts. Na_2SO_4 to 100 pts. H_2O.

B.-pt.	Pts. Na_2SO_4	B.-pt.	Pts. Na_2SO_4
100.5°	9.5	102.5°	39.0
101.0	18.0	103.0	44.5
101.5	26.0	103.2	46.7
102.0	33.0	...	...

(Gerlach, Z. anal. **26.** 430.)

M.-pt. of $Na_2SO_4+10H_2O$ = 34°. (Tilden, Chem. Soc. **45.** 409.)

Sol. with decomp. in HCl+Aq.

Solubility in H_2SO_4+Aq at 25°.

1000 g. of the solution contain		Solid phase
Mols H_2SO_4	Mols Na_2SO_4	
...	1.539	Na_2SO_4, $10H_2O$
0.286	1.671	"
0.338	1.742	"
0.884	2.256	Na_2SO_4, $10H_2O+Na_2SO_4$
1.576	2.363	$Na_2SO_4+Na_3H(SO_4)_2$
1.666	2.437	"
2.611	2.091	$Na_3H(SO_4)_2+Na_3H(SO_4)_2$, H_2O

(D'Ans, Z. anorg. 1906, **49.** 356.)

Solubility of Na_2SO_4 in H_2SO_4+Aq at 25.°

1000 g. of the solution contain		Solid phase
Mol. Na_2SO_4	Mol. H_2SO_4	
1.55	0.08	Na_2SO_4
1.59	0.147	"
1.85	0.60	Na_2SO_4, $10H_2O$
2.00	0.763	"
0.77	4.23	$NaHSO_4$, H_2O
0.47	4.96	"
0.32	6.61	Na_2HSO_4
0.305	6.87	"
0.07	7.18	$Na_3H(SO_4)_2$
0.79	8.78	"

(D'Ans, Z. anorg. 1909, **61.** 92.)

10 ccm. of sat. Na_2SO_4+absolute H_2SO_4 contain approx. 2.999 g. Na_2SO_4. (Bergius, Z. phys. Ch. 1910, 72. 355.)

Solubility in H_2SO_4+Aq at 25°.

Solid Phase, $Na_2SO_4+10H_2O$.

Millimols H_2SO_4 in 10 ccm.	Millimols Na_2SO_4 in 10 ccm.
...	18.81
5.10	22.38
7.79	24 65

(Herz, Z. anorg. 1912, **73.** 276.)

Solubility in H_2SO_4+Aq at 25°.

1000 g. of the solution contain		Solid phase
Mols SO_3	Mols Na_2SO_4	
5.91	0.409	$NaHSO_4$
6.30	0.332	"
6.64	0.297	$NaHSO_4+NaH_3(SO_4)_2$, H_2O
6.90	0.173	$NaH_3(SO_4)_2$, H_2O
7.36	0.071	"
7.74	0.047	"
7.82	0.044	"
8.12	0.037	"
8.29	0.042	"
8.40	0.046	"
8.70	0.076	"
8.86	0.156	"
8.93	0.259	"
8.93	0.269	"
8.93	0.273	
8.84	0.527	$NaH_3(SO_4)_2$, H_2O metastable solutions
8.73	0.681	
8.70	0.808	
8.62	0.834	
8.62	0.844	
8.61	0.899	
8.87	0.445	$NaH_3(SO_4)_2$, $H_2O+Na_2SO_4$, $4.5H_2SO_4$
8.93	0.437	Na_2SO_4, $4.5H_2SO_4$
9.08	0.394	"
9.36	0.425	Na_2SO_4, $4.5H_2SO_4+NaHS_2O_7$
9.18	0.567	$NaHS_2O_7$
9.42	0.728	"
9.48	0.760	"
9.55	0.775	"
9.48	0.953	$NaHS_2O_7$+?
9.85	0.787	?
9.98	0.908	?
(9.77)	(1.03)	Metastable
10.16	0.797	
10.78	0.302	?

(D'Ans, Z. anorg. 1913, **80.** 236.)

Sl. sol. in conc. $HC_2H_3O_2$. (Ure's Dict.)
Not pptd. by addition of glacial $HC_2H_3O_2$ to Na_2SO_4+Aq. (Persoz.)

Solubility in NaOH+Aq at 25°.

1000 g. of the solution contain		Solid phase
Mols $(NaOH)_2$	Mols Na_2SO_4	
0	1.54	Na_2SO_4, $10H_2O$
0.074	1.41	"
0.70	1.08	"
1.47	0.90	Na_2SO_4, $10H_2O+Na_2SO_4$
2.02	0.59	Na_2SO_4
2.82	0.24	"
3.52	0.126	"
5.83	0.013	"
6.62	..	NaOH, H_2O

(D'Ans and Schreiner, Z. anorg. 1910, **67.** 437.)

Sol. in sat. NH_4Cl+Aq.

Rapidly and abundantly sol. in sat. KCl+Aq with pptn. of K_2SO_4.

$Na_2SO_4+10H_2O$ is sol. in sat. NaCl+Aq without pptn. If effloresced Na_2SO_4 is used, a ppt. of NaCl is caused at first, and subsequently of $Na_2SO_4+10H_2O$. (Karsten.)

Sol. in boiling sat. NaCl+Aq with pptn. of NaCl, but from cold solutions the Na_2SO_4 separates out first. (Vauquelin.)

Less sol. in NaCl+Aq than in H_2O. (Hunt, Am. J. Sci. (2) **25.** 368.)

Solubility in NaCl+Aq at t°.

t°	g. NaCl per 100 g. H_2O	g. Na_2SO_4 per 100 g. H_2O
10	0.00	9.14
	4.28	6.42
	9.60	4.76
	15.65	3.99
	21.82	3.97
	28.13	4.15
	30.11	4.34
	32.27	4.59
	33.76	4.75
21.5	0.00	21.33
	9.05	15.48
	17.48	13.73
	20.41	13.62
	26.01	15.05
	26.53	14.44
	27.74	13.39
	31.25	10.64
	31.80	10.28
	32.10	8.43
	33.69	4.73
	34.08	2.77
	35.46	0.00
25	0.00	28.74
	2.74	26.57
	8.15	23.15
	19.86	20.52
	24.58	14.86
	31.21	9.95
	32.02	9.61

Solubility in NaCl+Aq at t°—*Continued.*

t°	g. NaCl per 100 g. H_2O	g. Na_2SO_4 per 100 g. H_2O
27	0.00	31.10
	2.66	28.73
	5.29	27.17
	7.90	26.02
	16.13	24.83
	18.91	21.39
	19.64	20.11
	20.77	19.29
	32.33	9.53
30	0.00	39.70
	2.45	38.25
	5.61	36.50
	7.91	35.96
	10.61	31.64
	12.36	29.87
	15.65	25.02
	18.44	21.30
	20.66	19.06
	32.43	9.06
33	0.00	48.48
	1.22	46.49
	1.99	45.16
	2.64	44.09
	3.47	42.61
	12.14	29.32
	21.87	16.83
	32.84	8.76
	33.99	4.63
	34.77	2.75
35	0.00	47.94
	2.14	43.75
	13.57	26.26
	18.78	19.74
	31.91	8.28
	35.63	0.00

At 33° and above the values represent the solubility of Na_2SO_4 in NaCl+Aq. At 10° the solid phase in contact with the solution is probably Na_2SO_4, $7H_2O$. Between 17° and 33° the solid phase is either Na_2SO_4, $10H_2O$ or Na_2SO_4. An inversion of Na_2SO_4, $10H_2O$ to Na_2SO_4 takes place at various temp. below 33°, depending on the amount of NaCl contained in the solution in contact with the solid sodium sulphate.

(Seidell, Am. Ch. J. 1902, **27.** 55.)

Solubility in NaCl+Aq at 15°.

Composition of the sat. solution		Solid Phase
% by wt. Na_2SO_4	% by wt. NaCl	
11.5	0	$Na_2SO_4+10H_2O$
7.86	5.42	"
5.87	11.51	"
5.23	15.97	"
5.26	21.03	"
5.64	23.39	Na_2SO_4, $10H_2O$+NaCl
2.26	25.21	NaCl
0	26.3	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, **67.** 554.)

Sol. in sat. NH_4NO_3+Aq. (Margueritte, C. R. **38.** 307.)

Sol. in sat. KNO_3+Aq with pptn. after several hours. (Karsten.)

$Na_2SO_4+10H_2O$ is sol. in sat. $NaNO_3$+Aq without pptn., but if effloresced Na_2SO_4 is used, $NaNO_3$ is pptd. at first, and subsequently $Na_2SO_4+7H_2O$.

The presence of $CaSO_4$ does not affect the solubility of Na_2SO_4 in H_2O to any great extent. (Barre, A. ch. 1911, (8) **24.** 160.)

More sol. in K_2SO_4, $CuSO_4$, $MgSO_4$+Aq. than in H_2O. (Pfaff, A. **99.** 226.)

100 pts. H_2O dissolve 20.7 pts. $CuSO_4$ and 15.9 pts. Na_2SO_4. (Rüdorff, B. **6.** 484.)

Sol. in sat. $MgSO_4$, K_2SO_4, $CuSO_4$+Aq, but if more Na_2SO_4 than can be dissolved is added to the $CuSO_4$+Aq, a large quantity of a double sulphate separates out. (Karsten.)

The solubility of Na_2SO_4 in K_2SO_4+Aq has been determined at 15°, 25°, 40°, 50°, 60°, 70° and 80°. From the results the conclusion is drawn that sodium and potassium sulphates form a double salt of the formula $K_3Na(SO_4)_2$. (Okada, Chem. Soc. 1915, **108.** (2) 344.)

See also under $CuSO_4$, $MgSO_4$, and K_2SO_4.

Slowly but abundantly sol. in sat. $ZnSO_4$+Aq, with separation of a double salt after a few days.

Solubility of $ZnSO_4.7H_2O+Na_2SO_4.10H_2O$ in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4
0	40.305	7.905
5	42.285	9.515

(Koppel, Z. phys. Ch. 1905, **52.** 409.)

See also under $Na_2Zn(SO_4)_4+4H_2O$.

Solubility of $Na_2SO_4+Th(SO_4)_2$ at 16°. Solid phase $Th(SO_4)_2$.

Pts. per 100 pts. H_2O		Pts. per 100 pts. H_2O	
Na_2SO_4	$Th(SO_4)_2$	Na_2SO_4	$Th(SO_4)_2$
1.094	1.743	5.79	2.136
1.960	2.387	9.35	1.379
2.84	3.800	12.24	1.169
2.98	3.962	15.36	1.048
4.11	3.375	...	..

(Barre, C. R. 1911, **150.** 155.)

Solubility in Na acetate+Aq at 25°.

Solid phase, $Na_2SO_4+10H_2O$.

Composition of the solutions		
% Na acetate	% Na_2SO_4	% H_2O
0	21.9	78.10
4.10	17.72	78.18
7.71	16.48	75.81
12.58	13.50	73.92
16.26	11.50	72.24
20.63	8.10	71.27

(Fox, Chem. Soc. 1909, **95.** 888.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Alcohol precipitates $Na_2SO_4+10H_2O$ from the cold saturated aqueous solution. (Brandes and Firnhaber.)

Insol. in alcohol of from 0.817 to 0.90 sp. gr. (Kirwan.)

1000 pts. alcohol of 0.872 sp. gr. dissolve 0.7 pt. Na_2SO_4 at 12.5-15°; of 0.905 sp. gr. dissolve 3.8 pts. Na_2SO_4 at 12.5-15°.

Insol. in alcohol of 0.83-0.85 sp. gr. (Anthon.)

From supersaturated solution in alcohol, crystals with $7H_2O$ are formed. (Schiff, A. **106.** 11.)

100 pts. 10% alcohol at 15° contain 14.35 pts. $Na_2SO_4+10H_2O$; 20% alcohol at 15° contain 5.6 pts. $Na_2SO_4+10H_2O$; 40% alcohol at 15° contain 1.3% $Na_2SO_4+10H_2O$. (Schiff, A. **118.** 365.)

Very sl. sol. in abs. alcohol at ord. temp.; somewhat more, though still exceedingly sparingly, sol. in abs. alcohol acidulated with H_2SO_4. (Fresenius.)

Alcohol does not affect crystal H_2O of $Na_2SO_4+10H_2O$.

Solubility of Na_2SO_4 in alcohol+Aq at t°.

t°	% alcohol	g. per 100 g. solution			solid phase
		H_2O	alcohol	Na_2SO_4	
15	0.7	88.7	0.0	11.3	$Na_2SO_4+10H_2O$
	9.2	85.1	8.6	6.3	"
	19.4	78.6	18.9	2.9	"
	39.7	60.0	39.5	0.5	"
	58.9	41.1	58.8	0.1	"
	72.0	28.0	72.0	0.0	"
	0.0	72.8	0.0	27.2	$Na_2SO_4+7H_2O$
	11.2	76.5	9.5	14.0	"
	20.6	74.3	19.2	6.5	"
	30.2	68.4	29.6	2.0	"
25	0.0	78.1	0.0	21.9	$Na_2SO_4+10H_2O$
	10.6	78.5	9.3	12.2	"
	24.0	72.8	22.9	4.3	"
	54.0	45.6	54.0	0.4	"
36	0.0	67.0	0.0	33.0	Na_2SO_4
	8.8	70.0	6.8	22.6	"
	12.8	71.2	10.5	18.3	"
	17.9	71.1	15.5	13.4	"
	18.1	71.0	15.7	13.3	"
	28.9	66.5	28.4	5.1	"
	48.7	50.9	48.3	0.8	"
45	0.0	67.6	0.0	32.4	"
	9.0	71.3	7.1	21.6	"
	14.5	71.8	12.1	16.1	"
	20.6	70.6	18.4	10.0	"
	31.0	65.6	29.5	4.9	"

Between certain concentrations of alcohol, the liquid separates into two layers at 25°, 36° and 45°, of the following composition.

t°	Upper Layer			Lower Layer		
	g H_2O	g alcohol	g Na_2SO_4	g H_2O	g alcohol	g Na_2SO_4
25	66.5	27.3	6.2	67.4	5.1	27.5
	68.1	23.9	8.0	68.5	6.0	25.5
	68.3	23.1	8.6	68.3	6.7	25.0
36	...	...	...	66.6	4.1	29.3
	57.7	38.4	3.9	...	...	...
	65.0	28.3	6.7	68.8	5.9	25.3
	68.1	21.2	10.7	68.9	9.4	21.7
45	61.8	32.9	5.3	...	...	...
	65.8	25.3	8.9	68.4	8.8	22.8
	66.0	24.0	10.0	68.6	10.1	21.3

(de Bruyn, Z. phys. Ch. 1900, **32.** 101.)

Solubility in alcohol+Aq at 25°.

Composition of the sat. solution			Solid phase
% by wt. H_2O	% by wt. alcohol	% by wt. Na_2SO_4	
63.41	34.84	1.75	Na_2SO_4, $10H_2O$
49.0	50.5	0.5	"
46.6	53.0	0.4	Na_2SO_4, $10H_2O+Na_2SO_4$
34.9	64.95	0.15	Na_2SO_4

(Schreinemakers, Z. phys. Ch. 1909, **67.** 552.)

Solubility data for solution of NaCl in ethyl alcohol+Aq. at 15°, 25°, and 30° are given by Schreinemakers (Z. phys. Ch. 1909, **67.** 556).

Solubility in propyl alcohol+Aq at 20°.

% propyl alcohol	g. Na_2SO_4 per 100 g. solution	% propyl alcohol	g. Na_2SO_4 per 100 g. solution
42.20	1.99	56.57	0.55
49.77	1.15	60.64	0.44
55.65	0.72	62.81	0.38

(Linebarger, Am. Ch. J. 1892, **14.** 380.)

Sol. in glycerine.
Insol. in acetone. (Naumann, B. 1904 **37.** 4329; Eidmann, C. C. **1899.** II, 1014.); benzonitrile. (Naumann, B. 1914, **47.** 1370) methyl acetate. (Naumann, B. 1909, **42.** 7790); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

100 g. H_2O dissolve 183.7 g. sugar+30.5 g. Na_2SO_4 at 31.25°, or 100 g. sat. solution contain 52.2 g. sugar + 9.6 g. Na_2SO_4. (Köhler, Z. Ver. Zuckerind, 1897, **47.** 447.

Min. Anhydrous, *Thenardite.* $+10H_2O$, *Mirabilite.*

Sodium hydrogen sulphate, $NaHSO_4$.

Not deliquescent. Very sol. in H_2O with decomposition.

Sol. in 2 pts. H_2O at 0° (Link); 1 pt. H_2O at 100° (Schubarth). 100 pts. H_2O at 15.5° dissolve 92.72 pts. Sol. in 2 pts. H_2O at 18.75° (Abl); decomp. by alcohol.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829)

$+H_2O$. Deliquescent, and decomp. by the H_2O which it takes up.

$NaH_3(SO_4)_2$. Decomp. by H_2O. (Schultz.)

***Tri*sodium hydrogen sulphate, $Na_3H(SO_4)_2$.**

Sol. in H_2O with decomp.
$+H_2O$. (Rose.)

Sodium *pyro*sulphate, $Na_2S_2O_7$.

Sol. in fuming H_2SO_4 without decomp.

Sodium thallic sulphate, Na_2SO_4, $Tl_2(SO_4)_3$.

Sol. in H_2O. (Strecker, A. **135.** 207.)

Sodium thorium sulphate, Na_2SO_4, $Th(SO_4)_2$ $+6H_2O$.

Sol. in H_2O. 100 pts. cold sat. Na_2SO_4+Aq dissolve 4 pts. of this salt. (Cleve.)
See also under $Na_2SO_4+ThSO_4$.

Sodium titanium *sesqui*sulphate, $Na_2Ti_2(SO_4)_4$ $+5H_2O$.

Sol. in H_2O. (Spence, Chem. Soc. 1904, **86.** (2) 412.)
Insol. in alcohol. (Knecht, B. 1903, **36.** 169.)

Sodium titanyl sulphate, $Na_2TiO_2(SO_4)_2+10H_2O$.

Hygroscopic. (Mazzuchelli and Pantanelli, C. C. **1909,** II. 420.)

Sodium uranyl sulphate, $Na_2(UO_2)(SO_4)_2+3H_2O$.

(de Coninck, C. C. **1905,** I. 919.)

Sodium vanadium sulphate, $Na_2V_2(SO_4)_4+24H_2O$.

Very sol. in H_2O. (Piccini, Z. anorg. 1897, **13.** 444.)

Sodium vanadyl sulphate, Na_2SO_4, $VOSO_4+4H_2O$.

Easily sol. in H_2O and alcohol + conc. H_2SO_4. (Koppel, Z. anorg. 1903, **35.** 177.)

Na_2SO_4, $2VOSO_4+2\frac{1}{2}H_2O$. Slowly sol. in H_2O.

Can be cryst. from H_2SO_4 at 100°. (Koppel.)

Sodium yttrium sulphate, Na_2SO_4, $Y_2(SO_4)_3+2H_2O$.

Quite sol. in H_2O. (Cleve.)
The only double salt capable of existing at 25°. (James and Holden, J. Am. Chem. Soc. 1913, **35.** 562.)

Sodium zinc sulphate, Na_2SO_4, $ZnSO_4+4H_2O$.

Deliquescent in moist air.
Decomp. into constituents on dissolving in H_2O. (Graham, Phil. Mag. **18.** 417.)

Solubility of $Na_2Zn(SO_4)_2.+4H_2O$ in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4
25	26.32	23.40
30	26.475	23.445
35	26.365	23.525
40	26.68	23.63

(Koppel, Z. phys. Ch. 1905, **52.** 409.)

Solubility of $Na_2Zn(SO_4)_2.4H_2O+ZnSO_4.7H_2O$ in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4	t°	grams $ZnSO_4$	grams Na_2SO_4
10	45.79	11.24	25	56.155	7.215
15	48.81	10.175	30	60.55	6.34
20	52.34	8.625	35	65.25	5.64

(Koppel.)

Solubility of $Na_2Zn(SO_4)_2.4H_2O+ZnSO_4.6H_2O$ in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4
38	66.64	4.98
40	64.89	4.71

(Koppel.)

Solubility of $Na_2Zn(SO_4)_2.4H_2O+Na_2SO_4.10H_2O$ in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4
10	43.495	12.35
15	36.925	16.71
20	28.77	21.98
25	19.935	29.875
30	10.67	42.515

(Koppel.)

Solubility of $Na_2Zn(SO_4)_2.4H_2O+Na_2SO_4$ (anhydrous) in 100 g. H_2O at t°.

t°	grams $ZnSO_4$	grams Na_2SO_4
35	8.725	46.61
40	9.16	43.835

(Koppel.)

Sodium sulphate fluoride, Na_2SO_4, NaF.

Cryst. from H_2O without decomp. (Marignac, Ann. Min. (5) **15.** 236.)

Sodium sulphate antimony *tri*fluoride.

See **Antimony *tri*fluoride sodium sulphate.**

Strontium sulphate, $SrSO_4$.

Very sl. sol. in cold, and still less in boiling H_2O.

1 l. H_2O at 11–15° dissolves 0.066 g. $SrSO_4$ (Brandes and Silber); 0.145 g. $SrSO_4$ (Fresenius); 0.154–0.167 g. $SrSO_4$ (Marignac); 0.187 g. $SrSO_4$ (Kremers); 0.278 g. $SrSO_4$ (Andrews).

1 l. boiling H_2O dissolves 0.104 g. $SrSO_4$ (Fresenius); 0.282 g. $SrSO_4$ (Brandes and Silber).

When a Sr salt is precipitated by H_2SO_4, 1 pt. $SrSO_4$ remains dissolved in 700 pts. H_2O. (Marignac.)

Sol. in about 8000 pts. H_2O. (Schweitzer, J. B. **1877.** 1054.)

Calculated from electrical conductivity of the solution, $SrSO_4$ is sol. in 10,070 pts. H_2O at 16.1° and 10,090 pts. at 20.1°. (Holleman, Z. phys. Ch. **12.** 131.)

1 l. H_2O dissolves 107 mg. $SrSO_4$ at 18° and not much more at higher temp. (Kohlrausch and Rose, Z. phys. Ch. **12.** 241.)

100 g. H_2O dissol.e

at t°	0°–5°	10°–12°	20°	30°
g. $SrSO_4$	0.0983	0.0994	0.1479	1.0600
at t°	50°	80°	90°	95–98°
g. $SrSO_4$	0.1629	0.1688	0.1727	0.1789

(Wolfmann, C. C. **1897,** I. 632.)

1 l. H_2O dissolves 114 mg. $SrSO_4$ at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.); 114.3 mg at 18°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Sol. in 6895 pts. cold, and 9638 pts. boiling H_2O; in 11,000-12,000 pts. H_2O containing H_2SO_4; in 474 HCl+Aq containing 8.5% HCl; in 432 pts. HNO_3+Aq containing 4.8 % N_2O_5; in 7843 pts. $HC_2H_3O_2$+Aq containing 15.6% $HC_2H_3O_2$. (Fresenius.)

Or, 1 l. cold HCl+Aq of 8.5% dissolves 2.11 g. $SrSO_4$; 1 l. cold HNO_3+Aq of 4.8% N_2O_5 dissolves 2.31 g. $SrSO_4$; 1 l. cold $HC_2H_3O_2$+Aq of 15.6% $HC_2H_3O_2$ dissolves 0.1275 g. $SrSO_4$. (Fresenius.)

Solubility of $SrSO_4$ in HCl+Aq.

No. cc. HCl+Aq containing 1 mg. equiv. HCl	g. per 100 cc. solution	
	HCl	$SrSO_4$
0.2	18.23	0.161
0.5	7.29	0.207
1.0	3.65	0.188
2.0	1.82	0.126
10.0	0.36	0.048

(Banthisch, J. pr. 1884, (2) **29.** 54.)

Solubility of $SrSO_4$ in HNO_3+Aq.

No. cc. HNO_3+Aq containing 1 mg. equiv. HNO_3	g. per 100 cc. solution	
	HNO_3	$SrSO_4$
0.2	31.52	0.381
0.5	12.61	0.307
1.0	6.30	0.217
2.0	3.15	0.138
10.0	0.63	0.049

(Banthisch, J. pr. 1884, (2) **29.** 54.)

Sol. in conc. H_2SO_4. *See under* $SrH_2(SO_4)_2$.

Insol. in NH_4Cl+Aq or conc. $(NH_4)_2SO_4$+Aq. (Rose.)

Slowly but completely sol. in NaCl+Aq. (Wackenroder.)

H_2O containing Na_2SO_4 dissolves less $SrSO_4$.

than pure H_2O; H_2O containing H_2SO_4 still less. (Andrews, Phil. Mag. Ann. **7.** 406.)

Insol. in $Na_2S_2O_3$+Aq.

Insol. in boiling conc. $(NH_4)_2SO_4$+Aq. (Rose, Pogg. **110.** 292.)

Sol. in 16.949 pts. $(NH_4)_2SO_4$+Aq (1:4). (Fresenius, Z. anal. **32.** 195.)

Pptn. is hindered by alkali metaphosphates and citrates, but not by citric acid.

Decomp. at ord. temp., and more rapidly on boiling by alkali carbonates+Aq.

Sol. in $MgCl_2$ or KCl+Aq, solubility increasing with strength of solution; sol. in NaCl or $CaCl_2$+Aq, maximum solubility occurring when the solutions are of a medium concentration. The numerical results are as follows:

100 pts. of the salt solutions containing given pts. salt dissolve pts. $SrSO_4$.

Salt	Pts. salt	Pts. $SrSO_4$
NaCl	22.17	0.1811
	15.54	0.2186
	8.44	0.1653
KCl	18.08	0.2513
	12.54	0.1933
	8.22	0.1925
$MgCl_2$	13.63	0.2419
	4.03	0.2057
	1.59	0.1986
$CaCl_2$	33.70	0.1706
	16.51	0.1853
	8.67	0.1756

(Virck, C. C. **1862.** 402.)

Solubility in H_2O, and in solutions of the sulphates chlorides and nitrates of the alkalies and alkaline earths and in solutions of salts of the alkalies with strong organic acids has been determined. No data in abstract. (Wolfmann, Chem. Soc. 1898, (2) **74.** 220.)

Solubility in H_2O is considerably decreased by the presence of K_2SO_4. (Barre, A. ch. 1911, (8) **24.** 175.)

Solubility of $SrSO_4$ in $Ca(NO_3)_2$+Aq at ord. temp.

G. per 100 cc. sat. solution.

$Ca(NO_3)_2$	$SrSO_4$	$Ca(NO_3)_2$	$SrSO_4$
0.5	0.0483	4	0.1489
1	0.0619	5	0.1689
2	0.1081	6	0.1955
3	0.1275	....	....

(Raffo and Rossi, Gazz. ch. it. 1915, **45.** (1) 45.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

100 g. 95% formic acid dissolve 0.02 g. $SrSO_4$ at 18.5°. (Aschan, Chem. Ztg. 1913, **37.** 1117.)

Insol. in absolute alcohol; scarcely sol. in dil. alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Min. *Celestite.*

Strontium hydrogen sulphate, $SrH_2(SO_4)_2$.

100 pts. H_2SO_4 dissolve 2.2 pts. $SrSO_4$ (Lies-Bodart and Jacquemin); 100 pts. H_2SO_4 dissolve 5.68 pts. (Struve, Z. anal. **9.** 34); 100 pts. fuming H_2SO_4 dissolve 9.77 pts. (Struve).

1 g. $SrSO_4$ dissolves in 1256 g. 91% H_2SO_4+Aq (Varenne and Pauleau, C. R. **93.** 1016); boiling H_2SO_4 dissolves about 15% $SrSO_4$, and still more at 100°. (Schultz, Pogg. **133.** 147).

Sol. in 1519 pts. 91% H_2SO_4. (Varenne and Pauleau, C. R. **93.** 1016.)

100 pts. H_2SO_4 (sp. gr. 1.843) dissolve 14 pts. $SrSO_4$ at 70°. (Garside, C. N. **31.** 245.)

Decomp. by H_2O.

100 pts. hot conc. H_2SO_4 dissolve about 9.0 pts. $SrSO_4$. (Rohland, Z. anorg. 1910, **66.** 206.)

10 ccm. of sat. $SrSO_4$+absolute H_2SO_4 contain approx. 2.17 g. $SrSO_4$. (Bergius, Z. phys. Ch. 1910, **72.** 355.)

$+H_2O$. Decomp. by H_2O.

Strontium tin (stannic) sulphate, $SrSO_4$, $Sn(SO_4)_2+3H_2O$.

Decomp. by H_2O. Sol. in HCl. (Weinland and Kühl, Z. anorg. 1907, **54.** 249.)

Strontium titanium sulphate, $SrSO_4$, $Ti(SO_4)_2$.

Ppt; decomp. by H_2O giving titanic acid. (Weinland and Kühl, Z. anorg. 1907, **54.** 254.)

Tantalum sulphate, $3Ta_2O_5$, SO_3+9H_2O.

(Hermann, J. pr. **70.** 201.)

Tellurium sulphate, basic, TeO_2, SO_3.

Sol. in cold dil. H_2SO_4. Decomp. by hot H_2O. (Klein, C. R. **99.** 326.)

Terbium sulphate, $Tr_2(SO_4)_3+8H_2O$.

Sol. in H_2O.

Sol. in H_2O; pptd. by alcohol. (Urbain, C. R. 1908, **146.** 127.)

Thallous sulphate, Tl_2SO_4.

1 pt. dissolves at t° in pts. H_2O, according to C = Crookes; L = Lamy:

15°	18°	62°	100°	101.2°
21.1	20.8	8.7	5.4	5.22 pts. H_2O.
C	L	L	C	L

Solubility of Tl_2SO_4 in H_2O.

t°	% Tl_2SO_4	t°	% Tl_2SO_4
0	2.63	60	9.85
10	3.57	70	11.31
20	4.64	80	12.75
30	5.80	90	14.19
40	7.06	99.7*	15.57
50	8.44		

B.-pt. at 748 mm.
(Berkeley, Phil. Trans. Roy. Soc. 1904, **203.** A, 189; calc. by Landolt-Börnstein.)

100 g. H_2O dissolve 3.36 g. Tl_2SO_4 at 6.5°; 4.3 g. at 12°; 19.14 g. at 100°. (Tutton, Proc. Roy. Soc. 1907, **79.** A, 351.)

1 l. H_2O dissolves 0.1923 equivalents Tl_2SO_4 at 20°, or 48.59 g. in 1 l. of solution. (Noyes, J. Am. Chem. Soc. 1911, **33.** 1657.)

1 l. H_2O dissolves 0.1083 g. equiv. Tl_2SO_4 at 25°, or 27.28 g. in 1 l. of solution. (Noyes.)

Solubility in H_2SO_4+Aq at 25°.

Strength of H_2SO_4+Aq g. mols. per l.	g. mols. Tl_2SO_4 per l.
0.0494	0.1172
0.0987	0.1249

(Noyes, J. Am. Chem. Soc. 1911, **33.** 1662.)

1 l. $TlClO_3$+Aq. containing 0.1058 equivalents $TlClO_3$, dissolves 0.1366 equivalents Tl_2SO_4 at 20°. (Noyes.)
See also $TlClO_3$.

Solubility in salts+Aq at 25°.

g. mols. per l.	g. mols. per l. Tl_2SO_4 dissolved
0.0996 $TlNO_3$	0.08365
0.0497 Na_2SO_4	0.1080
0.1988 Na_2SO_4	0.1173
0.1010 $NaHSO_4$	0.1161

(Noyes.)

Thallous hydrogen sulphate, $TlHSO_4$.
Sl. hydroscopic.
Solubility in H_2SO_4+Aq at 25°.

1000 g. of the solution contain:

Mols. H_2SO_4	Mols. Tl_2SO_4
4.55	0.56
4.79	0.55
4.89	0.59
4.92	0.66
4.78	0.75
4.26	1.01
4.03	1.08

(D'Ans, Z. anorg. 1910, **65.** 232.)

Tl_2SO_4, $TlHSO_4$. Sol. in H_2O. (Stortenbecker, R. t. c. 1902, **21.** 90.)

Thallous ***pyro*****sulphate,** $Tl_2S_2O_7$.
Decomp. by H_2O (Weber, B. **17.** 2502.)

Thallous ***octo*****sulphate,** $Tl_2S_8O_{25}$.
Decomp. by H_2O (Weber, B. **17.** 2502.)

Thallic sulphate, basic, Tl_2O_3, $2SO_3+3H_2O$.
Sol. in H_2O.
$+5H_2O$ As above. (Willm, A ch. (4) **5.** 5.)

Thallic sulphate, $Tl_2(SO_4)_3+7H_2O$.
Decomp. by cold H_2O with separation of $TlO(OH)$. (Crookes.)

Thallothallic sulphate. $2Tl_2O$, $3Tl_2O_3$, $12SO_3$+$25H_2O$.
Gradually efflorescent. (Willm.)
$Tl_2(SO_4)_2$. (Lepsius, Chem. Ztg. **1890.** 1327.)
$TlH(SO_4)_2$. (Lepsius.)

Thallous uranyl sulphate, $Tl_2(UO_2)(SO_4)_2+3H_2O$.
Sl. sol. in cold H_2O.
Easily forms supersat. solutions. (Kohn, Z. anorg. 1908, **59.** 112.)

Thallium vanadium sulphate, $Tl_2V_2(SO_4)_4+24H_2O$.
100 pts. H_2O dissolve 11.06 pts. salt at 10°.
Sp. gr. of solution at 4°/20° = 2.342.
Very sol. in hot H_2O. (Piccini, Z. anorg. 1897, **13.** 446.)
256 g. anhydrous, or 433 g. hydrated salt, or 0.573 g. mols. of anhydrous salt are sol. in 1 l. H_2O at 25°.
Melts in crystal H_2O at 48°. (Locke, Am. Ch. J. 1901, **26.** 175.)

Thallous zinc sulphate, $Tl_2Zn(SO_4)_2+6H_2O$.
1 l. H_2O dissolves 86 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, **27.** 459.)

Thallothallic sulphate bromide, $Tl_2Br_2SO_4$.
Very sol. in cold H_2O. Decomp. by much H_2O. (Meyer and Goldschmidt, B. 1903, **36.** 242.)

Thorium sulphate, basic, $3[Th(SO_4)_2+2H_2O]$, $Th(SO_4)O+2H_2O$.
Insol. in H_2O; very slowly attacked by dil. acids. (Demarcay.)
$ThO(SO_4)+2H_2O$. Stable in aq. solution at 100°. (Hauser, B. 1910, **43.** 2776.)
$+5H_2O$. Somewhat sol. in hot conc. $MgSO_4$+Aq. (Halla, Z. anorg. 1912, **79.** 260.)

Thorium sulphate, $Th(SO_4)_2$.
Anhydrous. Easily sol. if brought into a large amount of H_2O, but very slowly sol. if only a little H_2O is added to the salt.

100 pts. H_2O dissolve about 4.86 pts. $Th(SO_4)_2$ at 0°. (Cleve.)

When heated, a hydrous salt separates out, which redissolves on cooling. (Cleve.)

Solubility of anhydrous salt cannot be determined, as it begins to separate out $Th(SO_4)_2+9H_2O$ before a saturated solution is reached. At 0°, 100 pts. H_2O dissolved 22.97 pts. $Th(SO_4)_2$ in 15 minutes; at 25°, 27.00 pts. $Th(SO_4)_2$ were dissolved in 5 minutes. (Roozeboom, Z. phys. Ch. **5.** 198.)

$+2H_2O$. Shows same behaviour as anhydrous salt. 100 pts. H_2O dissolved 35.50 pts. $Th(SO_4)_2$ from this salt at 1°, but this is not the maximum solubility. (Roozeboom.)

$+4H_2O$. Pptd. by alcohol from hot aqueous solution; also formed by heating $Th(SO_4)_2+9H_2O$ in aqueous solution above 60°.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+4H_2O$, calculated as $Th(SO_4)_2$, at t°. D=according to Demarcay (C. R. **96.** 1860); R=according to Roozeboom (Z. phys. Ch. **5.** 202).

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
17	9.41 D	50	2.54 R	70	1.09 R
35	4.50 D	55	1.94 D	75	1.32 D
40	4.04 R	60	1.634 R	95	0.71 D

$+6H_2O$. Behaves as the anhydrous salt, but action is much slower.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+6H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	1.50	45	3.85
15	1.63	60	6.64
30	2.45	..	...

(Roozeboom.)

This determination gives too low figures, especially at the higher temperatures. (Roozeboom.)

$+8H_2O$.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+8H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	1.00	25	1.85
15	1.38	44	3.71

(Roozeboom.)

100 g. $Th(SO_4)_2$+Aq sat. with $Th(SO_4)_2+8H_2O$ at 30° contain 2.152 g. anhydrous $Th(SO_4)_2$. (Koppel and Holzkampf, Z. anorg. 1910, **67.** 274.)

100 g. H_2O dissolve 1.722 g. at 25°. (Barre, Bull. Soc. 1912, (**4**). 11.)

$+9H_2O$. Pptd. by alcohol from cold aqueous solution. Sol. in about 88 pts. H_2O at 0°. (Cleve.) Extremely slowly sol. in H_2O.

100 pts. H_2O dissolve pts. $Th(SO_4)_2+9H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	0.88	30	1.85	50	4.86
10	1.02	40	2.83	55	6.5±
20	1.25	..	...	..	...

Above 55°, $Th(SO_4)_2+4H_2O$ separates out.
(Demarcay C. R. **96.** 1860, calculated by Roozeboom.)

100 pts. H_2O dissolve pts. $Th(SO_4)_2+9H_2O$, calculated as $Th(SO_4)_2$, at t°.

t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$	t°	Pts. $Th(SO_4)_2$
0	0.74	30	1.995	51	5.22
10	0.98	40	2.998	55	6.76
20	1.38	..	...	..	...

Above 60°, $Th(SO_4)_2+4H_2O$ separates out.
(Roozeboom, Z. phys. Ch. **5.** 201.)

For further data, see Roozeboom (Z.phys. Ch. **5.** 198), where there is a full discussion of the subject.

100 g. sat. solution of $Th(SO_4)_2+9H_2O$ in H_2O at 25° contain 1.593 g. anhyd. salt. (Wirth, Z. anorg. 1912, **76.** 174.)

Solubility of $Th(SO_4)_2$ in H_2SO_4+Aq at t°.

t°	% H_2SO_4	% $ThSO_4$	Solid phase
30	0.000	2.152	$Th(SO_4)_2+8H_2O$
	0.466	2.055	"
	0.72	2.085	"
	1.468	2.267	"
	2.983	2.311	"
	4.38	2.367	"
	4.97	2.323	"
	9.95	1.961	"
	15.03	1.484	"
	18.95	1.078	"
	23.64	0.7196	"
	32.68	0.3364	$Th(SO_4)_2+4H_2O$
	37.80	0.077	"
	43.28	0.0213	"
	45.69	0.0047	"
	74.0	0.1208	"
	80.5	0.000	"
20	5	1.722	$Th(SO_4)_2+8H_2O$
	15	0.9752	"
	25	0.3838	"
	40	0.0103	$Th(SO_4)_2+4H_2O$
Boiling temp.	5	0.7407	"
	10	0.4808	"
	15	0.3882	"

(Koppel and Holzkampf, Z. anorg. 1910, **67.** 274.)

Solubility in H_2SO_4+Aq at 25°.

Per 100 g. of solution	
g. $Th(SO_4)_2$	g. H_2SO_4
1.722	0.000
1.919	1.072
2.017	1.941
2.060	2.821
2.061	3.843
2.035	5.212
1.863	8.055
1.702	10.105

(Barre, Bull. Soc. 1912, (4) **11.** 647.)

Solubility in H_2SO_4+Aq at 25°.

Normality H_2SO_4	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	g. anhydrous sulphate	
0	1.015	1.593	$Th(SO_4)_2+9H_2O$
1.1	1.14	1.831	"
2.16	0.9265	1.488	"
4.32	0.545	0.8751	"
6.68	0.2685	0.4312	"
9.68	0.0651	0.1045	$Th(SO_4)_2+8H_2O$
10.89	0.0396	0.0636	"
15.15	0.0192	0.0308	$Th(SO_4)_2+4H_2O$

(Wirth, Z. anorg. 1912, **76.** 186.)

Solubility of $Th(SO_4)_2$ in HCl+Aq at 30°.

% HCl	% $Th(SO_4)_2$	Solid phase
0.0	2.15	$Th(SO_4)_2+8H_2O$
4.55	3.541	"
6.95	3.431±	"
12.14	2.811	"
15.71	2.360	"
18.33	2.199	"
20	2.13	$Th(SO_4)_2+4H_2O$
23.9	1.277	"

(Koppel and Holzkampf, Z. anorg. 1910, **67.** 274.)

Solubility of $Th(SO_4)_2$ in HNO_3+Aq at 30°.

% HNO_3	% $Th(SO_4)_2$	Solid phase
0.0	2.15	$Th(SO_4)_2+8H_2O$
5.17	3.68	"
10.04	4.20	"
16.68	4.84	"
21.99	4.47	"
28.33	3.96	"
28.51	3.88	"
33.17	3.34	$Th(SO_4)_2+4H_2O$
38.82	2.51	"

(Koppel and Holzkampf, Z. anorg. 1910, **67.** 274.)

The presence of phosphoric acid increases the solubility of thorium sulphate in HCl and HNO_3. (Koppel and Holzkampf, Z. anorg. 1910, **67.** 280.)

For solubility of $Th(SO_4)_2$ in $(NH_4)_2SO_4$, Li_2SO_4, and K_2SO_4, see respective sulphates.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Thorium hydrogen sulphate, $ThH_2(SO_4)_3$.

Hydroscopic.

Sol. in excess of hot H_2SO_4; insol. in cold H_2SO_4. (Brauner, Z. anorg. 1904, **38.** 333.)

Thulium sulphate, $Tm_2(SO_4)_3+8H_2O$.

Insol. in alcohol. (James, J. Am. Chem. Soc. 1911, **33.** 1343.)

Tin (stannic) sulphate, basic, $(SnO)SO_4+H_2O$.

Easily sol. in cold H_2O, but quickly decomp. with separation of stannic hydroxide. (Ditte, C. R. **104.** 178.)

$3SnO_2, SO_3$. Easily sol. in dil. acids. (Ditte, A. ch. 1882, (5) **27.** 159.)

$+1\frac{1}{2}H_2O$. Not decomp. by cold H_2O. (Ditte.)

Tin (stannous) sulphate, $SnSO_4$.

Sol. in 5.3 pts. H_2O at 19°, and 5.5 pts. at 100°. (Marignac.) Solution soon decomposes with separation of a basic salt. Sol. in H_2SO_4+Aq. (Bouquet.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Tin (stannic) sulphate, $Sn(SO_4)_2+2H_2O$.

Deliquescent. Easily sol. in H_2O; decomp. by much H_2O. Sol. in dil. H_2SO_4+Aq. Slowly sol. in HCl+Aq. Decomp. by absolute alcohol. (Ditte, C. R. **104.** 178.)

Titanium sulphate, $Ti(SO_4)_2+3H_2O$.

Deliquescent, and sol. in H_2O. The aqueous solution is decomp. on boiling. (Glatzel, B. **9.** 1833.)

Titanium *sesqui*sulphate, $Ti_2(SO_4)_3$.

Very deliquescent, and easily sol. in H_2O. Aqueous solution is decomp. by boiling. (Ebelmen.)

Insol. in H_2O, alcohol, ether and conc. H_2SO_4. Slowly sol. in dil. H_2SO_4 and HCl. (Stähler, B. 1905, **38.** 2624.)

Not sol. in alcohol. (Knecht, B. 1903, **36.** 169.)

$+8H_2O$. Sol. in H_2O. (Glatzel, B. **9.** 1833.)

Titanium hydrogen *sesqui*sulphate, $3Ti_2(SO_4)_3$, $H_2SO_4+25H_2O$.

Gradually sol. in H_2O.

Insol. in 60% H_2SO_4, alcohol, ether and glacial acetic acid. (Stähler, B. 1905, **38.** 2621.)

Titanyl sulphate, $(TiO)SO_4$.

Decomp. by H_2O. Slowly sol. in cold, rapidly in warm HCl+Aq. (Merz, J. pr. **99.** 157.)

$+2H_2O$. Sol. in H_2O. (Blondel, Bull. Soc. 1899, (3) **21.** 262.)

$2TiO_2, 3SO_3+3H_2O$. Sol. in H_2O acidified with HCl. (Blondel, Bull. Soc. 1899, (3) **21.** 262.)

$5TiO_2, SO_3+5H_2O$. (Blondel.)

$7TiO_2, 2SO_3+xH_2O$. (Blondel.)

$2TiO_2, SO_3+xH_2O$. (Blondel.)

Uranous sulphate, basic, $U(OH)_2SO_4+H_2O$.

Insol. in H_2O. H_2O dissolves out H_2SO_4. (Ebelmen, A. ch. (3) **5.** 217.)

$+5H_2O$. Sol. in alcohol.

Pptd. by ether. (Rosenheim, Z. anorg. 1901, **26.** 251.

Uranous sulphate, $U(SO_4)_2+4H_2O$.

Sol. in H_2O with immediate decomp. Easily sol. in dil. H_2SO_4+Aq. (Kohlschütter, B. 1901, **34.** 3629.)

Decomp. by H_2O into insol. basic, and sol. acid salt. Sol. in dil. H_2SO_4 or HCl+Aq. Difficultly sol. in conc. acids. (Ebelmen, A. ch. (3) **5.** 215.)

Solubility of $U(SO_4)_2+4H_2O$ in H_2O at t°.

t°	% $U(SO_4)_2$	t°	% $U(SO_4)_2$
29	9.8	48.2	8.1
37	8.3	63	7.3

(Giolitti and Bucci, Gazz. ch. it. 1905, **35.** (2) 162.)

1 pt. is sol. in 4.23 pts. H_2O at 13°; 4.3 pts. at 11.3°; 4.4 pts. at 9.1°. (de Coninck, A. ch. 1903, (7) **28.** 12.)

$+8H_2O$.

Solubility of $U(SO_4)_2+8H_2O$ in H_2O at t°.

t°	% $U(SO_4)_2$	t°	% $U(SO_4)_2$
18	10.17	48.2	28.72
25.6	13.32	62	36.8
37	19.98	93	63.2

(Giolitti and Bucci, Gazz. ch. it. 1905, **35.** (2) 162.)

Sp. gr. of $U(SO_4)_2$+Aq at t°.

t°	% salt	Sp. gr.
16	1	1.0058
16.8	2	1.0107
16	3	1.0165
17.8	4	1.0218
17.2	5	1.0272
18	6	1.0320
18.3	7	1.0379
17.4	8	1.0429
15.2	9	1.0485
15.6	10	1.0539

(de Coninck, A. ch. 1903, (7) **28.** 11.)

Solubility in acids+Aq.

1 pt. $U(SO_4)$ is sol. in pts. acid at t°.

t°	Acid	Concentration of acid	Pts. acid
9.7	HCl	1:4	5.74
9.2	"	"	5.8
11.2	HNO_3	1:4	5.4
10.3	"	"	5.53
11.4	H_2SeO_4 (sp. gr. 1.4)	1:4	4.57
10.7	"	"	4.66
15	HBr	1:4	4
14.2	"	"	4.23
15.5	$HC_2H_3O_2$	1:4.5	4.1
14.4	"	"	4.3
16.5	"	1:2	3.72
15.9	"	"	3.85
11.7	H_2SO_4	1:4	6.36
10.9	"	"	6.42
10.1	"	"	6.45
9	"	"	6.5

(de Coninck, Chem. Soc. 1902, **82.** (2) 459.

Sp. gr. of $U(SO_4)_2$+HCl(d=1.046) at t°.
d_1=Sp. gr. referred to H_2O.
d_2=Sp. gr. referred to HCl.

t°	% salt	d_1	d_2
16	1	1.0525	1.0063
17	2	1.0572	1.0109
18	3	1.0619	1.0154
18.4	4	1.0667	1.0199
17.6	5	1.0714	1.0243

(de Coninck, A. ch. 1903, (7) **28.** 11.)

Sp. gr. of $U(SO_4)_2+H_2SO_4$(d=1.14) at t°.
d_1=Sp. gr. referred to H_2O.
d_2=Sp. gr. referred to H_2SO_4.

t°	% salt	d_1	d_2
18.7	1	1.1442	1.0038
18.3	2	1.1494	1.0083
17.4	3	1.1539	1.0123
17.6	4	1.1583	1.0162
18.1	5	1.1626	1.0204

(de Coninck, A. ch. 1903, (7) **28.** 11.)

1 pt. is sol. in 8 pts. alcohol (94°)+Aq (1:4) at 10.4°. (de Coninck.)

Solubility in glycol at 14.8°=3.15%. (de Coninck, C. C. **1905,** II. 883.)

Min. *Johannite.* Sl. sol. in H_2O.

Uranous hydrogen sulphate, $U(SO_4)_2, H_2SO_4+10H_2O$.

(Giolitti, C. C. **1905,** II. 1226.)

Uranyl sulphate, basic, $3UO_3$, SO_3+2H_2O.
(Athanasesco.)
$+14H_2O$. Sol. in H_2O. (Ordway, Sill. Am. J. (2) **26.** 208.)
$4UO_3$, SO_3+7H_2O. (Athanasesco, C. R. **103.** 271.)
UO_2, $4UOSO_4+8H_2O$. Less sol. in min. acids, especially dil. H_2SO_4+Aq, than $UOSO_4+2H_2O$. (de Coninck, C. C. **1901,** II. 1038.)

Uranyl sulphate, $(UO_2)SO_4$.
$+H_2O$. (de Coninck.)
$+3H_2O$. Efflorescent. Very sol. in H_2O and alcohol.
1 pt. is sol. in 0.6 pt. cold H_2O, in 0.45 pt. boiling H_2O; in 25 pts. cold absolute alcohol; in 20 pts. boiling absolute alcohol (Bucholz.)
Sol. in 0.47 pt. H_2O at 21°, and 0.28 pt. boiling H_2O. (Ebelmen.)
100 pts. H_2O at 15.5° dissolve 160 pts., and at 100°, 220 pts. (Ure's Dict.)
1 pt. is sol. in 5.3 pts. H_2O at 13.2°; 5.16 pts. at 14.1°; 4.96 pts. at 15.1°; 4.88 pts. at 15.5°. (de Coninck, A. ch. 1903, (7) **28.** 8.)

Sp. gr. of $(UO_2)SO_4$+Aq at t°.

t°	% $(UO)_2SO_4$	Sp. gr.
14	1	1.0062
15.5	2	1.0113
11.3	3	1.0172
10.2	4	1.0229
10.2	5	1.0280
10	6	1.0338
14	7	1.0389
15.6	8	1.0442
11	9	1.0503
10 3	10	1.0557
11.4	11	1.0612
11.6	12	1.0669

(de Coninck, A. ch. 1903, (7) **28.** 7.)

Solubility in acids +Aq.
1 pt. $(UO_2)SO_4$ is sol. in:
3.4 pts. conc. HCl at 12.8°
3.25 " " " " 13.6°
5.9 " HBr(d=1.21) " 12.9°
6.1 " " " " 11.2°
10.8 " conc. HNO_3 " 12.3°
11.2 " " " " 10.8°
4.3 " H_2SO_4(d=1.38) " 12.7°
4.1 " " " " 14.0°
5.6 " aqua regia (equal vol. HCl+ HNO_3) at 15.4°
5.47 pts. aqua regia (equal vol. HCl+ HNO_3) at 16 4°.
3.7 pts. selenic acid (d=1.4) at 15.3°.

(de Coninck, A. ch. 1903, (7) **28.** 8.)

Sp. gr. of $(UO_2)SO_4+H_2SO_4$(d=1.168) at t°.
d_1=Sp. gr. referred to H_2O.
d_2=Sp. gr. referred to H_2SO_4.

t°	% salt	d_1	d_2
20 6	1	1.1738	1.0050
22.2	2	1.1775	1.0082
21.1	3	1.1880	1.0129
22.7	4	1.1872	1.0165
22.3	5	1.1918	1.0204

(de Coninck A. ch. 1903, (7) **28**, 7.)

1 pt is sol. in 37.9 pts. alcohol (85°) at 16.7°; 38.6 pts. at 15.8°. (de Coninck, A. ch. 1903, (7) **28.** 8.)
Very sl. sol. in formic and glacial acetic acids. (de Coninck, A. ch. 1903, (7) **28.** 9.)
Completely pptd. from $(UO_2)SO_4$+Aq by $UC_2H_3O_2$. (Persoz.)

Uranyl hydrogen sulphate, $(UO_2)SO_4$, H_2SO_4.
Very deliquescent. (Schultz-Sellack.)
$2(UO_2)SO_4$, $H_2SO_4+5H_2O$. Very deliquescent. (Wyrouboff, Bull. Soc. Min. 1909, **32.** 351.)

Uranyl *pyro*sulphate, $(UO_2)S_2O_7$.
Very deliquescent. Hisses with H_2O. (Schultz-Sellack.)

Uranouranyl sulphate, USO_4, $(UO_2)SO_4$.
Sol. in H_2O. (Ebelmen.) Decomp. by boiling. (Berzelius.)
Min. *Voglianite.*

Uranyl sulphate ammonia, $(UO_2)SO_4$, $2NH_3$.
(v. Unruh, Dissert. **1909.**)
$(UO_2)SO_4$, $3NH_3$. (v. Unruh.)
$(UO_2)SO_4$, $4NH_3$. (v. Unruh.)

Vanadous sulphate, V_2O_3, $4SO_3+9H_2O$.
Sol. in H_2O. (Brierley, Chem. Soc. **49.** 882.)

Vanadium sulphate, V_2O_5, $2SO_3=(VO_2)_2S_2O_7$.
Deliquescent. Easily sol. in H_2O.
V_2O_5, $3SO_3$. Deliquescent. Sol. in H_2O and alcohol.
$+3H_2O$. Deliquescent. Very sol. in H_2O, but decomp. by boiling. Sol. in alcohol. (Ditte, C. R. **102.** 757.)
VSO_4+7H_2O. Decomp. by air; very unstable; sol. in H_2O. (Piccini, Z. anorg. 1899, **19.** 204.)

Vanadium *sesqui*sulphate, $V_2(SO_4)_3$.
Anhydrous.
Insol. in H_2O.
Insol. in conc. H_2SO_4, but slowly sol. in boiling dil. H_2SO_4. Sol. in HCl.
Insol. in alcohol and ether. (Stähler, B. 1905, **38.** 3979.)

Vanadium hydrogen sulphate, $V_2(SO_4)_3$, $H_2SO_4+12H_2O$.

Sol. in H_2O.

Sol. in HCl. Insol. in 60% H_2SO_4+Aq, alcohol, ether and acetic acid. (Stähler, B. 1905, **38.** 3978.)

***Di*vanadyl sulphate,** $V_2O_2(SO_4)_2$.

Insol. in H_2O, HCl, or H_2SO_4+Aq, but on heating to 400° becomes sol. in H_2O if heated to 130° therewith. (Gerland.)

$+4H_2O$. Very slowly sol. in H_2O at 10°, quickly at 60°, and still more rapidly at 100°. Deliquesces in warm moist air more quickly than it dissolves in H_2O at 10°. Insol. in absolute alcohol. Very sol. in alcohol of 0.833 sp. gr. (Berzelius.)

$+5H_2O$. (Koppel and Behrendt, Z. anorg. 1903, **35.** 168.)

$+7H_2O$, and $10H_2O$.

$+13H_2O$. Efflorescent. (Gerland.)

$2V_2O_4$, $5SO_3+18H_2O$. (Gain, C. R. 1906, **143.** 1154.)

V_2O_4, $3SO_3+10H_2O$. (G.)

$2V_2O_4$, $7SO_3+20H_2O$. (G.)

$2V_2O_4$, $9SO_3+22H_2O$. (G.)

V_2O_4, $5SO_3+12H_2O$. (G.)

***Di*vanadyl hydrogen sulphate,** $(V_2O_2)H_2(SO_4)_3=V_2O_4$, $3SO_3+H_2O$.

$+2H_2O$.

$+3H_2O$. Deliquescent. Very slowly sol. in cold H_2O or alcohol. Easily sol. in hot H_2O. (Gerland.)

$+5H_2O$. Deliquescent. Insol. in ether. Scarcely sol. in alcohol. Slowly sol. in cold, easily in hot H_2O, (Crow.)

$+14H_2O$. Easily sol. in cold H_2O or dil. alcohol. (Gerland.)

$2VO_2$, $3SO_3$. Sl. sol. in H_2O. (Koppell and Behrendt, Z. anorg. 1903, **35.** 163.)

$2VOSO_4$, $H_2SO_4+H_2O$. Very slowly sol. in H_2O. (Koppel and Behrendt, Z. anorg. 1903, **35.** 163.)

$2VOSO_4$, $3H_2SO_4+15H_2O$. (Gain, C. R. 1906, **143.** 1156.)

$2VOSO_4$, $4H_2SO_4+16H_2O$. (G.)

$2VOSO_4$, $5H_2SO_4+15H_2O$. (G.)

$2VOSO_4$, $7H_2SO_4+15H_2O$. (G.)

$2VOSO_4$, $8H_2SO_4+16H_2O$. (G.)

Ytterbium sulphate, $Yb_2(SO_4)_3+8H_2O$.

Quite slowly sol. in H_2O even at 100°. Anhydrous salt is easily sol. in much H_2O, but if little H_2O is used the hydrous salt is formed, which only slowly dissolves. Sol. in K_2SO_4+Aq.

100 pts. H_2O dissolve at:

0°	15.5°	35°	55°	60°	
44.2	34.6	19.1	11.5	10.4	pts. $Yb_2(SO_4)_3$,
70°	80°	90°	100°		
7.22	6.93	5.83	4.67		pts. $Yb_2(SO_4)_3$.

(Cleve, Z. anorg. 1902, **32.** 143.)

Yttrium sulphate, basic, Y_2O_3, SO_3 = $(YO)_2SO_4$.

Insol. in H_2O. (Berzelius.)

$2Y_2O_3$, SO_3+10H_2O. (Cleve.)

Yttrium sulphate, $Y_2(SO_4)_3$.

Anhydrous. More sol. in H_2O than the hydrous salt, and more sol. in cold than hot H_2O. Solution sat. at 0° separates $Y_2(SO_4)_3+8H_2O$ at 50°. 100 pts. H_2O dissolve 15.2 pts. anhydrous salt. at ord. temp.

5.38 pts. are sol. in 100 pts. H_2O at 25°. (James and Holden, J. Am. Chem. Soc. 1913, **35.** 561.)

Easily sol. in large amount of sat. K_2SO_4+Aq, from which $3K_2SO_4$, $2Y(SO_4)_3$ is pptd. on warming. (Cleve and Höglund, Sv. V. A. H. Bih. 1. No. 8.)

Solubility of $Y_2(SO_4)_3$ in Na_2SO_4+Aq at 25°.

Pts. $Y_2(SO_4)_3$ per 100 pts. H_2O	Pts. Na_2SO_4 per 100 pts. H_2O	Solid phase
5.61	1.29	
6.38	3.85	
7.40	6.21	$Y_2(SO_4)_3$
8.43	8.53	
5.86	7.57	
4.75	7.72	
3.42	10.14	
2.36	11.36	
2.02	13.42	
1.90	14.89	
1.79	16.51	
1.86	18.44	$Y_2(SO_4)_3$, $Na_2SO_4+2H_2O$
2.99	19.96	
3.04	21.05	
2.27	27.14	
1.52	28.22	
1.61	28.13	
5.38	0.0	$Na_2SO_4+10H_2O$

(James and Holden, J. Am. Chem. Soc. 1913, **35.** 560.)

$+8H_2O$. 100 pts. H_2O dissolve 9.3 pts. of cryst. salt at ord. temp., and 4.8 pts. at 100°. (Cleve, Bull. Soc. (2) **21.** 344.)

Less sol. in H_2O containing H_2SO_4 than in pure H_2O. (Berzelius.)

Completely pptd. by $HC_2H_3O_2$+Aq. Insol. in alcohol.

Yttrium hydrogen sulphate, $Y_2(SO_4H)_3$.

(Brauner, Z. anorg. 1904, **38.** 332.)

Zinc sulphate, basic, $8ZnO$, SO_3+2H_2O.

Insol. in H_2O. (Schindler, Mag. Pharm. **31.** 181.)

$6ZnO$, SO_3+10H_2O. Insol. in H_2O. (Kane, A. ch. **72.** 310.)

$4ZnO$, SO_3+2H_2O. Scarcely sol. in hot or cold H_2O. Sol. in $ZnSO_4$+Aq. (Kühn, Schw. J. **60.** 337.)

$+3H_2O$. (Werner, B. 1907, **40.** 4443.)

$+5H_2O$. Nearly insol. in H_2O. (Habermann, M. **5.** 432.)

$+6H_2O$. (Kraut, Z. anorg. 1897, **15.** 5.)

$+7H_2O$. (Athanasesco, C. R. **103.** 271.)

$+8H_2O$. Extremely slowly decomp. by H_2O. (Reindel, J. pr. 1869, (1) **106** 373.)

$+10H_2O$. (Schindler.)

$3ZnO, SO_3$. Insol. in cold. sl. sol. in hot H_2O. (Vogel.)

$2ZnO, SO_3$. (Athanasesco.)

$5ZnO, SO_3$. (Pickering, Chem. Soc. 1907, **91.** 1986.)

$+4H_2O$. (Moody, Am. J. Sci. 1906, [4] **22.** 184.)

$9ZnO, 2SO_3+12H_2O$. (Reindel, J. pr. 1869, (1) **106.** 374.)

Zinc sulphate, $ZnSO_4$.

Sol. in H_2O with evolution of heat.

Sol. in $HCl+Aq$.

$+H_2O$. (Étard.)

$+2H_2O$. Insol. in alcohol. (Kühn.)

$+3\frac{1}{2}H_2O$. (Anthon.)

$+5H_2O$. Insol. in boiling alcohol of 0.86 sp. gr. (Kühn.)

$+6H_2O$. (Marignac.)

$+7H_2O$. Slowly efflorescent.

M.-pt. of $ZnSO_4+7H_2O=50°$. (Tilden, Chem. Soc. **45.** 409.)

For solubility data on hydrated salts, see below.

Sol. in 2+ pts. H_2O at ord. temp., and in less at 100°. (Bergmann.)

100 pts. H_2O at 104.4° dissolve 81.81 pts. $ZnSO_4$. (Griffiths.)

100 pts. H_2O at ord. temp. dissolve 140 pts. $ZnSO_4+7H_2O$. (Dumas.)

Sol. in 2.29 pts. H_2O at 18.75°. (Abl.)

100 pts. H_2O at 15.56° dissolve 140 pts. $ZnSO_4+7H_2O$. Ure's Dict.)

100 pts. H_2O at 15° dissolve 140.53 pts. $ZnSO_4+7H_2O$, and has sp. gr. =1.4442. (Michel and Krafft.)

1 pt. of the crystals dissolves in 0.923 pt. H_2O at 17.5°, and forms a solution of 1.4353 sp. gr. (Karsten.)

100 pts. $ZnSO_4+Aq$ sat. at 18-20° contain 35.36 pts. $ZnSO_4$. (v. Hauer, J. B. **1866.** 59.)

100 pts. H_2O dissolve at:

0°	20°	50°	75
41.3	53.0	66.9	80.4 pts. $ZnSO_4$.

(Tobler, J. B. **1855.** 309.)

100 pts. H_2O at 20.5° dissolve 163.2 pts. $ZnSO_4+7H_2O$. (Schiff, A. **109.** 336.)

100 pts. H_2O at t° dissolve pts. anhydrous $ZnSO_4$, and pts. $ZnSO_4+7H_2O$.

t°	Pts. $ZnSO_4$	Pts. $ZnSO_4+7H_2O$	t°	Pts. $ZnSO_4$	Pts. $ZnSO_4+7H_2O$
0	43.02	115.22	60	74.20	313.48
10	48.36	138.21	70	79.25	369.36
20	53.13	161.49	80	84.60	442.62
30	58.40	190.90	90	89.78	533.02
40	63.52	224.05	100	95.03	653.59
50	68.75	263.84	...	...	...

(Poggiale, A. ch. (3) **8.** 467.)

Solubility of $ZnSO_4$ in 100 pts. H_2O at t°.

t°	Pts. $ZnSO_4$	t°	Pts. $ZnSO_4$	t°	Pts. $ZnSO_4$
0	44.0	14	52.8	27	62.1
1	44.6	15	53.5	28	62.8
2	45.2	16	54.2	29	63.6
3	45.8	17	54.9	30	64.3
4	46.4	18	55.6	31	65.1
5	47.0	19	56.3	32	65.8
6	47.6	20	57.0	33	66.6
7	48.3	21	57.7	34	67.3
8	48.9	22	58.4	35	68.1
9	49.5	23	59.2	36	78.8
10	50.2	24	59.9	37	69.3
11	50.8	25	60.7	38	70.4
12	51.5	26	61.4	39	71.2
13	52.2	..	...	.	...

Decomp. into basic salt above 40°.

(Mulder, Scheik. Verhandel. **1864.** 74.)

If solubility S represents number of pts. anhydrous salt in 100 pts. of solution, $S=27.6+0.2604t$ from −5° to +81°; $S=50.0-0.2244t$ from 81° to 175°. (Étard, C. R. **106.** 207.)

Sat. $ZnSO_4+Aq$ contains at:

1°	13°	20°	41°	49°	
29.1	32.6	34.8	40.2	40.9% $ZnSO_4$,	
55°	62°	70°	77°	100°	
43.4	45.0	47.0	46.5	44.7% $ZnSO_4$,	
111°	12.°	137°	144°	169°	171°
43.0	40.7	38.0	37.4	30.0	29.0% $ZnSO_4$.

(Étard, A. ch. 1894, (7) **2.** 551.)

Transition point from $+6H_2O$ to $+1H_2O$ is 70°. (Étard.)

Solubility of $ZnSO_4+6H_2O$ in H_2O at t°.

t°	g. $ZnSO_4$ in 100 g. H_2O
−5.0	47.08
+0.1	49.48
9.1	54.20
15.0	57.15
25.0	63.74
30.0	65.82
35.0	67.99
39.0	70.08

(Cohen, Z. phys. Ch. 1900, **34.** 182.)

Solubility of the hepta-and hexa-hydrates of $ZnSO_4$ at t°.

p = wt. of salt expressed in percent of solution.

t°	p
0	29.43
0	29.53
0	29.49
15.00	33.66
15.88	33.85
30.70	38.46
39.92	41.36
39.95	41.37
40.73	41.43
41.49	41.70
46.40	42.68
49.97	43.51
49.99	43.41
50.00	43.50
50.02	43.51

Transition point from $+7H_2O$ to $+6H_2O$ is 39°.

The formula representing the change of solubility between 0° and 39° is

$$p = 29.5 + 0.270t + 0.00068t^2$$

while the expression for the hexahydrate above 40° is

$$p = 41.35 + 0.210t + 0.00070t^2.$$

(Barnes, J. phys. Chem. 1900, **4.** 19.)

Solubility of $ZnSO_4+7H_2O$ in H_2O at t°.

t°	g. $ZnSO_4$ in 100 g. H_2O
—5	39.30
+0.1	41.93
9.1	47.09
15.0	50.88
25.0	57.90
35.0	66.61
39.0	70.05

(Cohen, Z. phys. Ch. 1900, **34.** 182.)

Solubility in H_2O at high pressures:

Pressure in atm.	t°	g. $ZnSO_4$ in 100 g. H_2O	Solubility at 25°
1	26	57.95	57.95
500	26	58.43	57.92
500	25.8	58.32	57.91
1000	25.8	57.95	57.55
1000	25.8	57.95	57.55

(Cohen and Sinnige, Z. phys. Ch. 1909, **67.** 444.)

Liable to form supersaturated solutions.

Sat. $ZnSO_4$+Aq at 8° has sp. gr. = 1.421. (Anthon.)

Sp. gr. of $ZnSO_4+7H_2O$ at 20.5°.

% = % $ZnSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0057	21	1.1288	41	1.2754
2	1.0115	22	1.1355	42	1.2834
3	1.0173	23	1.1423	43	1.2917
4	1.0231	24	1.1491	44	1.3000
5	1.0289	25	1.1560	45	1.3083
6	1.0348	26	1.1629	46	1.3167
7	1.0407	27	1.1699	47	1.3252
8	1.0467	28	1.1770	48	1.3338
9	1.0527	29	1.1842	49	1.3424
10	1.0588	30	1.1914	50	1.3511
11	1.0649	31	1.1987	51	1.3599
12	1.0710	32	1.2060	52	1.3688
13	1.0772	33	1.2134	53	1.3779
14	1.0835	34	1.2209	54	1.3871
15	1.0899	35	1.2285	55	1.3964
16	1.0962	36	1.2362	56	1.4057
17	1.1026	37	1.2439	57	1.4151
18	1.1091	38	1.2517	58	1.4246
19	1.1156	39	1.2595	59	1.4342
20	1.1222	40	1.2674	60	1.4439

(Schiff, A. **110.** 72.)

Sp. gr. of $ZnSO_4$+Aq at 15°.

% = % $ZnSO_4+7H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.006	21	1.130	41	1.280
2	1.013	22	1.137	42	1.288
3	1.019	23	1.143	43	1.295
4	1.024	24	1.150	44	1.304
5	1.0288	25	1.1574	45	1.3100
6	1.035	26	1.164	46	1.320
7	1.041	27	1.171	47	1.330
8	1.047	28	1.179	48	1.337
9	1.053	29	1.185	49	1.346
10	1.0593	30	1.1933	50	1.3532
11	1.066	31	1.200	51	1.362
12	1.073	32	1.209	52	1.380
13	1.079	33	1.216	53	1.370
14	1.085	34	1.224	54	1.390
15	1.0905	35	1.231	55	1.3986
16	1.097	36	1.240	56	1.408
17	1.103	37	1.246	57	1.416
18	1.110	38	1.255	58	1.425
19	1.116	39	1.263	59	1.435
20	1.1236	40	1.2709	60	1.4451

(Gerlach, Z. anal. **8.** 288.)

Sp. gr. of $ZnSO_4$+Aq at 23.5°. a = no. of g., equivalent to ½ mol. wt., dissolved in 1000 g. H_2O; b = sp. gr. if a is $ZnSO_4$+$7H_2O$, ½ mol. wt. = 143.5; c = sp. gr. if a is $ZnSO_4$, ½ mol. wt. = 80.5.

a	b	c	a	b
1	1.077	1.084	7	1.368
2	1.143	1.162	8	1.400
3	1.199	1.236	9	1.428
4	1.249	1.307	10	1.453
5	1.294	1.376	11	1.476
6	1.333	1.443	.	..

(Favre and Valson, C. R. **79.** 968.)

Sp. gr. of $ZnSO_4$+Aq at 18°.

% $ZnSO_4$	Sp. gr.	% $ZnSO_4$	Sp. gr.	% $ZnSO_4$	Sp. gr.
5	1.0509	15	1.1675	32	1.3045
10	1.1369	20	1.2313	50	1.3788

(Kohlrausch, W. Ann. **1879.** 1.)

Sp. gr. of $ZnSO_4$+Aq at room temp. containing:

7.12	16.64	23.09%	$ZnSO_4$.
1.1064	1.1953	1.2814	

(Wagner, W. Ann. 1883, **18.** 271.)

Sp. gr. of $ZnSO_4$+Aq at 19.5°.

Mass of salt per unit mass of solution	Density of solution. (g. per cc.)
0.00186	1.00179
0.00371	1.00356
0.00556	1.00530
0.00740	1.00711
0.01106	1.01065
0.01469	1.01410
0.01829	1.01753
0.02187	1.02112
0.02542	1.02446
0.02895	1.02798

(McGregor, C. N. 1887, **55.** 4.)

Sp. gr. of $ZnSO_4$+Aq at 25°.

Concentration of $ZnSO_4$ +Aq	Sp. gr.
1—normal	1.0792
1/2— "	1.0402
1/4— "	1.0198
1/8— "	1.0094
1/16— "	1.0047

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of $ZnSO_4$+Aq.

g. salt in 100 g. solution	Sp. gr.
24.7170	1.3152
21.4444	1.2665
17.7573	1.2145
14.0307	1.1645
9.7426	1.1106
5.1110	1.0565

(Charpy, A. ch. 1893, (6) **29.** 27.)

Sp. gr. of $ZnSO_4$+Aq.

g. equivalents $ZnSO_4$ per liter	t°	Sp. gr. t°/t°
0.001309	15.59	1.0001126
0.002616	13.575	1.0002258
0.005212	13.573	1.0004451
0.01039	13.585	1.000886
0.09818	13.621	1.008189
0.18842	13.642	1.015587
0.1890	16.11	1.01550
2.493	15.88	1.19385

(Kohlrausch and Hallwachs, W. Ann. 1894, **53.** 27.)

Sp. gr. of $ZnSO_4$+Aq at 18.5°, when p = percent strength of solution; d = observed density; and w = volume conc. in grams per cc. $\left(\frac{pd}{100}=w\right)$

p	d	w
29.22	1.3718	0.40057
25.14	1.3091	0.32910
21.28	1.2528	0.26659
17.08	1.1957	0.20422
11.20	1.1220	0.12567
8.44	1.0894	0.09195
6.65	1.0696	0.07112
3.82	1.0387	0.03968
3.18	1.0318	0.03281
1.46	1.0138	0.01480
0.577	1.0045	0.00580

(Barnes, J. phys. Chem. 1898, **2.** 542.)

Sp. gr. of dil. $ZnSO_4$+Aq at 20.004°.
Conc. = g. equiv. per l. at 20.004°.
Sp. gr. compared with H_2O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,008,6
0.0002	1.000,017,2
0.0005	1.000,043,2
0.0010	1.000,086,3
0.0020	1.000,172,3
0.0050	1.000,429,1
0.0060	1.000,514,3
1.0100	1.000,853,9

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35.** 1690.)

Sat. $ZnSO_4$+Aq boils at 104.4°, and solution contains 45 pts. $ZnSO_4$ to 100 pts. H_2O. (Griffiths.)

Crust forms at 103.5°, the solution containing 68 pts. $ZnSO_4$ to 100 pts. H_2O. Highest temp. observed, 105°. (Gerlach, Z. anal. **26.** 426.)

B.-pt. of $ZnSO_4$+Aq containing pts. $ZnSO_4$ to 100 pts. H_2O.

B.-pt.	Pts. $ZnSO_4$	B.-pt.	Pts. $ZnSO_4$
100.5°	13.1	103.0°	61.0
101.0	25.0	103.5	68.0
101.5	37.7	104.0	74.9
102.0	45.4	104.5	80.7
102.5	53.9	105.0	85.7

(Gerlach, Z. anal. **26** 432.)

B.-pt. of $ZnSO_4$+Aq.

g. $ZnSO_4$ in 100 g. H_2O	Rise of the b.-pt.	Barometric pressure mm.
2.886	0.080	743.0
6.647	0.169	"
10.139	0.266	"
13.389	0.372	"
17.713	0.461	"
22.202	0.591	"
25.199	0.690	"
28.249	0.811	"
30.470	0.899	742.0
32.89	0.995	"
35.18	1.122	"
37.36	1.240	"
39.83	1.381	"
41.30	1.459	"
44.56	1.671	"

(Kahlenberg, J. phys. Chem. 1901, **5.** 370.)

1 l. absolute H_2SO_4 dissolves 0.0021 mols. $ZnSO_4$ at 25°. (Bergius, Z. phys. Ch. 1912, **72.** 353.)

Completely pptd. from $ZnSO_4$+Aq by $HC_2H_3O_2$. (Persoz.)

Solubility of $ZnSO_4$ in KOH+Aq.

Mols. KOH to 1 mol. $ZnSO_4$	per cent ZnO in ppt.
0.25	17.11
0.50	35.10
1.00	68.08
1.62	100.00
2.00	98.49
3.00	96.79
5.00	89.76
7.00	68.87
13.20	0.00

(Linebarger, J. Am. Chem. Soc. 1895, **17.** 360.)

Difficultly and slowly sol. in sat. NH_4Cl+Aq, with separation of a double sulphate.

Sol. in considerable quantity in sat. NaCl +Aq, without pptn. at first, but finally Na_2SO_4 separates out. *See under* NaCl.

Sol. in sat. $NaNO_3$+Aq as in NaCl+Aq. *See under* $NaNO_3$.

Sol. in sat. KNO_3+Aq with immediate pptn. of double sulphate. (Karsten.) *See under* KNO_3.

Very rapidly sol. in sat. K_2SO_4+Aq, with separation of a double salt. (Karsten.) *See under* K_2SO_4.

Abundantly. in sat. $CuSO_4$+Aq.

Slowly sol. in sat. $MgSO_4$+Aq.

Very rapidly and abundantly sol. in sat. $NaSO_4$+Aq.

For solubility of $ZnSO_4+Na_2SO_4$ *see under* Na_2SO_4 and $Na_2Zn(SO_4)_2+4H_2O$.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Insol. in alcohol of 0.88 sp. gr. ; 1000 pts. alcohol of 0.905 sp. gr. dissolve 2 pts. (Anthon.)

100 pts. of a saturated solution in 40% alcohol contain 3.48 pts. $ZnSO_4+7H_2O$; 20%, 39 pts.; 10%, 51.1 pts. (Schiff, J. B. **1861.** 87.)

100 pts. absolute methyl alcohol dissolve 0.65 pt. $ZnSO_4$ at 18°. (de Bruyn, Z. phys. Ch. **10.** 783.)

100 pts. absolute methyl alcohol dissolve 59 pts. $ZnSO_4+7H_2O$ at 17°.

100 pts. 50% methyl alcohol dissolve 15.7 pts. $ZnSO_4+7H_2O$ at 17°. (de Bruyn.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

100 pts. glycerine dissolve 35 pts. $ZnSO_4$ at ord. temp. (Klever, Bull. Soc. 1872, (2) **18.** 372.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Min. *Gosslarite.*

Zinc hydrogen sulphate, $ZnH_2(SO_4)_2+8H_2O$.

Somewhat difficultly sol. in cold, easily in hot H_2O. (v. Kobell, J. pr. **28.** 492.)

Zinc sulphate ammonia, basic, $4NH_3$, $4ZnO$, SO_3+4H_2O.

Ppt. (Schindler.)

Zinc sulphate ammonia, $ZnSO_4$, $2NH_3$.

$+H_2O$. Decomp. by H_2O into basic zinc sulphate.

$ZnSO_4$, $4NH_3+4H_2O$. Sol. in H_2O. (Kane, A. ch. **72.** 304.)

$+3H_2O$. (André, C. R. **100.** 241.)

$ZnSO_4$, $5NH_3$. Sol. in H_2O with partial decomp. (Rose, Pogg. **20.** 149.)

Zinc sulphate cupric oxide, $ZnSO_4$, $2CuO+5H_2O$.

(Mailhe, A. ch. 1902, (7) **27.** 169.)

$ZnSO_4$, $3CuO+xH_2O$. (Recoura, C. R. 1901, **132.** 1415.)

+$5H_2O$.

$2ZnSO_4$, $3CuO+12H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 169.)

$7ZnSO_4$, $24CuO+xH_2O$. (Recoura, C. R. 1901, **132.** 1415.)

Zinc sulphate hydrazine, $ZnSO_4$, $2N_2H_4$.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 278.)

Sol. in NH_4OH+Aq without decomp. (Curtius, J. pr. 1894, (2) **50.** 345.)

$ZnH_2(SO_4)_2$, N_2H_4. 1 pt. is sol. in 185 pts. H_2O at 12°. Sl. sol. in dil. acids. Decomp. by conc. HNO_3 and by hot conc. H_2SO_4. Very sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 331.)

Zirconium sulphate, basic, $3ZrO_2$, $2SO_3$.

Insol. in H_2O. Sol. in HCl+Aq. (Paykull, B. **12.** 1719.)

$4ZrO_2$, $3SO_3+14H_2O$. Ppt. Difficulty sol. in H_2O. (Hauser, B. 1904, **37.** 2024.)

$3ZrO_2$, SO_3. Insol. in boiling H_2O. (Franz, B. **3.** 58.)

$7ZrO_2$, $6SO_3$. Insol. in H_2O. (Endemann, J. pr. (2) **11.** 219.)

ZrO_2, SO_3. Sol. in very little H_2O. More H_2O decomp. into $3ZrO_2$, $2SO_3$ and $Zr(SO_4)_2$. (Berzelius.)

$3ZrO_2$, $4SO_3+15H_2O$. Sol. in H_2O. (Paykull.)

$6ZrO_2$, $7SO_3+19H_2O$. Sol. in H_2O. (Paykull.)

Zirconium sulphate, $Zr(SO_4)_2$.

Anhydrous. Slowly but completely sol. in cold, quickly in hot H_2O.

Sol. in warm H_2SO_4, but separates on cooling. Precipitated from aqueous solution by alcohol.

+$4H_2O$. Easily sol. in H_2O.

100 pts. of the solution contain 59.3 pts. of the hydrated salt at 39.5°. (Hauser, B. 1904, **37.** 2025.

Solubility of $Zr(SO_4)_2+4H_2O$ in H_2SO_4+Aq at t°.

100 g. of the solution contain:

t°	g. ZrO_2	g. SO_3
39.5	19.5	25.46
	19.3	25.6
	19.6	25.99
	19.3	26.5
	18.8	27.0
	18.15	27.6
	17.3	25.3
	16.2	29.1
	9.6	32.3
	5.3	34.7
	3.51	36.01
	1.03	38.2
	0.46	39.8
	0.31	42.0
	0.33	42.1
	0.14	46.8
	0.13	47.1
	0.15	56.7
	0.20	56.8
	0.27	57.1
	0.50	57.5
	0.60	57.8
	2.00	59.5
	3.25	60.4
	4.40	61.4
22	0.10	56.1
	0.13	46.5
	0.21	57.2

(Hauser, Z. anorg. 1907, **54.** 197.)

Zirconium hydrogen sulphate, $Zr(SO_4)_2$, $H_2SO_4+H_2O$.

Solubility in H_2SO_4+Aq. at 39.5°.

100 g. of the solution contain:

0.11	0.10	0.10	g. ZrO_2
81.4	81.6	81.5	g. SO_3.

(Hauser, Z. anorg. 1907, **54.** 200.)

+$3H_2O$.

Solubility in H_2SO_4+Aq at t°.

100 g. of the solution contain:

t°	g. ZrO_2	g. SO_3
39.5	4.55	61.5
	3.25	62.5
	3.33	63.8
	3.35	63.8
	1.80	64.2
	1.60	64.6
	1.55	65.0
	1.12	66.8
	0.96	68.4
22	0.80	66.4
	0.65	67.5
	0.60	68.1

(Hauser, Z. anorg. 1907, **54.** 200.)

***Per*sulphuric acid, HSO_4**

See **Persulphuric acid.**

***Pyro*sulphuric acid *and pyro*sulphates.**

See under **Sulphuric acid** *and* **sulphates.**

Sulphuric boric acid.

See **Borosulphuric acid.**

Sulphuric vanadic acid, V_2O_5, $3SO_3+3HO_2$.

See **Sulphate, vanadium.**

Sulphurous acid, anhydrous, SO_2.

See **Sulphur *di*oxide.**

Sulphurous acid, H_2SO_3.

Known only in aqueous solution, from which SO_2 is given off upon heating. Crystallizes in cold, with various amounts of water, forming compounds which approximate $H_2SO_3+8H_2O$ (Pierre, A. **68.** 228); $H_2SO_3+10H_2O$ (Döpping, Bull. Ac. St. Pétersb. **7.** 100); $H_2SO_3+14H_2O$ (Schönfeld, A. **95.** 22); $H_2SO_3+6H_2O$ (Roozeboom, R. t. c. **3.** 29, 59, 75, 84; Geuther, A. **224.** 218). Crystals are sol. in 2 pts. H_2O at 10°. (Pierre.)

For sp. gr. of solutions, etc., see sulphur *di*oxide.

Sulphites.

Normal. Only the alkali sulphites are sol. in H_2O, and they are insol. or only sl. sol. in alcohol.

Insol. in liquid NH_3. (Franklin, Am. ch. J. 1898, **20.** 824.)

Acid. All the acid sulphites are sol. in H_2O. In general it is rarely possible to determine whether the compd. described is a pure chemical compound or not. It is probable that many substances described by Svenssen and others are isomorphic mixtures whose composition depends upon the temp. and conc. of the solution in which it was pptd. (Rosenheim, Z. anorg. 1900, **25.** 72.)

Aluminum sulphite, basic, Al_2O_3, SO_2+4H_2O.

Insol. in H_2O; sol. in H_2SO_3+Aq. (Fourcroy and Vauquelin.)

$6Al(OH)_3,Al_2(SO_3)_3+9H_2O$. Ppt. (Seubert, Z. anorg. 1893, **4.** 66.)

Ammonium sulphite, basic, $(NH_4)_2SO_3, NH_3 +{}^3/_2H_2O$.

Sol. in H_2O. Pptd. from aqueous solution by alcohol. (Muspratt.)

Does not exist. (Marignac.)

Ammonium sulphite, $(NH_4)_2SO_3$.

Very hydroscopic. (Divers, Chem. Soc. 1900, **77.** 336.)

Insol. in acetone. (Eidmann, C.C. **1899,** II. 1014.)

$+H_2O$. Slowly sol. in H_2O. (Muspratt, A. **50.** 268.)

Sol. in 1 pt. H_2O at 12°. (Fourcroy and Vauquelin, Crell. Ann. **1800. 2.** 415.)

More sol. in hot H_2O with evolution of NH_3. Sl. sol. in absolute alcohol. (Muspratt.)

Much more sol. in alcohol than K_2SO_3. (Pierre.)

Loses NH_3 in the air.

Sol. in H_2O. Conc. solution charged with NH_3 will deposit salt on evaporation over KOH. Dil. solution decomp. on evaporation. (Divers, Chem. Soc. 1900, **77.** 335.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Ammonium hydrogen sulphite, NH_4HSO_3.

Insol. in acetone. (Eidmann, C.C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329.)

Ammonium *pyro*sulphite, $(NH_4)_2S_2O_5$.

Deliquescent. Very sol. in H_2O and alcohol. Insol. in ether. (Fock and Klüss, B. **23.** 3149.)

Very sol. in H_2O; very hydroscopic. Aq. solution is sl. decomp. on evaporation. (Divers, Chem. Soc. 1900, **77.** 336.)

Ammonium cadmium sulphite, $(NH_4)_2SO_3, CdSO_3$.

Nearly insol. in H_2O. Partly sol. in excess of H_2SO_3+Aq, but separates out on boiling. (Schuler, A. **87.** 34.)

Ammonium cobaltous sulphite, $(NH_4)_2SO_3, CoSO_3+xH_2O$.

Decomp. on air. (Berglund, B. **7.** 469.)

Ammonium cobaltocobaltic sulphite.

See **Cobaltisulphite, ammonium cobalt.**

Ammonium cuprous sulphite, $(NH_4)_2SO_3, 2Cu_2SO_3+2H_2O$.

(Böttinger, A. **51.** 411.)

$(NH_4)_2SO_3, Cu_2SO_3$. Insol. in cold, decomp. by boiling H_2O. (Rogojski, J. B. **1851.** 366.)

Decomp. by warming with H_2O, in which it is insol. Sol. in acids with evolution of SO_2. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 99.)

$+2H_2O$. (Commaille, J. B. **1867.** 300.)

$2(NH_4)_2SO_3, Cu_2SO_3+3H_2O$. Very sol. in H_2O. Solution decomp. on standing. Decomp. by acids. (Rosenheim and Steinhäuser.)

$5(NH_4)_2SO_3, Cu_2SO_3+2H_2O$. Decomp. on air. Sol. in H_2O with decomp. (Svensson.)

$6(NH_4)_2SO_3, Cu_2SO_3+4H_2O$. Easily decomp. (Rosenheim and Steinhäuser.)

$7(NH_4)_2SO_3, Cu_2SO_3+4H_2O$. Very sol. in H_2O. Solution soon decomp. (Rosenheim and Steinhäuser.)

$+10H_2O$. Decomp. on air. Sl. sol. in warm, less sol. in cold H_2O. (de Saint-Gilles.)

$+14H_2O$. Decomp. on air. Sol. in H_2O, but solution decomp.

Very easily sol. in mother liquor. (Svensson, Acta Lund. **1899.** 13.)

Ammonium cuprocupric sulphite, $(NH_4)_2SO_3, 2Cu_2SO_3,CuSO_3+5H_2O$.

Insol. in H_2O and weak acids. Sol. in NH_4OH+Aq. (de Saint-Gilles, A. ch. (3) **42.** 31.)

$+6½H_2O$. Ppt. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 98.)

Ammonium glucinum sulphite, $(NH_4)_2O, 2GlO, 3SO_2+4H_2O$.

Ppt. Very unstable in the air. (Rosenheim, Z. anorg. 1897, **15.** 310.)

Ammonium gold (aurous) sulphite, $3(NH_4)_2SO_3, Au_2SO_3$.

Very easily sol. in H_2O. Insol. in alcohol. (Haase, Z. Ch. **1869.** 535.)

Ammonium gold (aurous) sulphite ammonia, $(NH_4)_2SO_3, 3Au_2SO_3, 6NH_3+H_2O$.

Decomp. by H_2O. Sol. in warm NH_4OH+Aq, but decomp. by boiling.

$(NH_4)Au_3(SO_3)_2, 3NH_3+4H_2O$. Decomp. by H_2O. (Rosenheim, Z. anorg. 1908, **59.** 201.)

Ammonium iridium sulphite.

See **Iridosulphite, ammonium.**

Ammonium iron (ferrous) sulphite, $(NH_4)_2SO_3, FeSO_3+xH_2O$.

(Berglund.)

Ammonium iron (ferric) sulphite sulphate, $FeSO_3SO_4NH_4+H_2O$.

Sl. sol. in cold H_2O. Decomp. by cold dil. HCl. (Hofmann, Z. anorg. 1897, **14.** 287.)

Ammonium magnesium sulphite, $(NH_4)_2Mg_3(SO_3)_4+18H_2O$.

Very sl. sol. in H_2O. (Fourcroy and Vauquelin.)

Sol. in H_2SO_3+Aq.

$+5H_2O$. Much more sol. in H_2O than $MgSO_3$. (Rammelsberg.)

Ammonium manganous sulphite, $(NH_4)_2SO_3, MnSO_3$.

Relatively easily decomp. by H_2O. (Berglund, Bull. Soc. (2) **21.** 213.)

Not easily decomp. (Gorgeu, C. R. **96.** 376.)

Ammonium mercuric sulphite, $(NH_4)_2SO_3, HgSO_3$.

Very easily sol. in H_2O, but H_2O solution gradually decomp., even in the cold.

Ammonium nickel sulphite, $(NH_4)_2SO_3, 3NiSO_3+18H_2O$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium platinous sulphite.

See **Platosulphite, ammonium.**

Ammonium potassium sulphite, $10(NH_4)_2SO_3, K_2SO_3+11H_2O$.

Decomp. by H_2O, etc. (Hartog, C. R. **109.** 221.)

Ammonium scandium sulphate, $(NH_4)_2SO_3, Sc_2(SO_3)_3+7H_2O$.

Insol. in H_2O. Difficulty sol. in H_2SO_3+Aq. (Meyer, Z. anorg. 1914, **86.** 281.)

Ammonium silver sulphite, $(NH_4)_2SO_3, Ag_2SO_3$.

Insol. in H_2O, but gradually decomp. thereby. (Svensson, B. **4.** 714.)

$6(NH_4)_2SO_3, Ag_2SO_3+19H_2O$. Sol. in H_2O without decomp. (Svensson.)

$3(NH_4)_2SO_3, 4NH_4HSO_3, Ag_2SO_3+18H_2O$. Easily sol. in H_2O, but decomp. by warming.

Ammonium sodium hydrogen sulphite, $NH_4Na_2H(SO_3)_2+4H_2O$.

Not deliquescent (Marignac, Ann. Min. (5) **12.** 29.)

100 pts. H_2O dissolve 42.3 pts. salt at 12.4°, and 48.5 pts. at 15°. (Schwicker, B. **22.** 1732.)

$+5H_2O = 2Na_2SO_3, (NH_4)_2S_2O_5+H_2O$. (Tauber, Techn. J. B. **1888.** 444.)

Ammonium tellurium sulphite, $(NH_4)_2SO_3, TeSO_3+xH_2O$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium uranyl sulphite, $NH_4(UO_2)(OH)SO_3$.

Insol. in pure H_2O. More sol. in H_2SO_3+Aq than the K salt, and less than the Na salt. (Scheller, A. **144.** 240.)

$(NH_4)_2O, 2UO_3, 3SO_2$.

$(NH_4)_2O, 4UO_3, 5SO_2$.

$(NH_4)_2O, 3UO_3, 2SO_2$.

$(NH_4)_2O, UO_3, 2SO_2$. (Kohlschütter, A. 1900, **311.** 10.)

Ammonium vanadium sulphite.

See **Vanadiosulphite, ammonium.**

Ammonium vanadyl sulphite, $(NH_4)_2SO_3, VOSO_3+2H_2O$.

Sol. in H_2O with decomp. (Koppel, Z. anorg. 1903, **35.** 184.)

$(NH_4)_2O, 3VO_2, 2SO_2+H_2O$. Sol. in cold H_2O without decomp.

Easily sol. in mineral acids and alkalies.

Sl. sol. in alcohol and ether. (Koppel Z. anorg. 1903, **35.** 182.)

Ammonium zinc sulphite, $(NH_4)_2SO_3, ZnSO_3$.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Ammonium sulphite mercuric chloride, $2(NH_4)_2SO_3, HgCl_2$.

Sl. sol. in cold, decomp. by boiling H_2O. (de St-Giles, A. ch. (3) **36.** 95.)

Antimony sulphite, $Sb_2O_3, 3SO_2(?)$.

Insol. in H_2O. (Berzelius.)

Could not be obtained. (Röhrig, J. pr. (2) **37.** 241.)

Barium sulphite, $BaSO_3$.

Very sl. sol. in H_2O. (Fourcroy and Vauquelin, A. ch. **24.** 301.)

Sol. in about 46,000 pts. H_2O at 16°. (Autenrieth, Z. anal. 1898, **37.** 294.)

Sol. in H_2SO_3+Aq.

Insol. in acetone. (Naumann. B. 1904, **37.** 4329); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Solubility in sugar+Aq at t°.

Solvent	t°	100 ccm. of solution contain g. $BaSO_3$
water	20	0.01974
sucrose+Aq 10° Brix		0.01040
" " 20° "		0.00968
" " 30° "		0.00782
" " 40° "		0.00484
" " 50° "		0.00298
(sat.)" " 60° "		0.00223
water	80	0.00177
sucrose+Aq 10° Brix		0.00335
" " 20° "		0.00289
" " 30° "		0.00223
" " 40° "		0.00158
" " 50° "		0.00149
(sat.)" " 60° "		0.00112

(Rogowicz, C. C. **1905,** II. 1223.)

Barium cobaltic sulphite.

See **Cobaltisulphate, barium.**

Barium gold (aurous) sulphite, $3BaSO_3$, $Au_2SO_3+xH_2O$.

Ppt. (Haase.)

Barium mercuric sulphite, $BaSO_3$, $HgSO_3+H_2O$.

Ppt. (Barth, Z. phys. Ch. **9.** 196.)

Barium mercuric sulphite chloride, $BaSO_3$, $BaCl_2$, $2HgSO_3+3\frac{1}{2}H_2O$.

(Barth, Z. phys. Ch. 1892, **9.** 208.)

Bismuth sulphite, basic, Bi_2O_3, $3SO_2+5H_2O$.

Insol. in H_2O, alcohol, or ether. Sl. sol. in H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 241.)

$(BiO)_2SO_3$, $3(BiOH)SO_3+H_2O$. (Seubert and Elten, Z. anorg. 1893, **4.** 72–5.)

$2(BiO)_2SO_3$, $3(BiOH)SO_3+2H_2O$. (S. and E.)

$3(BiO)_2SO_3$, $7(BiOH)SO_3+10H_2O$. (S. and E.)

$4(BiO)_2SO_3$, $(BiOH)SO_3+5H_2O$. (S. and E.)

$9(BiO)_2SO_3$, $(BiOH)SO_3+2H_2O$. (S. and E.)

Bismuth cobaltic sulphite.

See **Cobaltisulphite, bismuth.**

Cadmium sulphite, $CdSO_3$.

Difficultly sol. in H_2O. Easily sol. in dil. acids. (Rammelsberg, Pogg. **67.** 256.)

$+2H_2O$. Difficultly sol. in H_2O. Sol. in H_2SO_3+Aq. Sol. in NH_4OH+Aq. Insol. in alcohol. (Muspratt, Phil. Mag. (3) **30.** 414.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Contains $2\frac{1}{2}H_2O$. (Deniges, Bull. Soc. (3) **7.** 569.)

Cadmium sodium sulphite, $3CdSO_3$, Na_2SO_3.

Sol. in H_2O. (Berglund, B. **7.** 469.)

Cadmium sulphite, ammonia, $CdSO_3$, NH_3.

Decomp. by H_2O. Sol. without decomp. in hot NH_4OH+Aq. (Rammelsberg, Pogg. **67.** 256.)

Cæsium sulphite, Cs_2SO_3.

Easily sol. in H_2O. Sl. sol. in alcohol. (Chabrié, C. R. 1901, **133.** 297.)

Cæsium hydrogen sulphite, $CsHSO_3$.

Easily sol. in H_2O. Sl. sol. in alcohol. (Chabrié, C. R. 1901, **133.** 297.)

Calcium sulphite, basic, $Ca_6S_5O_{16}=6CaO$, $5SO_2$.

(Schott, Dingl. **202.** 52.)

Calcium sulphite, $CaSO_3+2H_2O$.

Slowly effloresces. Sol. in 800 pts. cold H_2O. (Berzelius.)

Insol. in H_2O. (Röhrig, J. pr. (2) **37.** 230.)

0.043 g. is sol. in 1 l. H_2O at 18°. (Weisberg, Bull. Soc. 1896, (3) **15.** 1249.)

$CaSO_3$ equiv. to 78 mg. CaO is sol. in 1 l. H_2O at 100°. (Robart, C. A. **1913.** 2500.)

Very sol. in H_2SO_3+Aq. *See* $CaH_2(SO_3)_2$.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 827.)

$CaSO_3$ equiv. to 37 mg. CaO is sol. in 1 l. 12% cane sugar+Aq at 100°. (Robart, C. A. **1913.** 2500.)

0.0825 g. is sol. in 1 l. 10% sugar +Aq. at 18°; 0.0800 g. is sol. in 1 l. 30% sugar +Aq. at 18°. (Weisberg, Bull. Soc. 1896, (3) **15.** 1249.)

Insol. in acetone. (Krug and M'Elroy.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790; ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

$+\frac{1}{2}H_2O$. (Rammelsberg.)

Calcium hydrogen sulphite, $CaH_2(SO_3)_2$.

Know only in solution.

100 ccm. H_2O containing 9 g. SO_2 dissolve 0.553 g. $CaSO_3$ to form a solution of 1.06 sp. gr. (Gerland, J. pr. (2) **4.** 119.)

Calcium cobaltic sulphite.

See **Cobaltisulphite, calcium.**

Cerous sulphite, $Ce_2(SO_3)_3+3H_2O$.

More sol. in cold than hot H_2O.

Solution gradually decomposes. (Berthier, A. ch. (3) **7.** 77.)

Chromous sulphite, $CrSO_3$.

Precipitate. Insol. in H_2O. (Moberg.)

Chromium sulphite, basic, Cr_2O_3, SO_2.

Colloidal modification. Sol. in H_2O.

$2Cr_2O_3$, SO_2. Ppt. (Recoura, Bull. Soc. 1898, (3) **19.** 169.)

Chromic sulphite.

Known only in aqueous solution, which precipitates a basic salt on boiling.

$2Cr_2O_3$, $3SO_2+16H_2O$. Precipitate. (Danson, Chem. Soc. **2.** 205.)

Chromic potassium sulphite, K_2O, Cr_2O_3, $2SO_2+xH_2O$.

Precipitate. (Berglund, B. **7.** 470.)

Cobaltous sulphite, basic.

Ppt. Decomp. by H_2O. (Berthier.)

$Co(OH)_2$, $5CoSO_3+10H_2O$. Ppt. (Seubert and Elten, Z. anorg. 1893, **4.** 89.)

$Co(OH)_2$, $10CoSO_3+15H_2O$. (Seubert and Elten.)

Cobaltous sulphite, $CoSO_3$.

$+3H_2O$. Nearly insol. in H_2O. Sol. in H_2SO_3+Aq. (Rammelsberg.)

Partly sol. in NH_4OH+Aq.

$+5H_2O$. Insol. in H_2O. Sol. in H_2SO_3+Aq. (Muspratt, A. **30.** 282.)

Cobaltocobaltic sulphite.

See **Cobaltisulphite, cobaltous.**

Cobaltic sulphite *with* $3M_2SO_3$.

See **Cobaltisulphite, M.**

Cobaltous potassium sulphite, $CoSO_3$, $K_2SO_3+xH_2O$.

Insol. in H_2O; easily sol. in HCl+Aq. (Schultze, J. B. **1864.** 270.)

Cobaltic potassium sulphite, $Co_2(SO_3)_3$, K_2SO_3.

Sl. sol. in H_2O; easily sol. in H_2SO_3+Aq or HCl+Aq. (Schultze.)

Cobaltous sodium sulphite, $3CoO$, Na_2O, $3SO_2$.

Insol. in H_2O. Easily sol. in HCl+Aq. (Schultze.)

Cobaltic sodium sulphite, Co_2O_3, Na_2O, $3SO_2$.

Sl. sol. in H_2O. (Schultze.)

Cuprous sulphite, $Cu_2SO_3+H_2O$.

(*a*) *Red.* Sl. sol. in H_2O. Sol. in NH_4OH or HCl+Aq. (Rogojski, J. B. **1851.** **366.**)

Could not be obtained by St. Gilles or Svensson (B. **4.** 713).

Insol. in H_2O, alcohol, or ether. (Étard, C. R. **95.** 38.)

Composition is $(Cu_2)_8H_{16}(SO_4)_8$, "Cuprous isosulphite," according to Étard.

$+\frac{1}{2}H_2O$. Étard's formula, $Cu_2SO_3+H_2O$ is incorrect.

The salt is almost colorless. (Ramberg Z. phys. Ch. 1909, **69.** 512.)

(*β*) *White. Normal salt.* Insol. in H_2O, alcohol, or ether. (Étard.)

Cupric sulphite, basic, $4CuO$, SO_2+7H_2O.

Insol. in H_2O, and decomp. by washing therewith. (Millon and Commaille.)

$7CuO$, $4SO_2+8H_2O$. Sol. in dil. H_2SO_4. (Seubert and Elten, Z. anorg. 1893, **4.** 48.)

$3CuO$, $2SO_2+1\frac{1}{2}H_2O$. Sl sol. in H_2O. (Newbury, Am. Ch. J. **14.** 232.)

$7CuO$, $4SO_2+8H_2O$, or $4CuSO_3$, $3Cu(OH)_2+5H_2O$. Sol. in dil. H_2SO_4+Aq. (Seubert and Elten, Z. anorg. 1893, **4.** 50.)

Cuprocupric sulphite, $CuSO_3$, $Cu_2SO_3+2H_2O$.

Nearly insol. in cold H_2O. Decomp. by boiling.

Sol. in H_2SO_3+Aq, HCl, or NH_4OH+Aq. (Berthier.)

Sol. in very dil. HNO_3+Aq. (Döpping, J. B. **1851.** 365.)

Insol. in H_2SO_3, $HC_2H_3O_2$, or Cu salts+Aq. (de St. Gilles.)

$+5H_2O$. Insol. in H_2O. Easily sol. in H_2SO_3+Aq, $HC_2H_3O_2$+Aq, in cupric salts +Aq, NH_4OH+Aq, or HCl+Aq. (de St. Gilles, A. ch. (3) **42.** 34.)

Composition is $(Cu^I_2)Cu^{II}_{10}H_{10}(SO_4)_8+21H_2O$, "acid cuprosocupric *octo*sulphite." (Étard, C. R. **96.** 1475.)

Cuprous ferroferric sodium sulphite, Cu_2O, $2FeO$, Fe_2O_3, Na_2O, $6SO_2+16H_2O$.

Sol. in about 1000 pts. H_2O.

Sol. in cold dil. H_2SO_4+Aq; sol. in cold dil. HCl+Aq with a residue of Cu_2Cl_2. (Stromeyer, A. **109.** 237.)

Cuprous lithium sulphite, Cu_2SO_3, $Li_2SO_3+2H_2O$.

Insol. in H_2O, but gradually decomp. thereby. (Étard, C. R. **95.** 138.)

Cupric mercuric sulphite, $CuSO_3$, $HgSO_3$.

Sol. in H_2O in all proportions, but decomp. on boiling.

Cuprous potassium sulphite, Cu_2SO_3, K_2SO_3 (?).

(Vohl, J. pr. **95.** 219.)

$+2H_2O$. Sol. in H_2O with **decomp.**

(Rosenheim and Steinhäuser, Z. anorg. 1890, **25.** 96.)

Cu_2SO_3, $2K_2SO_3$. (Chevreul, Graham, etc.)

Does not exist. (Svensson.)

Cu_2O, $3K_2O$, $6SO_2+7H_2O=4KHSO_3$, K_2SO_3, $Cu_2SO_3+5H_2O$. Decomp. by H_2O. (Svensson, B. **4.** 713.)

Could not be obtained. (Rosenheim and Steinhäuser.)

Cu_2O, $4K_2O$, $8SO_2+3H_2O=6KHSO_3$, K_2SO_3, Cu_2SO_3. Decomp. by H_2O. (Svensson.)

Could not be obtained. (Rosenheim and Steinhäuser.)

Cu_2SO_3, $8K_2SO_3+16H_2O$. Sol. in H_2O with decomp. (Rammelsberg, Pogg. **57.** 391.)

Does not exist, according to Svensson.

Cuprocupric potassium sulphite, $3Cu_2SO_3$, $3CuSO_3$, K_2SO_3.

Properties as cuprous potassium sulphite. (Rogojski, J. B. **1851.** 367.)

$2Cu_2SO_3$, $CuSO_3$, $K_2SO_3+5H_2O$. Insol. in H_2O and weak acids. (de St-Gilles.)

Cu_2SO_3, $4CuSO_3$, $K_2SO_3+16H_2O$. Decomp. by H_2O. (Rosenheim and Steinhäuser.

Cuprous sodium sulphite, Cu_2SO_3, Na_2SO_3. $+2H_2O$. Decomp. by H_2O. (Svensson, **1870.**)

$+11H_2O$. Insol. in cold H_2O, but decomp. by excess. (Étard, C. R. **95.** 138.)

$2Cu_2SO_3$, $3Na_2SO_3+29H_2O$. Insol. in H_2O. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 94.)

Cu_2SO_3, $5Na_2SO_3+38H_2O$. Decomp. by H_2O. (Svensson.)

Cu_2SO_3, $7Na_2SO_3+19H_2O$. Completely sol. in H_2O, but solutions decomp. on standing. (Svensson.)

"Cuprous sodium *octo*sulphite," $(Cu_2)_3H_{10}Na_{16}S_8O_{32}+43H_2O$. (Étard.)

$5Cu_2SO_3$, $2Na_2SO_3+30H_2O$. Easily decomp. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 94.)

Cuprocupric sodium sulphite, Cu_2SO_3, $2CuSO_3$, $2Na_2SO_3+6H_2O$.

Nearly insol. in cold, decomp. by hot H_2O. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 95.)

$+8H_2O$. Decomp. by H_2O. (Rosenheim and Steinhäuser.)

Cuprocupric sodium hydrogen sulphite, $Na_8Cu^{II}_{10}(Cu^I_2)H_2(SO_4)_8,6H_4(SO_4)+5H_2O$.

Insol. in H_2O. (Étard, C. R. **94.** 1422.)

$(Cu^I_2)Cu^{II}_2Na_8H_{18}(SO_4)_8$. (Étard.)

Copper sodium sulphites.

Doubtless many of the compds. described in this class are in reality isomorphic mixtures whose composition depends upon the temp. and conc. of the solution in which pptd. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 92–95.)

Didymium sulphite, $Di_2(SO_3)_3+3H_2O$, or $6H_2O$.

Precipitate. Insol. in H_2O. Sol. in H_2SO_3 +Aq, from which it is reprecipitated by heating, redissolving on cooling. (Marignac, A. ch. (3) **38.** 167.)

Erbium sulphite, $Er_2(SO_3)_3+3H_2O$.

Precipitate.

Glucinum sulphite, basic, $2GlSO_3$, $9Gl(OH)_2$ $+6H_2O$.

Ppt. (Seubert, Z. anorg. 1893, 4. 52.)

$GlSO_3$, GlO. Decomp. by H_2O or alcohol. (K. and M.)

$3GlSO_3$, GlO. Sol. in alcohol. (K. and M.)

Glucinum sulphite, $GlSO_3$.

Decomp. by H_2O or alcohol. (Krüss and Moraht, B. **23.** 734.)

Glucinum potassium sulphite, $2GlSO_3$, $K_2SO_3+9H_2O$.

Unstable in the air. (Rosenheim, Z. anorg. 1897, **15.** 310.)

Gold (aurous) potassium sulphite, Au_2SO_3, $3K_2SO_3$.

Very sol. in H_2O; insol. in alcohol. (Haase.)

Gold (auric) potassium sulphite, Au_2O_3, $5K_2O$, $8SO_2+5H_2O=5K_2SO_3$, $Au_2(SO_3)_3$ $+5H_2O$.

Sol. in H_2O with decomp.

Decomp. by acids; insol. in alkalies. (Fremy, A. **79.** 46.)

Gold (auric) potassium sulphite, $Au_2(SO_3)_3$, $5K_2SO_3+10H_2O$.

(Rosenheim and Hertzmann, Z. anorg. 1908, **59.** 199.)

Gold (auric) potassium sulphite ammonia, $Au_2(SO_3)_3$, $3K_2SO_3$, $4NH_3+4H_2O$.

As the corresponding NH_4 salt. (Rosenheim and Hertzmann, Z. anorg. 1908, **59.** 202.)

Gold (aurous) sodium sulphite, Au_2SO_3, $3Na_2SO_3+3H_2O$.

Sol. in less than 1 pt. H_2O. Insol. in alcohol (Hasse.)

$+5H_2O$. (Himly.)

Gold (auric) sodium sulphite, $Au_2(SO_3)_3$, $5Na_2SO_3+28H_2O$.

As K salt. (Rosenheim and Hertzmann, anorg. 1908, **59.** 199.)

Gold (aurous) sulphite ammonia, $3Au_2O$, $4SO_2$, $8NH_3+4H_2O$.

Sl. sol. in H_2O with decomp. Decomp. by acids.

Sl. sol. in cold, more easily in hot NH_4OH+Aq. Decomp. by boiling. (Hasse, Zeit. Ch. **1869.** 535.)

Gold (auric) sulphite ammonia, $Au_2(SO_3)_2$, $4NH_3+4H_2O$.

Ppt. Decomp. in moist air and in neutral solution (Herzmann, Z. anorg. 1908, **59.** 198.)

Indium sulphite, $2In_2O_3$, $3SO_2+8H_2O$.

Insol. in H_2O. (Bayer, A. **158.** 372.)

Iridium sulphite, $Ir_2(SO_3)_3+6H_2O$.

Scarcely sol. in H_2O; easily sol. $HCl+Aq$. (Birnbaum, A. **136.** 179.)

Iridyl sulphite, $(IrO)SO_3+4H_2O$.

Insol. in H_2O. Sol. in HCl or H_2SO_4+Aq. (Birnbaum.)

Iridous potassium sulphite, IrO, $3K_2O$, $5SO_2(?)$.

Sl. sol. in H_2O, more sol. in $KOH+Aq$. Easily sol. in $HCl+Aq$. (Claus, J. pr. **42.** 359.)

Iridous sulphite potassium chloride.

See **Iridosulphite, potassium.**

Iridium sulphite *with* M_2SO_3.

See **Iridosulphite, M.**

Iron (ferrous) sulphite, $FeSO_3+2\frac{1}{2}H_2O$.

Very sl. sol. in H_2O. Easily sol. in H_2SO_3+Aq. Insol. in alcohol, but sol. therein in presence of SO_2. (Muspratt.)

Iron (ferric) sulphite, Fe_2O_3, SO_2+6H_2O.

Very sl. sol. in H_2O. Sol. in acids. (Koene.)

$2Fe_2O_3$, $3SO_2$. Deliquescent; decomp. by H_2O into SO_2 and above comp.

$3Fe_2O_3$, SO_2+7H_2O. Ppt.

Iron (ferroferric) potassium sulphite, $FeSO_3$, $(FeO)_2SO_3$, $2K_2SO_3$.

Ppt. (Berglund.)

Iron (ferric) potassium sulphite, K_2O, Fe_2O_3, $3SO_2+2H_2O$.

Sol. in H_2SO_3+Aq. (Koene, Pogg. **63.** 453.)

Fe_2O_3, $2K_2O$, $3SO_2+5H_2O$. Ppt. (Muspratt, Phil. Mag. (3) **30.** 414.)

Iron (ferric) potassium sulphite sulphate, $FeSO_3SO_4K$.

Sl. sol. in cold H_2O.

Sol. in 20% HCl; decomp. on boiling. (Hofmann, Z. anorg. 1897, **14.** 286.)

$Fe(SO_3)_2SO_4K_3$. Almost insol. in cold H_2O. Decomp. by boiling with dil. acids. (Hofmann.)

$Fe_2(SO_3)_4SO_4K_4+5H_2O$. Insol. in cold H_2O; sol. in cold 20% $HCl+Aq$; decomp. on boiling with H_2O. (Hofmann.)

Iron (ferric) sodium sulphite sulphate, $Fe(SO_3)_2SO_4Na_3+6H_2O$.

Almost insol. in H_2O.

Decomp. by boiling with dil. acids. (Hofmann, Z. anorg. 1897, **14.** 289.)

Iron (ferric) sodium hydrogen sulphite sulphate, $FeSO_4(SO_3)_4H_2Na_2+2H_2O$.

Only very sl. sol. in H_2O. (Hofmann.)

Lanthanum sulphite, $La_2(SO_3)_3+4H_2O$.

Precipitate. (Cleve.)

Lead sulphite, $PbSO_3$.

Insol. in H_2O. Decomp. by acids. Sl. sol. in H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 233.)

Lithium sulphite, $Li_2SO_3+6H_2O$.

Sol. in H_2O; precipitated from aqueous solution by abs. alcohol. (Danson, Chem. Soc. **2.** 205.) Sol. in H_2SO_3+Aq.

$+H_2O$. Sl. sol. in alcohol, and still less sol. in ether. (Röhrig, J. pr. (2) **37.** 225.)

$+2H_2O$. (Röhrig.)

Lithium potassium sulphite, $LiKSO_3+\frac{1}{2}H_2O$.

Easily sol. in H_2O. (Röhrig, J. pr. (2) **37.** 251.)

Lithium sodium sulphite, $6Li_2SO_3$, $Na_2SO_3+8H_2O$.

Sol. in H_2O. (Röhrig.)

Magnesium sulphite, $MgSO_3+6H_2O$.

Sol. in 20 pts. cold, and in less hot H_2O. (Fourcroy and Vauquelin.)

Sol. in 80 pts. cold, and in 120 pts. boiling H_2O. (Hager, C. C. **1875.** 135.)

More easily sol. in H_2SO_3+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 828.)

Precipitated from aqueous solution by alcohol.

$+3H_2O$. (Röhrig, J. pr. (2) **37.** 234.)

Manganous sulphite, $MnSO_3+2H_2O$.

Insol. in H_2O, alcohol, or ether. Easily sol. in acids, also in H_2SO_3+Aq.

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

$+2\frac{1}{2}H_2O$. (Rammelsberg.)

$+3H_2O$. Sol. in 10,000 pts. cold, and 5000 pts. hot H_2O; more sol. in conc. Mn salts$+Aq$; sol. in 1000 pts. H_2CO_3+Aq. 100 pts. H_2SO_3+Aq dissolve 15–17 pts. (Gorgeu, C. R. **96.** 341.)

Salt with $2\frac{1}{2}H_2O$ is the only one which exists. (Röhrig, J. pr. (2) **37.** 2.)

Manganous potassium sulphite, $2MnSO_3$, K_2SO_3.

Insol. in H_2O, even when boiling. (Gorgeu, C. R. **96.** 376.)

$MnSO_3$, K_2SO_3. Sol. in H_2O. (Gorgeu.)

Manganous sodium sulphite, $MnSO_3$, $Na_2SO_3+H_2O$.

Insol. in hot H_2O, but decomp. by cold H_2O. (Gorgeu.)

$4MnSO_3$, Na_2SO_3. Insol. in H_2O. (Gorgeu.)

Mercuric sulphite, $2HgO$, SO_2.

Insol. in H_2O. Sol. in HCl, alkali sulphites with subsequent decomp., and in KCN+Aq. (de St-Gilles, A. ch. (3) **36.** 80.)

$HgSO_3$. Decomp. by cold H_2O. (de St-Gilles.)

Does not exist. (Divers and Shimidzu, Chem. Soc. **49.** 553.)

HgO, $2SO_2+H_2O$. Sol. in H_2O, but decomp. by boiling. (de St-Gilles.) Exists only in aqueous solution. (Divers and Shimidzu.)

Mercuromercuric sulphite, $Hg_3(SO_3)_2+2H_2O=Hg_2SO_3$, $HgSO_3$.

Very efflorescent. Insol. in H_2O. Decomp. by hot H_2O. Insol. in dil. HNO_3 or H_2SO_4+Aq.

$+4H_2O$. Very efflorescent.

***Hypo*mercurosic sulphite,** $Hg_4(SO_3)_2+H_2O$.

Insol. in H_2O, but easily decomp. on standing therewith. Almost absolutely insol. in dil. HNO_3 or H_2SO_4+Aq. (Divers and Shimidzu.)

Mercuric *oxy*sulphite, $Hg(SO_2OHgO)_2Hg+H_2O$.

Insol. in H_2O. Decomp. by hot H_2O. Insol. in dil. HNO_3 or H_2SO_4+Aq. Sol. in H_2SO_3+Aq. (Divers and Shimidzu.)

Mercuric potassium sulphite, basic, K_2O, $2HgO$, $2SO_2$.

(Barth, Z. phys. Ch. 1892, **9.** 210.)

K_2O, $3HgO$, $3SO_2$. Insol. in H_2O. Partly sol. in KOH+Aq. (Barth.)

Mercuric potassium sulphite, $HgSO_3$, $K_2SO_3+H_2O$.

Sl. sol. in cold H_2O. Decomp. on boiling. (de St-Gilles, A. ch. (3) **36.** 90.)

Mercuric potassium sulphite mercuric chloride, $K_2Hg(SO_3)_2$, $HgCl_2$.

Decomp. by H_2O. (Barth, Z. phys. Ch. 1892, **9.** 206.)

Mercuric silver sulphite, $HgSO_3$, $Ag_2SO_3+2H_2O$.

Decomp. rapidly; insol. in H_2O. (Barth, Z. phys. Ch. **9.** 195.)

Mercuric sodium sulphite, $HgSO_3$, $Na_2SO_3+H_2O$.

Sol. in H_2O. (de St-Gilles.)

Sol. in 25 pts. cold H_2O, and decomp. on heating. (Divers and Shimidzu.)

$+2H_2O=Na_2(SO_3)_2Hg+2H_2O$. (Barth, Z. phys. Ch. **9.** 193.)

$2HgSO_3$, $Na_2SO_3+H_2O$. Much more sol. in H_2O than the above comp. especially on heating. (de St-Gilles.)

Does not exist. (Divers and Shimidzu.)

Mercuric strontium sulphite, $HgSO_3$, $SrSO_3+2H_2O$.

Ppt. (Barth.)

Mercuric sulphite ammonium bromide, $HgSO_3$, NH_4Br.

As NH_4Cl comp. (Barth, Z. phys. Ch. 1892, **9.** 215.)

Mercuric sulphite ammonium chloride, $HgSO_3$, NH_4Cl.

As K salt. (Barth.)

Mercuric sulphite potassium chloride, $HgSO_3$, KCl.

Sol. in H_2O. (Barth.)

Mercuric sulphite sodium chloride, $HgSO_3$, $NaCl+H_2O$.

Sol. in H_2O. (Barth.)

Nickel sulphite, basic, $2NiSO_3$, $Ni(OH)_2+6H_2O$.

Ppt. (Seubert and Elten, Z. anorg. 1893, **4.** 91.)

Nickel sulphite, $NiSO_3+4H_2O$.

Insol. in H_2O. Sol. in HCl+Aq. with evolution of SO_2. (Muspratt, A. **50.** 259.)

$+6H_2O$. Insol. in H_2O. Sol. in H_2SO_3+Aq. (Rammelsberg, Pogg. **67.** 391.)

Nickel sulphite ammonia, $NiSO_3$, $3NH_3+3H_2O$.

Sol. in little H_2O. Decomp. by much H_2O or heat. (Rammelsberg, Pogg. **67.** 245.)

Osmious sulphite, $OsSO_3$.

Insol. in H_2O. Easily sol. in HCl+Aq without evolution of SO_2. Very slowly decomp. by KOH+Aq. (Claus.)

Osmious potassium sulphite, $OsSO_3$, $2K_2SO_3$, $2KHSO_3+4H_2O$.

Nearly insol. in H_2O.

Osmious potassium sulphite chloride, OsO, $2SO_2$, $6KCl$.

Easily sol. in H_2O.

Palladous sodium sulphite, $PdSO_3$, $3Na_2SO_3+2H_2O = Na_6Pd(SO_3)_4+2H_2O$.

Sol. in hot H_2O. Sol. in $NaOH$+Aq or H_2SO_3+Aq. (Wöhler and Frerichs, A. **174.** 199.)

Platinous sulphite, PtO_2, $2SO_2$.

Easily sol. in H_2O or alcohol. (Döbereiner, J. pr. **15.** 315.)

Formula is $PtSO_3$. (Gmelin.)

$PtSO_3$, H_2SO_3. (Birnbaum, A. **139.** 172.)

Platinic potassium sulphite, PtO_2, SO_2, $K_2SO_3+H_2O$.

Sol. in KOH+Aq. (Birnbaum, A. **139.** 173.)

Platinic sodium sulphite, PtO_2, SO_2, $2Na_2SO_3+2H_2O$.

Sol. in H_2O. (Birnbaum.)

Platinous sulphite *with* M_2SO_3.

See **Platosulphite, M.**

Platinum sulphite ammonium chloride.

See **Chloroplatosulphite, ammonium.**

Potassium sulphite, $K_2SO_3+2H_2O$.

Somewhat deliquescent. Sol. in 1 pt. cold, and still less hot H_2O. (Fourcroy and Vauquelin, A. ch. **24.** 254.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Very slightly soluble in alcohol. Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Potassium hydrogen sulphite, $KHSO_3$.

Sol. in H_2O. Insol. in absolute alcohol.

Potassium ***pyro*****sulphite,** $K_2S_2O_5$.

Slowly sol. in H_2O. Very sl. sol. in alcohol; insol. in ether. (Muspratt, A. **50.** 259.)

Potassium rhodium sulphite, $3K_2SO_3$, $Rh_2(SO_3)_3+6H_2O$.

See **Rhodosulphite, potassium.**

Potassium ruthenium sulphite, $O[Ru(SO_3)_4K_6]_2+2H_2O$.

Ppt. (Miolati, C. C. **1901,** I. 501.)

Potassium sodium sulphite, $KNaSO_3$.

Sol. in H_2O. (Spring, B. **7.** 1161.)

+1, and $2H_2O$. (Schwicker, B. **22.** 1731.)

Isomeric salts, KSO_3Na and $NaSO_3K$. (Barth, Z. phys. Ch. **9.** 176.)

Potassium sodium hydrogen sulphite, $KNa_2H(SO_3)_2+4H_2O$.

Easily sol. in H_2O; 100 pts. H_2O dissolve 69 pts. salt at 15°. (Schwicker, B. **22.** 1731.)

$K_2NaH(SO_3)_2+3H_2O$. (Schwicker.)

Potassium uranyl sulphite, $K(UO_2)(OH)SO_3$.

Insol. in H_2O, but sol. in H_2SO_3+Aq. (Scheller.)

K_2O, $2UO_3$, $3SO_2$. (Kohlschütter, A. 1900, **311.** 10 *et seq.*)

K_2O, $4UO_3$, $5SO_2$. (K.)

K_2O, $3UO_3$, $2SO_2$. (K.)

K_2O, UO_3, $2SO_2$. (K.)

Potassium vanadium sulphite.

See **Vanadiosulphite, potassium.**

Potassium vanadyl sulphite, K_2SO_3, $VOSO_3+5\frac{1}{2}H_2O$

Sol. in H_2O without decomp. and can be recryst. therefrom. (Koppel and Behrendt, B. 1901, **34.** 3932.)

K_2O, $3VO_2$, $2SO_2$. Sol. without decomp. in cold and hot H_2O.

Insol. in alcohol and ether. (Koppel, Z. anorg. 1903, **35.** 182.)

Potassium zinc sulphite, K_2SO_3, $3ZnSO_3+7\frac{1}{2}H_2O$.

Sol. in H_2O with decomp. (Berglund, Acta Lund. **1872.**)

Rhodium sulphite, $Rh_2(SO_3)_3+6H_2O$.

Sol. in H_2O. Insol. in alcohol. (Claus.)

Rhodium sodium sulphite.

See **Rhodosulphite, sodium.**

Ruthenium sulphite, $Ru_2(SO_3)_3$.

Colloidal substance, sol. in a large quantity of H_2O. (Lucchesi, Gazz. ch. it. 1900, **30.** (2) 71.)

Ruthenium sodium sulphite, $Na_7Ru(SO_3)_5+2H_2O$.

Ppt. (Miolati, C. C. **1901,** I. 501.

Samarium sulphite, $Sm_2(SO_3)_3$.

Amorphous precipitate. (Cleve.)

Scandium sulphite, $Sc_2(SO_3)_3$.

Insol. in cold H_2O. Sl. sol. in hot H_2O.

Sol. in excess of sodium sulphite when heated. (Crookes, Phil. Trans. 1910, **210.** A, 363.)

$+6H_2O$. Very sl. sol. in H_2O.

Decomp. by boiling with H_2O with separation of H_2SO_3. (R. J. Meyer, Z. anorg. 1914, **86.** 281.)

Selenium sulphite, $SeSO_3$.

Correct composition for "selenium sulphoxide." (Divers, Chem. Soc. **49.** 583.)

Silver sulphite, Ag_2SO_3.

Very sl. sol. in cold H_2O. Decomp. on heating.

Solubility in H_2O is <1:20,000. (Baubigny, C. R. 1909, **149.** 858.)

Easily sol. in NH_4OH+Aq, and alkali sulphites+Aq. Insol. in H_2SO_3+Aq. Decomp. by strong acids, but not by acetic acid. (Berthier, A. ch. (3) **7.** 82.)

Easily sol. in alkali thiosulphates+Aq. (Herschel.)

Cold $NaHSO_3$+Aq dissolves a considerable amount of Ag_2SO_3. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 78.)

Practically insol. in HNO_3+Aq or dil. $AgNO_3$+Aq, also in H_2SO_3+Aq. (Divers, Chem. Soc. **49.** 579.)

Silver sodium sulphite, Ag_2SO_3, Na_2SO_3+H_2O.

Decomp. by H_2O. (Svensson, B. **4.** 714.)

Sodium sulphite, Na_2SO_3.

100 pts. dissolve at 0°, 14.1 pts.; at 20°, 25.8 pts.; at 40°, 49.5° pts. Na_2SO_3. (Kremers, Pogg. **99.** 50.) Maximum solubility is at 33.° (Mitscherlich.)

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2SO_3
60.4	28.29
59.8	28.29
59.8	28.65
59.8	28.75
37.0	28.01
37.0	28.07
47.0	28.19
47.0	28.07
55.6	28.21
84.0	28.26

The temp. at which Na_2SO_3+$7H_2O$ changes into Na_2SO_3 is about 21.6°.

(Hartley and Barrett, Chem. Soc. 1909, **95.** 1183.)

See also +$7H_2O$.

Sp. gr. of sat. solution at 15°=1.21. (Greenish and Smith, Pharm. J. 1901, **66.** 774.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol.

Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, **47.** 1370.)

+$7H_2O$. Decomp. slowly on air.

Sol. in 4 pts. H_2O at 15° with absorption of heat (Dumas), and in 1 pt. boiling H_2O (Fourcroy).

Solubility in 100 pts. H_2O at t°.

t°	Pts. Na_2SO_3
37.2	44.08
33.5	39.64
29.0	34.99
23.5	29.92
18.2	25.31
10.6	20.01
5.9	17.61
2.0	14.82
—1.9	13.09

Supersolubility curves have also been plotted for ice and Na_2SO_3+$7H_2O$.

(Hartley and Barrett, Chem. Soc. 1909, **95.** 1181.)

+$10H_2O$. Efflorescent. Somewhat less sol. than above salt. (Muspratt.)

Sodium hydrogen sulphite, $NaHSO_3$.

More difficulty sol. in H_2O than $NaHCO_3$, and is precipitated by alcohol from aqueous solution. (Muspratt.)

Insol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4329) methyl acetate. (Naumann, B. 1909, **42.** 3790.)

+$4H_2O$. (Clark.)

Sodium *pyro*sulphite, $Na_2S_2O_5$.

Decomp. gradually on the air.

Sodium uranyl sulphite, $Na(UO_2)(OH)SO_3$.

Sl. sol. in H_2O. More sol. in H_2SO_3+Aq than the K salt. (Scheller.)

Na_2O, $2UO_3$, $3SO_2$.

Na_2O, $3UO_3$, $2SO_2$. (Kohlschütter, A. 1900, **311.** 10 *et seq.*)

Sodium vanadyl sulphite, Na_2O, $2SO_2$, VO_2+$5H_2O$.

Sol. in H_2O with decomp.

Na_2O, $2SO_2$, $3VO_2$+$4H_2O$. Sol. in cold H_2O; decomp. on heating. (Koppel, B. 1901, **34.** 3933.)

Sodium zinc sulphite, Na_2SO_3, $3ZnSO_3$+$7\frac{1}{2}H_2O$.

Sol. in H_2O with decomp. (Berglund, Acta Lund, **1872.**)

Sodium sulphite silver chloride, $3Na_2SO_3$, $AgCl$+$21H_2O$.

Sol. in H_2O. (Svensson.)

Strontium sulphite, $SrSO_3$.

Precipitate. Almost insol. in H_2O. Sol. in H_2SO_3+Aq. (Muspratt.)

Sol. in about 30,000 pts. H_2O at 15–18°. (Autenrieth, Z. anal. 1898, **37.** 293.)

Abundantly sol. in H_2SO_3+Aq. (Röhrig.)

Tellurium sulphite, $TeSO_3$.

Correct composition of "tellurium sulphoxide." (Divers, Chem. Soc. **49.** 583.)

Thallous sulphite, Tl_2SO_3.

Sl. sol. in cold, easily in hot H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 229.)

100 pts. H_2O dissolve 3.34 pts. at 15.5°. Easily sol. in hot H_2O; insol. in alcohol. (Seubert and Elten, Z. anorg. **2.** 434.)

Thallous vanadyl sulphite, $2Tl_2SO_3$, $V_2O_3SO_3+4H_2O$.

(Gain, A. ch. 1908, (8) **14.** 278.)

Tl_2SO_3, $3V_2O_3SO_3+8H_2O$. (Gain.)

Thorium sulphite, $Th(SO_3)_2+H_2O$.

Precipitate. (Cleve.)

Tin (stannous) sulphite, $5SnO$, $2SO_2+xH_2O$.

Ppt. Partly sol. in H_2SO_3+Aq. (Röhrig, J. pr. (2) **37.** 249.)

$+20H_2O$. (Röhrig.)

$8SnO$, $2SO_2+20H_2O$.

$11SnO$, $2SO_2+20H_2O$ (Röhrig.)

Uranous sulphite, basic, $U(OH)_2SO_3+H_2O$.

Insol. in H_2O. Easily sol. in acids. Sol. in H_2SO_3+Aq, but is soon decomp. (Rammelsberg.)

Uranyl sulphite, basic, $3UO_2(OH)_2$, $5(UO_2)SO_3+10H_2O$.

(Seubert and Elten, Z. anorg. 1893, **4.** 80.)

Uranyl sulphite, $(UO_2)SO_3+4H_2O$.

Insol. in H_2O. Sol. in H_2SO_3+Aq or alcoholic solution of SO_2. (Röhrig, J. pr. (2) **37.** 240.)

Vanadyl sulphite, $3VO_2$, $2SO_2+4\frac{1}{2}H_2O$.

Decomp. slowly on standing.

Sol. in H_2O without apparent decomp. (Koppel, Z. anorg. 1903, **35.** 186.)

$2V_2O_4$, $3SO_2+10H_2O$. Sol. in H_2O; aq. sol. decomp. on boiling giving off SO_2 and forming V_2O_4, $2H_2O$. (Gain, C. R. 1906, **143.** 824.)

Vanadyl zinc sulphite, ZnO, $3VO_2$, $2SO_2$.

Decomp. slowly in the air.

Sol. in H_2O without decomp. (Koppel, Z. anorg. 1903, **35.** 183.)

Ytterbium sulphite, $Yb_2(SO_3)_3+9H_2O$.

Insol. in H_2O. (Cleve, Z. anorg. 1902, **32.** 143.)

Yttrium sulphite, $Y_2(SO_3)_3+3H_2O$.

Sl. sol. in H_2O. (Cleve.)

Zinc sulphite, basic, $2ZnSO_3$, $3Zn(OH)_2$.

(Seubert, Arch. Pharm. **229.** 321.)

$ZnSO_3$, $Zn(OH)_2$- H_2O. (Seubert.)

Zinc sulphite, $ZnSO_3+2$, and $2\frac{1}{2}H_2O$.

Very sl. sol. in H_2O. 100 pts. H_2O dissolve 0.16 pt. $ZnSO_3+2H_2O$. (Henstcn and Tichborne, Brit. Med. J. **1890.** 1063.)

Easily sol. in H_2SO_3+Aq (Koene.)

Sol. in NH_4OH+Aq.

Insol. in alcohol.

Decomp. into basic salt by boiling H_2O. (Seubert, Arch. Pharm. **229.** 1.)

Zinc sulphite ammonia, $ZnSO_3$, NH_3.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **67.** 255.)

Zirconium sulphite.

Insol. in H_2O. Somewhat sol. in H_2SO_3+Aq, from which it is repptd. on boiling. Sol. in $(NH_4)_2SO_3$+Aq, from which Zr hydroxide is pptd. on boiling. (Berzelius.)

$Zr(SO_3)_2+7H_2O$. Ppt. (Venable, J. Am. Chem. Soc. 1895, **17.** 449.)

Sulphuryl bromide, SO_2Br_2.

(Odling, Chem. Soc. **7.** 2.)

Does not exist. (Sestini, Bull. Soc. **10.** 226; Melsens, C. R. **76.** 92; Michaelis.)

Sulphuryl chloride, SO_2Cl_2.

Decomp. by H_2O and alcohol.

Decomp. by moist air, water, or abs. alcohol; more rapidly by alkalies, HCl, SO_2, etc. (Schiff, A. **102.** 111.)

$+H_2O$. Only sl. sol. in H_2O at 0° with slow decomp. (Baeyer, B. 1901, **34.** 737.)

$+15H_2O$. Sl. sol. in H_2O at 0° and stable therein for several hours. (Baeyer.)

Di**sulphuryl chloride (*****Pyro*****sulphuryl chloride),** $S_2O_5Cl_2$.

Decomp. slowly with H_2O. (Rose, Pogg. **44.** 291.)

Sol. in CCl_4 and $CHCl_3$; miscible with liquid SO_3.

Sulphuryl hydroxyl chloride,

$$SO_3HCl = {}^{HO}_{Cl}SO_2.$$

Decomp. on moist air, and violently with H_2O. Not miscible with CS_2. Decomp. with alcohol.

Sulphuryl titanium chloride, SO_3, $TiCl_4$ = $TiCl_3OSO_2Cl$.

Slowly deliquescent. (Clausnitzer, B. **11.** 2011.)

Disulphuryl chloride stannic oxychloride, $5S_2O_5Cl_2, 4SnOCl_2$.

Sol. in a little H_2O, but decomp. by more H_2O. (Rose, Pogg. **44.** 320.)

Sulphuryl fluoride, SO_2F_2.

1 pt. is sol. in 10 pts. H_2O at 9°. 3 vol. are sol. in 1 vol. alcohol at 9°; insol. in conc. H_2SO_4 at 66°; sol. in aq. solution of KOH, $Ca(OH)_2$, $Ba(OH)_2$ and in alcoholic solution of alkalies. (Moissan, C. R. 1901, **132.** 377.)

Sulphuryl hydroxyl fluoride, HSO_3F.

Violently decomp. by H_2O. (Thorpe and Kirwan, Z. anorg. **3.** 63.)

Sulphuryl *per*oxide, SO_4.

See **Sulphur *hept*oxide.**

Sulphydric acid.

See **Hydrogen Sulphide.**

Sulphydroxyl.

See **Sulphhydroxyl.**

Tantalic acid, $H_4Ta_2O_7$ (?).

Sol. in HF (Rose), and $KH_3(C_2O_4)_2$+Aq (Gahn, Schw. J. **16.** 437). At the instant of precipitation is sol. in various acids. (Rose.)

Aluminum tantalate.

Insol. in H_2O. (Berzelius.)

Ammonium *hexa*tantalate, $(NH_4)_2H_7Ta_7O_{19}+H_2O$.

Somewhat sol. in H_2O. (Rose, Pogg. **102.** 57.)

Barium *hexa*tantalate, $Ba_4Ta_6O_{19}+6H_2O$.

Sl. sol. in H_2O. (Rose.)

Cæsium tantalate, $4Cs_2O, 3Ta_2O_5+14H_2O$.

Completely sol. in a small amount of hot H_2O. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1666.)

$7Cs_2O, 6Ta_2O_5+38H_2O$. Pptd. from its aqueous solution by alcohol. (Smith.)

Ferrous tantalate, $Fe(TaO_3)_2$.

Min. *Tantalite.*

$5FeO, 4Ta_2O_5$. Min. *Tapiolite.*

Magnesium *hexa*tantalate, $Mg_4Ta_6O_{19}+9H_2O$.

Ppt. (Rose, Pogg. **102.** 61.)

$4MgO, Ta_2O_5$. Insol. in H_2O. (Joly, C. R. **81.** 266.)

Mercurous tantalate, $5Hg_2O, 4Ta_2O_5+5H_2O$.

Decomp. by warm HNO_3+Aq (1.21 sp. gr.) with separation of Ta_2O_5. (Rose, Pogg. **102.** 64.)

Potassium tantalate, $KTaO_3$.

Insol. in H_2O. Sol. in KOH+Aq. (Marignac, A. ch. (4) **9.** 249.)

Potassium *hexa*tantalate, $K_8Ta_6O_{19}+16H_2O$.

Sol. without decomp. in moderately warm H_2O. Decomp. by boiling. (Marignac, A. ch. (4) **9.** 259.)

Rubidium tantalate, $4Rb_2O, 3Ta_2O_5+14H_2O$.

Sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1908, **30.** 1666.)

Silver tantalate, $4Ag_2O, 3Ta_2O_5$.

Completely sol. in NH_4OH+Aq. HNO_3+Aq dissolves Ag_2O, and Ta_2O_5 separates out. (Rose, Pogg. **102.** 64.)

Sodium tantalate, $NaTaO_3$.

Insol. in H_2O. (Rose.)

Sodium *hexa*tantalate, $Na_8Ta_6O_{19}+25H_2O$.

1 pt. salt. dissolves in 493 pts. H_2O at 13.5°, and in 162 pts. at 100°. Very slightly sol. in alcohol. Insol. in alkaline solutions. (Rose.)

*Per*tantalic acid.

See **Pertantalic acid.**

Tantalum, Ta.

Not attacked by HCl, HNO_3, aqua regia, or hot conc. H_2SO_4. Easily sol. in a mixture of HNO_3 and HF (Berzelius, Pogg. **4.** 6; Rose). Also sol. in HF alone (Berzelius.)

Not attacked by alkali hydrates+Aq.

Insol. in single acids and in aqua regia. Oxidized by a mixture of HF and aqua regia. (Moissan, C. R. 1902, **134.** 211.)

Pure Ta is insol. in boiling H_2SO_4, HNO_3, HCl, aqua regia or mixtures of these acids; slowly sol. in HF+Aq. (v. Bolton, Zeit. Elektrochem. 1905, **11.** 45.)

Tantalum bromide, $TaBr_5$.

Decomp. by H_2O. (Rose.)

Tantalum *di*chloride, $TaCl_2+2H_2O$.

Sol. in H_2O when freshly prepared. (Chabrié, C. R. 1907, **144.** 805.)

Tantalum *penta*chloride, $TaCl_5$.

Takes up H_2O from the air without deliquescing. Decomp. by H_2O. Sol. in H_2SO_4. Sol. in cold HCl+Aq to a cloudy liquid, which gelatinises after a time. Not completely sol. in boiling HCl+Aq, and the solution does not gelatinise by the subsequent addition of water, but all goes into solution. Partly sol. in KOH +Aq. Insol. in K_2SO_3+Aq. Sol. in absolute alcohol.

Tantalum *penta*fluoride, TaF_5.

Very hydroscopic; sol. in H_2O. (Ruff, B. 1909, **42.** 494.)

Tantalum fluoride *with* MF.

See **Fluotantalate, M.**

Tantalum hydroxide, Ta_2O_5, xH_2O.

See **Tantalic acid.**

Tantalum nitride, TaN.

Not sol. in any acids, except a mixture of HF and HNO_3. (Rose, Pogg. **100.** 146.)

Ta_3N_5. (Joly, Bull. Soc. (2) **25.** 506.)

Tantalum *di*oxide, Ta_2O_2(?).

Sol. in HF with evolution of hydrogen. (Hermann, J. pr. (2) **5.** 69.)

Tantalum *tetr*oxide, Ta_2O_4.

Not attacked by any acid, not even a mixture of HNO_3 and HF. (Berzelius, Pogg. **4.** 20.)

Decomp. by HCl. (Smith, Z. anorg. 1894, **7.** 98.)

Tantalum *pent*oxide, Ta_2O_5.

Insol. in any acid, even boiling H_2SO_4 or in HF. (Berzelius.)

Sol. in fused $KHSO_4$, 10 pts. being necessary to dissolve 1 pt. Ta_2O_5.

Tantalum silicide, $TaSi_2$.

Insol. in most inorganic acids. Sol. in HF and in $HF+HNO_3$.

Decomp. by fused alkali hydroxides. (Hönigschmid, M. 1907, **28.** 1027.)

Tantalum sulphide, Ta_2S_4.

Not attacked by HCl+Aq. Oxidised by boiling with HNO_3+Aq, more rapidly with aqua regia. Attacked by H_2SO_4 on heating. Not completely sol. in HF or a mixture of HF and HNO_3.

Telluretted hydrogen, TeH_2.

See **Hydrogen telluride.**

Telluric acid, H_2TeO_4.

Insol. in H_2O, cold conc. HCl, hot HNO_3, or boiling KOH+Aq, but when heated with H_2O is gradually converted into $H_2TeO_4+2H_2O$ and dissolved.

$+2H_2O$. Very slowly sol. in cold H_2O, but sol. in hot H_2O in every proportion. Insol. in absolute alcohol; sol. in dil. alcohol according to the amount of H_2O present. Sol. in acids and alkalies. Insol. in alcohol or ether.

Insol. in alcohol; sol. in NaOH+Aq. (Mylius, B. 1901, **34.** 2216.)

Stable in the air.

Sol. in H_2O; pptd. by HNO_3. (Staudenmaier, Z. anorg. 1895, **10.** 191.)

Solubility in H_2O.

Solid phase	Temp.	% H_2TeO_4	Mols H_2O to 1 mol H_2TeO_4	Mols H_2TeO_4 to 100 mols H_2O
$H_2TeO_4+6H_2O$	0°	13.92	66.2	1.51
"	5°	17.84	49.2	2.03
"	10°	26.21	30.2	3.31
"	15°	32.79	21.9	4.55
$H_2TeO_4.2H_2O$	10°	25.29	31.7	3.15
"	18°	28.90	26.2	3.82
"	30°	33.36	21.4	4.67
"	40°	36.38	18.8	5.33
"	60°	43.67	14.2	7.04
"	80°	51.55	10.07	9.93
"	100°	60.84	6.89	14.52

(Mylius, B. 1901, **34.** 2211.)

$+6H_2O$. Obtained from solutions at 0°. (Staudenmaier, Z. anorg. 1895, **10.** 191.)

***Allo*telluric acid,** H_2TeO_4.

Miscible with H_2O.

Sol. in alcohol; pptd. by NaOH+Aq but sol. in excess. (Mylius, B. 1901, **34.** 2216.)

Tellurates.

Neutral alkali salts are sol. in H_2O; the acid salts are only sl. sol. therein, but dissolve in HCl+Aq.

Aluminum tellurate.

Ppt. Sol. in excess of aluminum salts+Aq. (Berzelius.)

Ammonium tellurate, $(NH_4)_2TeO_4$.

Slowly but completely sol. in H_2O. Sl. sol. in NH_4OH+Aq or NH_4Cl+Aq. Sl. sol. in alcohol. (Berzelius.)

$(NH_4)_2O$, $2TeO_3$. Sl. sol. in H_2O, but more sol. than the corresponding K salt.

$(NH_4)_2O$, $4TeO_3$. Very sl. sol. in H_2O. Insol. in alcohol. (Berzelius.)

Barium tellurate, $BaTeO_4+3H_2O$.

Sl. sol. in cold, more in boiling H_2O. Easily sol. in HNO_3+Aq. (Berzelius.)

$BaH_2(TeO_4)_2+2H_2O$. More sol. in H_2O than $BaTeO_4$. Decomp. by H_2O. (Berzelius.)

BaO, $4TeO_3$. More sol. in H_2O than either $BaTeO_4$ or $BaH_2(TeO_4)_2$. (Berzelius.)

Bismuth tellurate, $Bi_2TeO_6+2H_2O$.

Min. *Montanite.* Sol. in HCl+Aq with evolution of Cl.

Cadmium tellurate, $CdTeO_4$.

Ppt. Sol. in HCl+Aq. (Oppenheim.)

Cæsium hydrogen tellurate, $CsHTeO_4+\frac{1}{2}H_2O$.

1 pt. is sol. in 30 pts. H_2O. (Norris, Am. Ch. J. 1901, **26.** 321.)

Calcium tellurate, $CaTeO_4$.
Ppt. Sol. in hot H_2O. (Berzelius.)

Chromic tellurate, $Cr_2(TeO_4)_3$.
Ppt. Sol. in excess of Cr salts+Aq.

Cobaltous tellurate.
Ppt. (Berzelius.)

Cupric tellurate, $CuTeO_4$.
Ppt. (Berzelius.)
$CuO, 2TeO_3$. Ppt. (B.)
Cu_3TeO_6. Insol. in H_2O.
Sol. in HCl, HNO_3, NH_4OH, KCN and acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1181.)

Glucinum tellurate, $GlTeO_4$.
Insol. in H_2O.

Iron (ferrous) tellurate, $FeTeO_4$.
Ppt. Min. *Ferrotellurate.*

Iron (ferric) tellurate, $Fe_2(TeO_4)_3$.
Ppt. Sol. in ferric salts+Aq. (Berzelius.)

Lead tellurate, basic.
Not comrpletely insol. in H_2O.

Lead tellurate, $PbTeO_4$.
Somewhat sol. in H_2O.
$PbO, 2TeO_3$. More sol. than $PbTeO_4$.
$PbO, 4TeO_3$. Sl. sol. in H_2O. Sol. in HNO_3+Aq, less sol. in $HC_2H_3O_2$+Aq. (Berzelius.)

Lithium tellurate, $Li_4TeO_5+xH_2O$.
Sl. sol. in H_2O with decomp. (Mylius, B. 1901, **34.** 2209.)

Magnesium tellurate, $MgTeO_4$.
Ppt. More sol. in H_2O than the Ba, Sr. or Ca salts.
$MgTe_2O_7$. More sol. in H_2O than $MgTeO_4$.

Manganous tellurate.
Ppt.

Mercurous tellurate, basic, $3Hg_2O, 2TeO_3$.
Ppt. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1178.)

Mercurous tellurate, Hg_2TeO_4.
Ppt. Min. *Magnolite.*

Mercuric tellurate, $HgTeO_4$.
Ppt. Very easily decomp. by H_2O. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1179.)
$+2H_2O$. Slowly decomp. by cold H_2O. Rapidly decomp. by boiling H_2O. (Hutchins.)
Hg_3TeO_6. Insol. in H_2O. Unchanged by boiling with H_2O.
Sol. in HNO_3, but more readily sol. in HCl. (Hutchins.)

Mercuric tellurate.
Ppt. (Berzelius.)

Mercurous hydrogen tellurate, $HgHTeO_4+3H_2O$.
Stable in the air if protected from the light
Insol. in H_2O. Decomp. by boiling H_2O or by an excess of cold conc. $HgNO_3$+Aq.
Sol. in dil. HNO_3 or dil. acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1177.)

Nickel tellurate.
Ppt.

Potassium tellurate, $K_2TeO_4+5H_2O$.
Deliquesces. Sol. in H_2O. Very sl. sol. in H_2O containing KOH.
100 g. H_2O dissolve at:

0°	20°	30°
8.82	27.53	50.42 g. K_2TeO_4.

(Rosenheim and Weinheber, Z. anorg. 1911, **69.** 264.)

Insol. in alcohol. (Berzelius.)
$K_2O, 2TeO_3$. Insol. in H_2O, acids, or alkalies. (B).
$KHTeO_4+\frac{1}{2}H_2O$. Sl. sol. in cold, more sol. in hot H_2O. (Berzelius.)
$K_2O, 3TeO_3+5H_2O$. Much more sol. in hot than in cold H_2O. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1174.)
$K_2O, 4TeO_3$. Insol. in H_2O, HCl, or HNO_3+Aq. Sol. by long heating with conc. HNO_3+Aq.
$KHTeO_4, H_2TeO_4+\frac{1}{2}H_2O$. Sl. sol. in H_2O.

Rubidium tellurate, $Rb_2TeO_4+3H_2O$.
Sol. in about 10 pts. H_2O. (Norris, Am. Ch. J. 1901, **26.** 322.)

Rubidium hydrogen tellurate, $RbHTeO_4+\frac{1}{2}H_2O$.
Sol. in about 20 pts. cold H_2O. Sl. more sol. in hot H_2O. (Norris, Am. Ch. J. 1901, **26.** 320.)

Silver tellurate, $3Ag_2O, TeO_3$.
Sol. in NH_4OH+Aq.
$3Ag_2O, 2TeO_3$. Insol. in boiling H_2O.
$+3H_2O$. Ppt. Unchanged by cold H_2O. Gradually decomp. by boiling H_2O. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1169.)
Ag_2TeO_4. Decomp. by H_2O into $3Ag_2O, TeO_3$. Sol. in NH_4OH+Aq.
$+2H_2O$. Insol. in hot and cold H_2O. Sol. in NH_4OH, KCN, $Na_2S_2O_3$, HNO_3, H_2SO_4 and $HC_2H_3O_2$+Aq. Decomp. by conc. HNO_3 H_2SO_4 or acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1165.)

Ag_2TeO_7. Ppt.

$Ag_2O, 4TeO_3$. Ppt.

Could not be obtained. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1168.)

Sodium tellurate, $Na_2TeO_4+2H_2O$.

Very sl. sol. in hot or cold H_2O. When heated to drive off $2H_2O$ becomes insol. in H_2O, but sol. in dil. HNO_3+Aq. (Berzelius.)

1 pt. is sol. in about 130 pts. H_2O at 18°; 50 pts. H_2O at 100°.

$+4H_2O$. 1 pt. is sol. in about 70 pts H_2O at 18°; 40 pts. H_2O at 50°. (Mylius, B. 1901, **34.** 2209.)

$Na_2Te_2O_7+4H_2O = NaHTeO_4+1\frac{1}{2}H_2O$. Slowly but completely sol. in H_2O. Sl. sol. in $NaC_2H_3O_2$+Aq. Insol. in alcohol. (Berzelius.)

$Na_2O, 4TeO_3$. Insol. in H_2O, acids, or alkalies, except by long boiling with HNO_3+Aq.

$+xH_2O$. (α) Slowly sol. in H_2O. (β) Insol. even in boiling H_2O.

$Na_4TeO_5+8H_2O$. Very sol. in H_2O but with decomp. (Mylius.)

Strontium tellurates.

Resemble Ca salts.

Thallous tellurate, Tl_2TeO_4.

Sl. sol. in H_2O. (Dennis, J. Am. Chem. Soc. 1898, **18.** 975.)

Thorium tellurate.

Ppt. Insol. in excess of thorium salts +Aq.

Uranium tellurate, $U_2(Te_4O)_3(?)$.

Ppt. Insol. in H_2O or $UO_2(NO_3)_2$+Aq.

Yttrium tellurate.

Ppt. Insol. in H_2O or Yt salts+Aq.

Zinc tellurate, Zn_3TeO_6.

Insol. in H_2O.

Sol. in HNO_3, HCl, H_2SO_4 and acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1181.)

Zirconium tellurate.

Ppt. (Berzelius.)

Tellurium, Te.

Insol. in H_2O or HCl+Aq. Sl. sol. in hot conc. H_2SO_4, but separates out on cooling. Sol. in boiling conc. H_2SO_4. Easily oxidised by HNO_3 or aqua regia. Sol. in boiling very conc. KOH+Aq, separating out again on cooling.

Not attacked by boiling conc. HNO_3+Aq, according to Hartung-Schwartzkoff (Ann. Min. (4) **19.** 345).

Sol. in warm conc. KCN+Aq.

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

100 pts. methylene iodide dissolve 0.1 pt. Te at 12°. (Retgers, Z. anorg. **3.** 343.)

½ ccm. oleic acid dissolves 0.0014 g. Te in 6 days. (Gates, J. phys. Ch. 1911, **15.** 143.)

A colloidal solution of Te in H_2O can be obtained. It exists in two modifications, a brown and a blue-gray. Both can be diluted with H_2O or concentrated by boiling without decomp. They are, however, decomp. by electrolytes, especially NH_4Cl. (Gutbier, Z. anorg. 1902, **32.** 53.)

Tellurium ***di*****bromide,** $TeBr_2$.

Decomp. on air or by H_2O. (Rose, Pogg. **21** 443.)

Conc. tartaric acid dissolves partly without decomp. (Brauner, M. 1891, **12.** 34.)

Tellurium ***tetra*****bromide,** $TeBr_4$.

Sol. in a little, but decomp. by much H_2O.

Completely sol. in tartaric acid+Aq (1:1). (Brauner, M. 1891, **12.** 34.)

Tellurium hydrogen bromide, $TeBr_4$, $HBr+5H_2O$.

Fumes in the air. Deliquescent. Stable in an atmos. of HBr. (Metzner, C. R. 1897, **124.** 1951.)

Tellurium ***di*****chloride,** $TeCl_2$.

Decomp. on air, or by H_2O or HCl+Aq. (Rose, Pogg. **21.** 443.)

Tellurium ***tetra*****chloride,** $TeCl_4$.

Extremely deliquescent. Decomp. by cold H_2O, with separation of oxychloride and tellurous acid. Sol. in hot H_2O with decomp. Sol. in dil. HCl+Aq without decomp. (Rose, Pogg. **21.** 443.)

Insol. in sulphur chloride and in CS_2. (Lenher, J. Am. Chem. Soc. 1902, **24.** 188.)

Tellurium hydrogen chloride, $TeCl_4$, $HCl+5H_2O$.

Easily decomp. (Metzner, C. R. 1897, **125.** 24.)

Tellurium chloride ***with*** **MCl.**

See **Chlorotellurate, M.**

Tellurium ***tetra*****chloride ammonia,** $TeCl_4$, $3NH_3$.

Decomp. by H_2O. (Metzner, C. R. 1897, **124.** 33.)

$TeCl_4$, $4NH_3$. Not deliquescent. Decomp. by H_2O. (Espenschied, J. pr. **80.** 480.)

Tellurium ***tetra*****chloride sulphur** ***tri*****oxide,** $TeCl_4$, SO_3.

Ppt. ((Prandtl, Z. anorg. 1909, **62.** 247.)

$TeCl_4, 2SO_3$. Decomp. by moisture. On heating at 120°, it gives $TeCl_4, SO_3$. (Prandtl.)

Tellurium *tetra*fluoride, TeF_4.

(Metzner, C. R. 1897, **125.** 25.)

$+H_2O$. (Högbom, Bull. Soc. (2) **35.** 60.)

Tellurium *hexa*fluoride, TeF_6.

Decomp. by H_2O slowly but completely. (Prideaux, Chem. Soc. 1906, **39.** 322.)

Tellurium zirconium fluoride,

See **Fluozirconate, tellurium.**

Tellurium *di*iodide, TeI_2.

Insol. in H_2O. (Rose, Pogg. **21.** 443.)

Tellurium *tetra*iodide, TeI_4.

Insol. in cold, decomp. by hot H_2O or alcohol. Sol. in HI, but only sol. in MI+ Aq. (Berzelius.)

Data on solubility of TeI_4 in HI+I+Aq are given by Menke (Z. anorg. 1912, **77.** 283.)

Tellurium hydrogen iodide, TeI_4, HI+ $8H_2O$, and $+9H_2O$.

Deliquescent. (Metzner, A. ch. 1898, (7) **15.** 203.)

Tellurium nitride,

Two forms.

a. Stable at ord. temp.

b. Unstable at ord. temp.

(Franz Fischer, B. 1910, **43.** 1472.)

TeN. Not attacked by H_2O or dil. acetic acid.

Insol. in liquid NH_3. Decomp. by KOH+ Aq. (Metzner, A. ch. 1898, (7) **15.** 203.)

Tellurium *mon*oxide, TeO.

Sl. sol. in cold dil. HCl or H_2SO_4+Aq. Easily oxidised by HNO_3+Aq or aqua regia. Decomp. immediately by boiling conc. HCl+ Aq. Slowly decomp. by KOH+Aq. (Divers and Shimosé, Chem. Soc. **35.** 563.)

Tellurium *di*oxide, TeO_2.

Very sl. sol. in H_2O. Sl. attacked by acids. Sl. sol. in NH_4OH or alkali carbonates +Aq. Easily sol. in NaOH or KOH+Aq. Not sol. in less than 150,000 pts. H_2O. Easily sol. in warm dil. HNO_3+Aq. Sol. in warm H_2SO_4+Aq. (Klein and Morel, Bull. Soc. (2) **43.** 203.)

20% H_2SO_4+Aq. dissolves on warming about 0.7%; 30% H_2SO_4+Aq, about 0.85%; 50% H_2SO_4+Aq, about 4.4%.

These solutions are supersat. and TeO_2 separates from the more dil. acids on standing. (Brauner, M. 1891, **12.** 34.)

Min. *Tellurite.*

Tellurium *di*oxide hydrobromic acid, TeO_2, 3HBr.

(Ditte, C. R. **83.** 336.)

Tellurium *di*oxide hydrochloric acid, TeO_2, 2HCl.

(Ditte, C. R. **83.** 336.)

TeO_2, 3HCl. (Ditte.)

Tellurium *tri*oxide, TeO_3.

Insol. in cold or hot H_2O, cold HCl+Aq, or cold or hot HNO_3+Aq. Insol. in moderately conc. KOH+Aq, but, when the KOH+Aq is very conc., is sol. if boiling.

Tellurium oxide, $2TeO_2$, TeO_3.

"**Tellurium tellurate.**"

(Metzner, A. ch. 1898, (7) **15.** 203.)

Tellurium oxybromide.

Insol. in H_2O. (Ditte, A. ch. (5) **10.** 82.)

Tellurium oxybromide sulphur *tri*oxide, $TeOBr_2$, $2SO_3$.

Deliquescent. (Prandtl, Z. anorg. 1909, **62.** 247.)

Tellurium oxychloride, $TeOCl_2$.

Insol. in H_2O. (Ditte.)

Tellurium oxyfluoride, TeF_4, TeO_2+2H_2O.

Sol. in H_2O containing HNO_3. Decomp. by H_2O.

$2TeF_4$, $3TeO_2+6H_2O$. Decomp. by H_2O. (Metzner, C. R. 1897, **125.** 25.)

Tellurium sulphide, TeS.

Insol. in CS_2; very unstable. (Snelling, J. Am. Chem. Soc. 1912, **34.** 802.)

Tellurium *di*sulphide, TeS_2.

Insol. in H_2O or dil. acids. Sol. in alkali hydrates or sulphides+Aq.

CS_2 dissolves out S, so that the substance is probably a mixture. (Becker, A. **180.** 257.)

Tellurium *tri*sulphide, TeS_3.

Insol. in H_2O. Sol. in K_2S+Aq.

Tellurium sulphoxide, $TeSO_3$.

Decomp. by H_2O. Sol. in H_2SO_4. (Weber, J. pr. (2) **25.** 218.)

Is tellurium sulphite. (Divers, Chem. Soc. **49.** 583.)

Tellurous acid, H_2TeO_3.

Appreciably sol. in H_2O and acids. Sol. in alkali hydrates or carbonates+Aq.

Tellurites.

The neutral and acid tellurites of the alkali metals are sol. in H_2O. Ba, Sr, Ca, and Mg tellurites are sl. sol., and the other salts insol. in H_2O. Most tellurites are sol. in HCl+Aq.

Aluminum tellurite.

Ppt. Insol. in Al salts+Aq. (Berzelius.)

Ammonium tellurite, $(NH_4)HTeO_3$, $H_2TeO_3+3^1/_2H_2O$.

Sol. in H_2O, from which it is precipitated by NH_4Cl+Aq or alcohol (Berzelius.)

Barium tellurite, $BaTeO_3$.

Sl. sol. in H_2O when prepared in the moist way. (Berzelius.)

$BaO, 4TeO_2$.

Cadmium tellurite.

Ppt. Sol. in HNO_3, and HCl+Aq. (Oppenheim.)

Calcium tellurite, $CaTeO_3$.

Sl. sol. in cold, more sol. in hot H_2O. (Berzelius.)

$CaO, 4TeO_2$.

Chromium tellurite.

Ppt. Sol. in excess of chromic salts +Aq.

Cobaltous tellurite.

Ppt.

Cupric tellurite.

Insol. in H_2O. (Berzelius.)

Glucinum tellurite.

Insol. in H_2O.

Indium tellurite, $In_2(TeO_3, 2In(OH)_3$.

Ppt. (Renz, Dissert. **1902.**)

Ferrous tellurite.

Ppt.

Ferric tellurite.

Ppt.

Lead tellurite, $PbTeO_3$.

Ppt. Easily sol. in acids. (Berzelius.)

Lithium tellurite, Li_2TeO_3.

Sol. in H_2O. (Berzelius.)

$Li_2O, 2TeO_2$. Decomp. by cold H_2O into Li_2TeO_3 and $Li_2O, 4TeO_2$. (B.)

$Li_2O, 4TeO_2$. Sol. in hot, much less in cold H_2O. (B.)

Magnesium tellurite, $MgTeO_3$.

Precipitate. Much more sol. in H_2O than the Ba, Sr, or Ca salt. (Berzelius.)

Manganous tellurite.

Ppt.

Mercurous tellurite.

Ppt.

Mercuric tellurite.

Ppt.

Nickel tellurite.

Ppt.

Potassium tellurite, K_2TeO_3.

Not deliquescent. Slowly sol. in cold, more quickly in boiling H_2O. (Berzelius.)

$K_2O, 2TeO_2$ Completely sol. in boiling H_2O, from which $K_2O, 4TeO_2$ crystallises. (B.)

$K_2O, 4TeO_2+xH_2O$. Decomp. by cold H_2O into K_2O, TeO_2, and $K_2O, 2TeO_2$, which dissolve, and H_2TeO_3, which is insol. (B.)

Potassium *hexa*tellurite, $K_2O, 6TeO_2+2H_2O$.

Not decomp. by, but sl. sol. in H_2O. (Klein and Morel, C. R. **100.** 1140.)

Silver tellurite, Ag_2TeO_3.

Ppt. Sol. in NH_4OH+Aq. (Berzelius.)

The freshly pptd. salt is insol. in H_2O; sol. in HNO_3, H_2SO_4, acetic and tartaric acid; decomp. by HCl. (Lenher, J. Am. Chem. Soc 1913, **35.** 727.)

$AgHTeO_3$. Insol. in H_2O. Sol. in HNO_3 +Aq. (Rose, Pogg. **18.** 60.)

Sodium tellurite, Na_2TeO_3.

Slowly sol. in cold, more quickly in hot H_2O. Precipitated from aqueous solution by alcohol. (Berzelius.)

$Na_2O, 2TeO_2$. Decomp. by H_2O as K salt. (B.)

$Na_2O, 4TeO_2+5H_2O$. As above. (B.)

Strontium tellurite, $SrTeO_3$.

Resembles Ba salt.

$SrH_2Te_4O_{10}$. Very sl. sol. in H_2O, more easily in HNO_3+Aq.

Thorium tellurite.

Precipitate. Insol. in H_2O or Th salts+Aq.

Stannous tellurite.

Pptd. in presence of 60,000 pts. H_2O. (Fischer.)

Uranium tellurite, $U_2(TeO_3)_3$.

Ppt. Insol. in U salts+Aq.

Yttrium tellurite.

Precipitate.

Zinc tellurite, $ZnTeO_3$.

Ppt.

Zirconium tellurite.

Ppt.

Terbium, Tb.

Metal has not been isolated.

Has been decomp. into two or more elements by Krüss (Z. anorg. **4.** 27).

Terbium chloride, $TbCl_3+6H_2O$.
Sol. in H_2O; very hydroscopic; sol. in alcohol. (Urbain, C. R. 1908, **146.** 128.)

Terbium hydroxide.
Sol. in dilute acids. Decomposes NH_4 salts +Aq.

Terbium oxide, T_2O_3.
Sol. in dil. acids, even after ignition.

Terbium peroxide, Tb_4O_7.
Sol. in HNO_3 and in hot HCl. (Urbain, C. R. 1907, **146.** 127.)

Tetramine chromium compounds.
See—
Bromotetramine chromium compounds.
Chlorotetramine chromium compounds.
Iodotetramine chromium compounds.

Tetramine cobaltic compounds, $Co(NH_3)_4X_3$.
See—
Bromotetramine cobaltic compounds.
Carbonatotetramine cobaltic compounds.
Chlorotetramine cobaltic compounds.
Croceocobaltic compounds.
Fuscocobaltic compounds.
Flavocobaltic compounds.
Iodotetramine cobaltic compounds.
Nitratotetramine cobaltic compounds.
Praseocobaltic compounds.
Roseotetramine cobaltic compounds.
Sulphatotetramine cobaltic compounds.
See also under octamine cobaltic salts for many tetramine salts as yet unclassified.

Tetramine cobaltic nitrite *with* MNO_2, $Co_2(NH_3)_4(NO_2)_6$, $2MNO_2$.
See **Diamine cobaltic nitrite.**

Tetrathionic acid, $H_2S_4O_6$.
Known only in aqueous solution.
Dil. solution can be boiled without decomp. Conc. solution decomp. by boiling.
Addition of H_2SO_4 or HCl makes solution more stable. (Fordos and Gélis, C. R. **15.** 920.)

Tetrathionates.
Tetrathionates are all easily sol. in H_2O, but insol. in alcohol

Barium tetrathionate, $BaS_4O_6+2H_2O$.
Very sol. in H_2O, but precipitated by addition of alcohol

Cadmium tetrathionate.
Deliquescent. Solution in H_2O gradually decomposes. (Kessler, Pogg. **74.** 249.)

Cæsium tetrathionate, $Cs_2S_4O_6$.
(J. Meyer, B. 1907, **40.** 1361.)

Cuprous tetrathionate, $Cu_2S_4O_6$.
Decomp. by H_2O. (Chancel and Diacon, C. R. 1863, **56.** 711.)

Cupric tetrathionate, CuS_4O_6.
Sol. in H_2O.
Decomp. by long boiling. (Curtius and Henkel, J. pr. 1888, (2) **37.** 148.)

Lead tetrathionate, $PbS_4O_6+2H_2O$.
Sol. in H_2O.

Manganous hydrogen tetrathionate, $MnH_2(S_4O_6)_2$.
Deliquescent. Very sol. in H_2O and alcohol. (Curtius and Henkel, J. pr. (2) **37.** 148.)

Nickel tetrathionate ammonia, NiS_4O_6, $6NH_3$.
Ppt. Decomp. by H_2O. Insol. in alcohol. (Ephraim, B. 1913, **46.** 3109.)

Potassium tetrathionate, $K_2S_4O_6$.
Soluble in H_2O. Insol. in alcohol.
Difficultly sol. in H_2O. (Kessler, Pogg. 1847, **74.** 254.)

Rubidium tetrathionate, $Rb_2S_4O_6$.
Not hydroscopic. (J. Meyer, B. 1907, **40.** 1356.)

Sodium tetrathionate, $Na_2S_4O_6$.
Sol. in H_2O. Precipitated therefrom by a great excess of alcohol. (Kessler, J. pr. **95.** 13.)
$+2H_2O$. (Berthelot, A. ch. (6) **17.** 450.)

Strontium tetrathionate, $SrS_4O_6+6H_2O$.
Sol. in H_2O. (Kessler, Pogg. **74.** 255.)
More sol. in H_2O than Ba salt.

Zinc tetrathionate.
Sol. in H_2O. (Fordos and Gélis.)

Zinc hydrogen tetrathionate, $ZnH_2(S_4O_6)_2$.
Extremely sol. in H_2O and alcohol. (Curtius and Henkel, J. pr. (2) **37.** 147.)

Zinc tetrathionate ammonia, ZnS_4O_6, $3NH_3$.
Ppt. (Ephraim, B. 1915, **48.** 641.)

Thallic acid.

Potassium thallate.
Known only in aqueous solution. (Carstanjen, J. pr. **101.** 55.)
Does not exist. (Lepsius, Chem. Ztg. **1890,** 1327.)

Thallium, Tl.

Not attacked by pure H_2O. Easily sol. in dil. H_2SO_4 or HNO_3+Aq. Difficultly sol. in HCl+Aq. Absolute alcohol dissolves considerable quantity in a short time, also methyl alcohol, and acetic ether. (Böttger.)

Not easily attacked by HF+Aq. (Kuhlmann.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

1/2 ccm. oleic acid dissolves 0.0424 g. Tl in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Thallium arsenide, TlAs.

Decomp. by H_2SO_4. (Carstanjen.)

Thallous azoimide, TlN_3.

Sl. sol. in H_2O.

0.1712 pt. is sol. in 100 pts. H_2O at 0°;
0.1965 pt. is sol. in 100 pts. H_2O at 5°;
0.3 pt. is sol. in 100 pts. H_2O at 16°.
Insol. in abs. alcohol and ether.

(Curtius, J. pr. 1898, (2) **58.** 284.)

Thallothallic azoimide, TlN_3, TlN_9.

Explosive. Decomp. by hot H_2O and by acids. (Dennis, J. Am. Chem. Soc. 1896, **18.** 973.)

Thallous bromide, TlBr.

Nearly insol. in cold, sl. sol. in boiling H_2O. (Willm, Bull. Soc. (2) **2.** 89.)

1 l. H_2O dissolves 0.00869 g. mol. TlBr at 68.5°. (Noyes, Z. phys. Ch. **6.** 248.)

Sl sol. in H_2O. 0.48×10^{-2} g. is dissolved in a liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O dissolves 420 mg. TlBr at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

238 mg. TlBr are contained in 1 l. sat. solution at 0.13°; 289 mg. at 9.37°; 423 mg. at 18°; 579 mg. at 25.68°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

Solubility of TlBr in $Tl(NO_3)$+Aq at 68.5°.

g. mols. per l.		g. mols. per l.	
$TlNO_3$	TlBr	$TlNO_3$	TlBr
0	0.00869	0	2.469
0.0163	0.00410	4.336	1.164
0.0294	0.00289	7.820	0.821
0.0955	0.00148	25.400	0.420

(Noyes, Z. phys. Ch. 1890, **6.** 248.)

Insol. in acetone (Naumann, B. 1904, **37.** 4329); pyridine (Naumann, B. 1904, **37.** 4610); acetone (Eidmann, C. C. **1899,** II. 1014).

Thallic bromide, $TlBr_3$.

Deliquescent. Easily sol. in H_2O and alcohol. (Willm.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+H_2O$. Very unstable. Sol. in H_2O, alcohol and ether. (Meyer, Z. anorg. 1900, **24.** 353.)

$+4H_2O$. Very sol. in H_2O. (Thomas, C. R. 1902, **134.** 546.)

Thallothallic bromide, TlBr, $TlBr_3$.

Decomp. by H_2O. (Meyer, Z. anorg. 1900, **24.** 35[illegible].)

3TlBr, $TlBr_3$. Decomp. by H_2O into TlBr and $TlBr_3$.

Thallic hydrogen bromide, $TlBr_3$, HBr.

Very sol. in H_2O. (Thomas, C. R. 1902, **134.** 546.)

Thallic bromide ammonia, $TlBr_3$, $3NH_3$.

Decomp. by H_2O.

Thallium bromochloride, TlClBr.

Decomp. by H_2O. (Thomas, C. R. 1901, **132.** 1489.)

$TlClBr_2+4H_2O$. Ppt.

$TlCl_2Br+4H_2O$. Ppt. Decomp. by H_2O. (Thomas, C. R. 1902, **134.** 546.)

$Tl_3Cl_2Br_4$. Decomp. by H_2O, H_2SO_4 or HNO_3. (Thomas, C. R. 1900, **131.** 894; C. R. 1901, **132.** 1489.)

$Tl_4Cl_3Br_3$. Sol. in H_2O. (Thomas, C. R. 1901, **132.** 82.)

$TlClBr_2$, 3TlCl. Cryst. from H_2O containing HNO_3. (Cushmann, Am. Ch. J. 1900, **24.** 222.)

$TlCl_3$, 3TlBr. Sol. in H_2O without decomp. (Cushmann.)

$TlBr_3$, 3TlCl. Decomp. by H_2O. (Cushmann.)

$TlBr_3$, TlCl. Sol. in H_2O with decomp. (Cushmann.)

$TlCl_3$, 2TlBr, TlCl. Sol. in H_2O. (Meyer, Z. anorg. 1900, **24.** 355–360.)

$TlBr_3$, 2TlCl, TlBr. Ppt. Decomp. by H_2O. (Meyer.)

($TlCl_3$, TlCl), 2($TlBr_3$, TlBr). Ppt. (Meyer.)

2($TlCl_3$, TlCl), ($TlBr_3$, TlBr). Ppt. Decomp. by hot H_2O. (Meyer.)

Thallium bromofluoride, $TlFBr_2$.

Decomp. in moist air.

Sol. in abs. alcohol. (Gewecke, A. 1909, **366.** 233.)

Thallium bromofluoride ammonia, $TlFBr_2$, $4NH_3$.

Decomp. by moisture.

Difficultly sol. in abs. alcohol. (Gewecke, A. 1909, **366.** 234.)

Thallous chloride, TlCl.

Solubility in pts. H_2O at t°, according to H = Hebberling; C = Crookes; L = Lamy.

0°	15°	16°	16.5°
504	283.4	377	359 pts. H_2O,
H	C	H	H

100°	100°	100°
about 50	52.5	63 pts. H_2O.
L	C	H

1 l. H_2O dissolves 0.0161 g. mol. TlCl at 25°. (Noyes, Z. phys. Ch. **6.** 249.)

3.26×10^{2} grams are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46.** 603.)

1 l. H_2O at 25° dissolves 0.01606 g. mol. TlCl. (Geffcken, Z. phys. Ch. 1904, **49.** 296.)

Solubility in H_2O at t°.
100 cc. sat. solution contain at:

t°	0°	10°	20°	30°	40°	50°
g. TlCl	0.17	0.24	0.34	0.46	0.60	0.80

t°	60°	70	80°	90°	99.3°
g. TlCl	1.02	1.29	1.60	1.97	2.41

(Berkeley, Trans. Roy. Soc. 1904, **203,** A, 208.)

1 l. H_2O dissolves 3.040 TlCl at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)

2.27 g. are dissolved in 1 l. of sat. solution at 9.54°; 3.05 g. at 17.7°; 3.97 g. at 25.76°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)

0.01629 mol. is sol. in 1 l. H_2O at 25°. (Hill, J. Am. Chem. Soc. 1910, **32.** 1385.)

0.01607 g. equiv. is sol. in 1 l. H_2O at 25°. (Bray and Winninghoff, J. Am. Chem. Soc. 1911, **33.** 1665.)

Much less sol. in H_2O containing HCl or HNO_3.

Solubility in HCl+Aq at 25°. 1 l. dissolves g. mol. TlCl.

g. HCl added	TlCl	g. HCl added	TlCl
0	0.01610	0.1468	0.00316
0.0283	0.00836	1.000	0.00200
0.0560	0.00565	...	...

(Noyes, Z. phys. Ch. **6.** 249.)

Solubility in HCl+Aq. at 25°.

Concentration of HCl, equivalents per liter	Solubility of TlCl, equivalents per liter
0	0.01612
0.025	0.00869
0.05	0.00585
0.10	0.00384
0.20	0.00254

(Noyes, Z. phys. Ch. 1892, **9.** 614.)

Solubility in HNO_3+Aq at 25°.

Normality HNO_3	Sp. gr. of the solution	g. TlCl dissolved per l.
0.000	0.996	3.952
0.4977	1.0184	5.937
1.0046	1.0359	6.883
2.0452	1.0705	8.143
4.017	1.1362	9.926

(Hill and Simmons, Z. phys. Ch. 1909, **67.** 605.)

Nearly insol. in NH_4OH+Aq.

More sol. in K_2CO_3+Aq than in H_2O. 3.86 g. TlCl are sol. in 1 l. H_2O at 25°. 21.84 g. TlCl are sol. in 1 l. 5N-K_2CO_3+Aq at 25°. (Spencer and Le Pla, C. C. **1908,** II. 198.)

Solubility in KNO_3+Aq at 25°.

Concentration of KNO_3 milliequivalents per l.	Solubility of TlCl. milliequivalents per l.
10	16.07
20	17.16
50	18.26
100	19.61
300	23.13
1000	30.72

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, **33.** 1670.)

Solubility in K_2SO_4+Aq at 25°.

Concentration of K_2SO_4 milliequivalents per l.	Solubility of TlCl milliequivalents per l.
10	16.07
20	17.79
50	19.42
100	21.37
300	26.00
1000	34.16

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, **33.** 1670.)

Solubility in Tl_2SO_4+Aq at 25°.

Concentration of Tl_2SO_4 milliequivalents per l.	Solubility of TlCl milliequivalents per l.
10	16.07
20	10.34
50	6.77
100	4.68

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, **33.** 1670.)

Solubility of TlCl in salts+Aq at 25°.

Salt	Concentration of salt g. equiv. per l.	TlCl dissolved g. equiv. per l.
NH_4Cl	0.025	0.00872
	0.05	0.00593
	0.2	0.00271
$CaCl_2$	0.025	0.00899
	0.05	0.00624
	0.10	0.00417
	0.20	0.00284

Solubility of TlCl in salts+Aq at 25°.—*Continued.*

Salt	Concentration of salt g. equiv. per l.	TlCl dissolved g. equiv. per l.
$CdCl_2$	0.025	0.01040
	0.05	0.0073
	0.10	0.00578
	0.20	0.00425
$CuCl_2$	0.025	0.00905
	0.05	0.00614
	0.10	0.00422
	0.20	0.00291
$MgCl_2$	0.025	0.00904
	0.05	0.00618
	0.10	0.00413
	0.20	0.00275
$MnCl_2$	0.025	0.00898
	0.05	0.00617
	0.10	0.00412
	0.20	0.00286
KCl	0.025	0.00872
	0.05	0.00593
	0.1	0.00399
	0.2	0.00265
NaCl	0.025	0.00869
	0.05	0.00592
	0.10	0.00395
	0.20	0.00271
$ZnCl_2$	0.025	0.00899
	0.05	0.00627
	0.10	0.00412
	0.20	0.00281
$TlClO_3$	0.025	0.00897
$TlNO_3$	0.025	0.00883
	0.05	0.00626
	0.10	0.00423

(Noyes, Z. phys. Ch. 1892, **9.** 609.)

Solubility of TlCl in salts+Aq at 25°.

Salt	Mols TlCl sol. in 1 liter of				
	0.5-N solution	N solution	2-N solution	3-N solution	4-N solution
NH_4NO_3	0.02587	0.03121	0.03966		
KNO_3	0.02566	0.03077	0.03904	...	...
$NaNO_3$	0.02564	0.03054	0.03851	0.04544	0.05128
$LiNO_3$	0.02542	0.03035	0.03785	0.04438	...
$KClO_3$	0.02370	...	...	...	...
$NaClO_3$	0.02320	0.02687	0.03060	0.03303	0.03850

(Geffcken, Z phys. Ch. 1904, **49.** 295.)

Insol. in alcohol. Easily sol. in hot $HgCl_2$+Aq. (Carstanjen.)

Solubility of TlCl in $HC_2H_3O_2$+Aq at 25°. (g. equiv. per l.)

Acid	TlCl
0.000	0.01629
0.5134	0.01580
1.013	0.01495
2.016	0.0132
4.180	0.0099
8.130	0.0054
11.49	0.0026
14.31	0.0012
16.01	0.0005

(Hill, J. Am. Chem. Soc. 1910, **32.** 1189.)

Insol. in pyridine (Naumann, B. 1904, **37.** 4610); acetone. (Naumann, B. 1904, **37.** 4329.)

Thallic chloride, $TlCl_3$.

Anhydrous.

Easily sol. in H_2O and in most ord. solvents.

In contact with moist air, it rapidly becomes hydrated. (Thomas, C. R. 1902, **135.** 1053.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Very sol. in acetone. (Renz, B. 1902, **35.** 1110.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+H_2O$. Deliquescent, and very easily sol. in H_2O. (Werther.)

Deliquescent, and very easily sol. in H_2O. (Werther.)

$+4H_2O$. 86.2 pts. are sol. in 100 pts. H_2O at 17°. Sp. gr. of sat. aq. solution at 17° = 1.85. (Thomas, C. R. 1902, **135.** 1052.)

Very hydroscopic. (Meyer, Z. anorg. 1900, **24.** 336.)

Very sol. in alcohol and ether. (Meyer, Z. anorg. 1900, **24.** 338.)

$+7\frac{1}{2}H_2O$. Deliquescent. (Werther.)

Thallothallic chloride, 3TlCl, $TlCl_3$.

1 pt. dissolves in pts. H_2O at t°, according to C = Crookes; H = Hebberling; L = Lamy.

15°	17°	100°	100°
380.1	346	52.9	20–25 pts. H_2O.
C	H	C	L

Sl. decomp. by dissolving. (Lamy.)

Thallic hydrogen chloride, $TlCl_3$, $HCl+3H_2O$.

Very hygroscopic.

Decomp. by H_2O. (Meyer, Z. anorg. 1900, **24.** 337.)

Thallium tungsten chloride, $Tl_3W_2Cl_9$.

Nearly insol. in H_2O.

Sol. in a hot mixture of equal pts. H_2O and conc. HCl.

Sl. sol. in conc. HCl.
Nearly insol. in most organic solvents. (Olsson, B. 1913, **46.** 575.)

Thallic zinc chloride, $2TlCl_3, ZnCl_2+6H_2O$.
Can be cryst. from H_2O. (Gewecke, A. 1909, **366.** 224.)

Thallic chloride ammonia, $TlCl_3, 3NH_3$.
Decomp. by H_2O. Sol. in HCl+Aq (Willm.)

Thallium chlorofluoride, $TlFCl_2$.
Very hydroscopic.
Decomp. by moist air.
Easily sol. in abs. alcohol. (Gewecke, A. 1909, **366.** 230.)
$+3H_2O$. Not hydroscopic.
Decomp. by H_2O, alcohol and ether. (Gewecke.)

Thallium chlorofluoride ammonia, $TlFCl_2, 4NH_3$.
Decomp. by H_2O.
Difficultly sol. in abs. alcohol and in ether. (Gewecke, A. 1909, **366.** 232.)

Thallium chlorofluoride potassium chloride, $2TlFCl_2, KCl$.
Ppt. (Gewecke, A. 1909, **366.** 231.)

Thallous fluoride, TlF.
Sol. in 1¼ pts. H_2O at 15°, and in much less hot H_2O. Difficultly sol. in alcohol. (Buchner, W. A. B. **52. 2.** 644.)
$+\frac{1}{2}H_2O$. Deliquescent. (Willm.)

Thallic fluoride, TlF_3.
Insol. in H_2O and cold HCl+Aq. (Willm.)
Cannot be obtained in pure state. (Gewecke, A. 1909, **366.** 218.)

Thallous hydrogen fluoride, TlF, HF.
Sol. in 1 pt. H_2O. (Buchner.)

Thallous tungstyl fluoride,
See **Fluoxytungstate, thallous.**

Thallous vanadium fluoride.
See **Fluovanadate, thallous.**

Thallous vanadyl fluoride.
See **Fluoxyvanadate, thallous.**

Thallous hydroxide, TlOH.
Sol. in H_2O and alcohol.

Solubility of TlOH in H_2O at t°.

t°	g. equiv. TlOH per l	Sp. gr. 15°/4°
0	1.151	1.231
18.5	1.554	1.317
19.5	1.582	1.322
29	1.803	1.342
23.1	1.861	1.377
33.1	1.967	1.400
36	2.075	1.417
40	2.240	1.446
44.5	2.442	...
54.1	2.940	...
59.4	3.281	...
64.6	3.601	...
78.5	4.673	...
90.0	5.705	...
99.2	6.708	...

(Bahr, Z. anorg. 1911, **71.** 87.)

The solubility of Tl_2O in H_2O at these temperatures is the same as that of TlOH.
$+H_2O$. (Willm, Bull. Soc. (2) **5.** 354.)

Thallic hydroxide, $Tl_2O_3, H_2O=TlO(OH)$.
Insol. in H_2O. Sol. in dil. acids and ammonium salts+Aq. Insol. in caustic alkali solutions.
$Tl(OH)_3$. Easily sol. in dil. HCl or H_2SO_4 +Aq. (Carnegie, C. N. **60.** 113.)

Thallous iodide, TlI.
Very sl. sol. in H_2O.
1 pt. TlI is sol. in pts. H_2O at t°. C=according to Crookes; H=according to Hebberling; L=according to Lamy; W=according to Werther.

35°	15°,	16°	16–17°	19.4°	
20,000	4450	16,000	11,676	14,654	pts. H_2O,
W	C	L	H	W	

20°	23.4°	45°	100°	100°	
11,954	10,482	5407	842	804	pts. H_2O.
W	W	W	C	H	

Sol. in 17,000 pts. H_2O at 20°. (Long, Z. anal. **30.** 342.)
Sat. solution at 20.15° contains 63.6 mg. or 1.92×10^{-4} g. mol. TlI per l. (Böttger, Z. phys. Ch. 1903, **46.** 603.)
1 l. H_2O dissolves 56 mg. TlI at 18°. (Kohlrausch, Z. phys. Ch. 1904, **50.** 356.)
36.2 mg. are dissolved in 1 l. of sat. solution at 9.90°; 56 mg. at 18.1°; 84.7 mg. at 26°. (Kohlrausch, Z. phys. Ch. 1908, **64.** 168.)
Solubility in H_2O at 25°$=1.76\times10^{-4}$ mol. per litre. (Spencer, Z. phys. Ch. 1912, **80.** 708.)
Not decomp. by dil. H_2SO_4, HCl, or alkalies +Aq. Decomp. by hot dil. HNO_3+Aq, and cold conc. HNO_3. Sol. in aqua regia.
Also less sol. in acetic acid than in H_2O. (Carstanjen.)

Insol. in NH_4OH+Aq. (Werther.) Not wholly insol. in NH_4OH+Aq, and solubility is increased by presence of $(NH_4)_2SO_4$ or NH_4Cl. (Baubigny, C. R. **113**. 544.)

Sol. in 13,000 pts. NH_4OH+Aq (6¼ or 2½% NH_3). Sol. in 17,000 pts. NH_4OH+Aq (1¼% NH_3). (Long.)

Insol. in dil. KI+Aq (1% KI). (Baubigny.)

Much more insol. in KI+Aq than in H_2O; 1 pt. dissolves in 75,000 pts. dil. KI+Aq. (Lamy.)

Nearly insol. in $Na_2S_2O_3$+Aq, and absolutely insol. therein in presence of Pb salts. (Werner, C. N. **53**. 51.)

Sol. in 56,336 pts. 85% alcohol at 13°. (Werther.) Sol. in 18,934 pts 98% alcohol at 19°. (Hebberling.)

When TlI is shaken with alcohol of 78°B (1 vol. H_2O+3 vols. 98% alcohol) at 22°, and let stand with TlI for 24 hours, and then evaporated to 1/5 vol., there is shown no ppt. by NH_4SH+Aq. (Baubigny.)

Sol. in 260,000 pts. 90% alcohol, and 37,000 pts. 50% alcohol at 20°. (Long.)

Insol. in methylene iodide. (Retgers, Z. anorg. **3**. 343.)

Insol. in acetone. (Naumann, B. 1904, **37**. 4329; Eidmann, C. C., **1899**, II. 1014.)

Insol. in pyridine. (Naumann, B. 1904, **37**. 4601.)

Thallic iodide, TlI_3.

Sol. in alcohol.

Decomp. slowly in the air. (Wells, Z. anorg. 1894, **6**. 313.)

Sol. in ether.

Thallothallic iodide, Tl_3I_4 = 5TlI, TlI_3.

Sol. in H_2O. (Jörgensen, J. pr. (2) **6**. 82.)

Thallium nitride.

Very unstable. (Franz Fischer, B. 1901, **43**. 1470.)

Thallous oxide, Tl_2O.

Deliquescent. Sol. in H_2O.

See **Thallous hydroxide.**

Thallic oxide, Tl_2O_3.

Insol. in H_2O. Not attacked by cold H_2SO_4. Sol. in hot H_2SO_4. Sol. in cold HCl +Aq.

Insol. in alkalies+Aq. (Werther, J. pr. **91**. 385.)

Black modification.

Less sol. in dil. acids than the brown modification. Solution is accompanied by a slight reduction to thallous salt.

More sol. in 10% HCl than in 10% H_2SO_4 or HNO_3.

More sol. in conc. than in dil. acids. (Rabe, Z. anorg. 1906, **48**. 431.)

Brown modification.

Easily sol. in dil. mineral acids on warming, with slight reduction to thallous salt.

More sol. in conc. acid. (Rabe.)

Thallium *di*oxide, TlO_2.

Insol. in H_2O. (Piccini, Gazz. ch. it. **17**. 450.)

Thallic oxide ammonia, Tl_2O_3, $6NH_3$.

Decomp. by much H_2O. Insol. in alcohol. (Carstanjen.)

Thallic oxyfluoride, TlOF.

Insol. in H_2O. Slowly decomp. by boiling with H_2O.

Sol. in mineral acids. Almost insol. in HF. (Gewecke, A. 1909, **366**. 226.)

Thallium phosphide (?).

Ppt. (Crookes.)

Thallous selenide, Tl_2Se.

Insol. in H_2O. Scarcely attacked by cold dil. H_2SO_4+Aq, but dissolves when heated. (Carstanjen.)

Thallothallic selenide.

Not attacked by cold conc. or boiling dil. H_2SO_4+Aq. Conc. H_2SO_4 decomposes. (Carstanjen.)

Thallous sulphide, Tl_2S.

Insol. in H_2O, $(NH_4)_2S$+Aq, NH_4OH+Aq, KCN+Aq, and in alkali carbonates, and hydrates +Aq. Difficultly sol. in a solution of oxalic acid or acetic acid. (Crookes.) Easily sol. in HNO_3, and H_2SO_4+Aq. Difficultly sol. in HCl+Aq. (Willm.)

Sl. sol. in H_2O.

0.21×10^{-4} g. is dissolved in 1 l. sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, **46**. 603.)

Insol. in acetone. (Naumann, B. 1904, **37**. 4329.)

Thallic sulphide, Tl_2S_3.

Insol. in H_2O. Insol. in cold, sol. in warm dil. H_2SO_4+Aq without separation of S. Sol. in other dilute acids with separation of S. (Carstanjen.)

Thallium *penta*sulphide, Tl_2S_5.

Ppt. (Hofmann, B. 1903, **36**. 3092.)

Thallothallic sulphide, $5Tl_2S$, $3Tl_2S_3$.

Very slowly decomp. by cold dil. H_2SO_4+Aq.

Tl_2S, Tl_2S_3. (Carstanjen.)

Tl_2S, $2Tl_2S_3$. Decomp. by dil. acids. (Schneider, J. pr. (2) **10**. 55.)

Thallium telluride, Tl_2Te.

(Fabre, C. R. **105**. 673.)

Thio-
For compounds with prefix **thio-**, *see also under* **sulpho-**.

Thioantimonic acid.
See **Sulphantimonic acid.**

Thioarsenic acid.
See **Sulpharsenic acid.**

Thiomolybdic acid.
See **Sulphomolybdic acid.**

Thionamic acid, $NH_3SO_2 = NH_2SO(OH)$.
Very deliquescent, and sol. in H_2O.
H_2O solution decomp. gradually. (Rose, Pogg. **33.** 275; **42.** 425.)

Ammonium thionamate, $NH_2SO(ONH_4)$.
Deliquescent. Sol. in H_2O; easily decomp. when in solution. (Rose.)
Very sol. in alcohol with decomp. Sl. sol. in dry ether. (Divers and Ogawa, C. C. **1900,** I. 1259.)

***Di*thionic acid.**
See **Dithionic acid.**

***Tri*thionic acid.**
See **Trithionic acid.**

***Tetra*thionic acid.**
See **Tetrathionic acid.**

***Penta*thionic acid.**
See **Pentathionic acid.**

Thionyl bromide, $SOBr_2$.
Unstable.
Decomp. by H_2O. (Besson, C. R. 1896, **122.** 322.)

Thionyl bromochloride, SOClBr.
Decomp. slowly in the cold, rapidly at 115°.
Decomp. by H_2O. (Besson C. R. 1896, **122.** 321.)

Thionyl chloride, $SOCl_2$.
Sol. in $CHCl_3$, and C_6H_6. (Oddo, Gazz. ch. it. 1899, **29.** (2) 318.)

Thionyl fluoride, SOF_2.
Decomp. by H_2O.
Sol. in $AsCl_3$, C_6H_6, ether and oil of turpentine. (Moissan, C. R. 1900, **130.** 1439.)

Thiophosphamic acid, $H_2PNH_2O_2S$ (?).
Known only in its salts. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Cadmium thiophosphamate, $CdPNH_2O_2S$.
Sol. in dil. acids, and NH_4OH+Aq. (G. and H.)

Lead ——, $PbPNH_2O_2S$.
Ppt. Sol. in dil. HNO_3+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Thiophospho*di*amic acid, $H_2PN_2H_4OS$.
Known only in solution, which soon decomposes. (G. and H.)

Cadmium thiophospho*di*amate, $Cd(PN_2H_4OS)_2$.
Insol. in H_2O; sol. in dil. acids, and NH_4OH +Aq. (G. and H.)

Cupric ——, $Cu(PN_2H_4OS)_2$.
Insol. in H_2O, dil. HCl, or NH_4OH+Aq. Sol. in KCN+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Lead ——, $Pb(PN_2H_4OS)_2$.
Insol. in H_2O. Sol. in dil. HNO_3+Aq.

Nickel ——, $Ni(PN_2H_4OS)_2$.
Sol. in dil. acids, and NH_4OH+Aq. (Gladstone and Holmes, Chem. Soc. (2) **3.** 1.)

Zinc ——, $Zn(PN_2H_4OS)_2$.
Ppt. Sol. in dil. acids, and NH_4OH+Aq. (Gladstone and Holmes.)

Thiophosphonitrile, PSN.
Not decomp. by cold H_2O. Slowly decomp. by boiling H_2O. Easily decomp. by boiling dil. HCl. (Stock, B. 1906, **39.** 1974.)

Thiophosphoric acid, $H_3PSO_3 = PS(OH)_3$.
Known only in its salts.

Ammonium magnesium thiophosphate, $NH_4MgPSO_3+9H_2O$.
Sl. sol. in cold H_2O. (Kubierschky, J. pr. (2) **31.** 100.)

Barium ——, $Ba_3(PSO_3)_2$.
Insol. in H_2O. (Wurtz, A. ch. (3) **20.** 473.)

Cobalt ——.
Insol. in H_2O, but partially decomp. when boiled therewith. (Wurtz.)

Cupric ——.
Insol. in H_2O; very easily decomp. (Wurtz.)

Ferric ——.
Insol. in H_2O. (Wurtz.)

Magnesium ——, $Mg_3(PSO_3)_2+20H_2O$.
Sl. sol. in cold H_2O. (Kubierschky, J. pr. (2) **31.** 99.)

Nickel thiophosphate.

Insol. in H_2O, but decomp. when boiled therewith. (Wurtz.)

Potassium ——, K_3PSO_3.

Very sol. in H_2O. Known only in aqueous solution. (Wurtz.)

Sodium ——, $Na_3PSO_3+12H_2O$.

Easily sol. in boiling H_2O. Cryst. out on cooling. (Wurtz, A. ch. (3) **20.** 472.)
Insol. in alcohol.

Strontium ——.

Insol. in H_2O. (Wurtz.)

*Di*thio*meta*phosphoric acid.

Ammonium *di*thio*meta*phosphate, NH_4PS_2O.

Decomp. by H_2O. (Stock, B. 1906, **39.** 1990.)

*Mono*thio*ortho*phosphoric acid.

***Mono*ammonium *mono*thio*ortho*phosphate**, $O:P(SNH_4)(OH)_2$.

Sol. in H_2O.
Insol. in alcohol. (Stock, B. 1906, **39.** 1990.)

***Tri*ammonium *mono*thio*ortho*phosphate**, $SNH_4.PO.(ONH_4)_2$.

(Stock.)

*Di*thio*ortho*phosphoric acid.

Ammonium *di*thiophosphate, $(NH_4)_3PS_2O_2+2H_2O$.

Sl. efflorescent. Sol in H_2O. (Kubierschky, J. pr. (2) **31.** 93.)

Ammonium magnesium ——, $NH_4MgPS_2O_2+6H_2O$.

Sl. sol. in cold, H_2O. (Kubierschky.)

Barium ——, $Ba_3(PS_2O_2)_2+8H_2O$.

Precipitate. (Kubierschky, J. pr. (2) **31.** 103.)
$+18H_2O$. As the *tri*thio compound. (Ephraim, B. 1910, **43.** 287.)

Calcium ——.

Very easily decomposed. (Kubierschky.)

Sodium ——, $Na_3PS_2O_2+11H_2O$.

Very sol. in H_2O. (Kubierschky, J. pr. (2) **31.** 93.)

*Tri*thio*ortho*phosphoric acid.

Ammonium *tri*thio*ortho*phosphate, $(NH_4)_3PS_3O+H_2O$.

(Stock, B. 1906, **39.** 1985.)

Barium *tri*thio*ortho*phosphate, $Ba_3(PS_3O)_2+20H_2O$.

Decomp. by H_2O and dil. acids.
Sol. in conc. HNO_3 with oxidation of the sulphur to H_2SO_4. (Ephraim, B. 1910, **43.** 286.)

Magnesium ——, $Mg_3(PS_3O)_2+20H_2O$.

Decomp. by H_2O and dil. acids. (Ephraim.

Thiophosphorous acid.

Ammonium thiophosphite (?), $(NH_4)_4P_2S_2O_3+3H_2O$

Sol. in H_2O. (Lemoine, C. R. **98.** 45.)
$+6H_2O$.

Sodium thiophosphite (?), $Na_4P_2S_2O_3+5H_2O=P_2O_3,\ 2Na_2S+5H_2O$.

Sol. in H_2O. (Lemoine, C. R. **98.** 45.)
$Na_6P_2S_2O_4+4H_2O=P_2O_3,\ 3Na_2O,\ 2H_2S+2H_2O$. Sol. in H_2O. (Lemoine, *l. c.*)

Thiophosphoryl *tri*amide, $PS(NH_2)_3$.

Rapidly decomp. by H_2O. Scarcely sol. in alcohol, ether, or CS_2. (Chevrier, C. R. **66.** 748.)

***Meta*thiophosphoryl bromide**, PS_2Br.

Decomp. by H_2O. Insol. in ether. (Michaelis, A. **164.** 9.)

***Ortho*thiophosphoryl bromide**, $PSBr_3$.

Slowly decomp. by cold, rapidly by hot H_2O but volatile with only partial decomp. with steam. Easily sol. in ether, CS_2, PCl_3, PBr_3. Decomp. by cold alcohol. Forms hydrate $PSBr_3+H_2O$. (Michaelis, A. **164.** 9.)

***Pyro*thiophosphoryl bromide**, $P_2S_3Br_4$.

Decomp. by H_2O and alcohol. Sol. in CS_2 and ether. (Michaelis.)

Thiophosphoryl phosphorus bromide, $PSBr_3$, PBr_3.

Decomp. by H_2O into $PSBr_3$. (Michaelis.)

Thiophosphoryl *di*bromochloride, $PSClBr_2$.

Decomp. by H_2O and alkalies.
Fumes in the air. (Besson, C. R. 1896, **122.** 1059.)

Thiophosphoryl bromo*di*chloride, $PSCl_2Br$.

Decomp. by H_2O and alkalies. Reacts violently with HNO_3. (Besson, C. R. 1896, **120.** 1058.)

Thiophosphoryl chloride, $PSCl_3$.

Very slowly decomp. by H_2O, and may be distilled with steam without much decomp. Decomp. by alcohol. Miscible with CS_2. (Baudrimont, J. pr. **87.** 301.)
Sol. in CCl_4 and C_6H_6. (Oddo, Gazz. ch. it. 1899, **29.** (2) 318.)

Thiophosphoryl *penta*chloride, PS_2Cl_5 (?).

Decomp. by H_2O. Sol. in alkalies with residue of S. Attacked violently by HNO_3, alcohol, ether, oil of turpentine. Miscible with CS_2. (Gladstone, Chem. Soc. **3.** 5.)

Thiophosphoryl fluoride, PSF_3.

Slowly sol. in H_2O with decomp. Sl. sol. in ether.

Insol. in H_2SO_4, CS_2, or benzene. (Thorpe and Rodger, Chem. Soc. **55.** 306.)

More sol. in KOH or NaOH+Aq than in H_2O.

Thiophosphoryl iodide, P_2SI_2.

Very sol. in CS_2. Unstable when heated. Fumes in the air. (Besson, C. R. 1896, **122.** 1201.)

Thiosulphuric (*formerly* Hyposulphurous) acid, $H_2S_2O_3$.

Known only in aqueous solution, which is extremely unstable, and decomposes very quickly after its formation. The time before decomposition is exactly proportional to the ratio of the weight of H_2O to the weight of $H_2S_2O_3$ present; *i. e.*, if one solution contains twice as much H_2O for a given amt. of $H_2S_2O_3$ as a second solution, the first solution will decompose in twice the length of time. The length of time is about 20 secs. at 10°, and 2 secs. at 50° for conc. solutions, to 120 secs. at 10° and 12 secs. at 50° for very dilute solutions. (See Landolt (B. **16.** 2958) for further figures; also Winkelmann (B. **18.** 406).

Thiosulphates.

The thiosulphates of the alkalies and of Ca and Sr are easily sol. in H_2O; Ba and Sr salts are sl. sol. and the other salts insol. The salts of the metals dissolve in alkali thiosulphates + Aq. All are insol. in alcohol.

Double Salts of Thiosulphuric acid. It is impossible to determine whether substances of this class are true chem. individuals. Many described by Svensson and others are doubtless isomorphic mixtures, whose comp. depends on the temp. and conc. of the solution in which pptd. (Rosenheim, Z. anorg. 1900, **25.** 72.)

Ammonium thiosulphate, $(NH_4)_2S_2O_3$.

Very deliquescent. Very sol. in H_2O.

Not deliquescent. (Fock and Klüss, B. 1889, **22.** 3099.)

Crystallises with $^1/_3H_2O$. (Rammelsberg, Pogg. **56.** 298.) Anhydrous. (Arppe, A. **96.** 113.)

Insol. in alcohol. (Arppe.)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Ammonium cadmium thiosulphate, $3(NH_4)_2S_2O_3$, $CdS_2O_3+3H_2O$.

Can be recryst. from warm H_2O. (Fock and Klüss, B. **23.** 1758.)

$+H_2O$. (F. and K.)

$(NH_4)_2S_2O_3$, CdS_2O_3. (F. and K.)

Ammonium cuprous thiosulphate, $(NH_4)_2S_2O_3$, $Cu_2S_2O_3+2H_2O$.

Less sol. in H_2O than $2(NH_4)_2S_2O_3$, $Cu_2S_2O_3+1\frac{1}{2}H_2O$. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 91.)

$2(NH_4)_2S_2O_3$, $Cu_2S_2O_3+1\frac{1}{2}H_2O$. Very sol. in H_2O. Insol. in alcohol. (Rosenheim and Steinhäuser.)

Ammonium cuprous thiosulphate cuprous iodide, $7(NH_4)_2S_2O_3$, $Cu_2S_2O_3$, $8CuI+4H_2O$.

Insol. in H_2O. (Brun, C. R. 1892, **114.** 668.)

Could not be obtained. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 107.)

Ammonium cuprous sodium thiosulphate ammonia, $3Cu_2S_2O_3$, $4Na_2S_2O_3$, $(NH_4)_2S_2O_3$, $6NH_3$.

Ppt. When dry is fairly stable in the air. Partially decomp. by H_2O.

Sol. in dil. H_2SO_4 or acetic acid. (Shinn, J. Am. Chem. Soc. 1904, **26.** 948.)

Ammonium lead thiosulphate, $2(NH_4)_2S_2O_3$, $PbS_2O_3+3H_2O$.

Easily and completely sol. in cold H_2O, but deposits PbS_2O_3 by standing or warming. (Rammelsberg, Pogg. **56.** 312.)

Ammonium magnesium thiosulphate, $(NH_4)_2Mg(S_2O_3)_2+6H_2O$.

Very deliquescent, and sol. in H_2O. (Kessler, Pogg. **74.** 283.)

Not deliquescent. (Fock and Klüss, B. **23.** 540.)

Ammonium mercuric thiosulphate, $4(NH_4)_2S_2O_3$, $HgS_2O_3+2H_2O$.

Sol. in H_2O, from which it is precipitated by alcohol. Extremely easily decomp. (Rammelsberg, Pogg. **56.** 318.)

Ammonium potassium thiosulphate, $NH_4KS_2O_3$.

Sol. in H_2O. (Fock and Klüss, B. **23.** 536.)

Ammonium silver thiosulphate, $2(NH_4)_2S_2O_3$, $Ag_2S_2O_3+xH_2O$.

Easily sol. in H_2O. Somewhat sol. in alcohol. (Herschel, Edinb. Phil. J. **1.** 398.)

$(NH_4)_2S_2O_3$, $Ag_2S_2O_3+xH_2O$. Nearly insol. in H_2O; sol. in NH_4OH+Aq, from which it is repptd. by an acid. (Herschel.)

Ammonium zinc thiosulphate, $(NH_4)_2S_2O_3$, $ZnS_2O_3+H_2O$.

Very sol. in H_2O. (Rosenheim and Davidsohn, Z. anorg. 1904, **41.** 238.)

Ammonium thiosulphate ammonium cuprous bromide, CuBr, NH_4Br, $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim, Z. anorg. 1900, **25.** 107.)

The double salts of ammonium thiosulphate with silver and copper haloids are true chemical compounds and may be recryst. from H_2O without decomp. (Rosenheim, Z. anorg. 1900, **25.** 100.)

Ammonium thiosulphate ammonium silver bromide, AgBr, NH_4Br. $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim.)

Ammonium thiosulphate ammonium cuprous chloride, CuCl, NH_4Cl, $4(NH_4)_2S_2O_3$.

Sol. in H_2O and in NH_4OH+Aq. (Rosenheim.)

Ammonium thiosulphate ammonium silver chloride, AgCl, NH_4Cl, $4(NH_4)_2S_2O_3$.

Sol. in cold H_2O and NH_4OH+Aq.

Decomp. by boiling with H_2O and by dil. acids. (Rosenheim.)

Ammonium thiosulphate ammonium cuprous cyanide.

Composition not constant. (Rosenheim.)

Ammonium thiosulphate ammonium silver cyanide.

Composition not constant. (Rosenheim.)

Ammonium thiosulphate ammonium cuprous iodide, CuI, NH_4I, $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim.)

Ammonium thiosulphate ammonium cuprous iodide, $4(NH_4)_2S_2O_3$, NH_4I, CuI.

Very sol. in H_2O. Decomp. by boiling. (Brun, C. R. 1892, **114.** 668.)

Ammonium thiosulphate ammonium silver iodide, AgI, NH_4I, $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim.)

Ammonium thiosulphate ammonium cuprous sulphocyanide, CuSCN, NH_4SCN, $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim.)

Ammonium thiosulphate ammonium silver sulphocyanide, AgSCN, NH_4SCN, $4(NH_4)_2S_2O_3$.

Sol. in H_2O. (Rosenheim.)

Ammonium thiosulphate cuprous iodide, $(NH_4)_2S_2O_3$, $2CuI+H_2O$.

Insol. in H_2O. (Brun, C. R. 1892, **114.** 668.)

Could not be obtained. (Rosenheim and Steinhäuser.)

Barium thiosulphate, $BaS_2O_3+H_2O$.

Sl. sol. in H_2O. (Rose, Pogg. **21.** 437.)

Insol. in alcohol.

1 pt. cannot be dissolved in 2000 pts. H_2O.

Sol in dil. HCl+Aq without decomposition. (Herschel, **1819.**)

Pptd. from BaS_2O_3+Aq by dil. alcohol. (Sobrero and Selmi, A. ch. (3) **28.** 211.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Barium bismuth thiosulphate, $Ba_3[Bi(S_2O_3)_3]_2$.

Sol. in H_2O with decomp. (Hauser, Z. anorg. 1903, **35.** 9.)

Barium cadmium thiosulphate, $2BaS_2O_3$, $CdS_2O_3+8H_2O$.

Sl. sol. in H_2O. (Fock and Klüss, B. **23.** 1761.)

$3BaS_2O_3$, $CdS_2O_3+8H_2O$. Sl. sol. in H_2O.

Barium cuprous thiosulphate.

Easily sol. in hot, difficultly sol. in cold H_2O. (Cohen, Chem. Soc. **51.** 38.)

$2BaS_2O_3$, $Cu_2S_2O_3+7H_2O$. Nearly insol. in H_2O. (Vortmann, M. **9.** 165.)

Barium gold thiosulphate.

Sl. sol. in H_2O. Insol. in alcohol. (Fordos and Gélis.)

Barium lead thiosulphate.

Difficultly sol. in H_2O. (Rammelsberg, Pogg. **56.** 313.)

Barium thiosulphate chloride, BaS_2O_3, $BaCl_2+2H_2O$.

Sol. in H_2O. (Fock and Klüss, B. **23.** 3001.)

Bismuth cæsium thiosulphate, $Cs_3Bi(S_2O_3)_3$.

Sol. in H_2O.

Insol. in alcohol. (Hauser, Z. anorg. 1903, **35.** 8.)

Bismuth potassium thiosulphate, $K_3Bi(S_2O_3)_3$ $+\frac{1}{2}H_2O$.

Solubility in H_2O.

100 cc. of the sat. solution contain 3.5 g. at 2°; 7.0 g. at 18°. At 18° the solution decomposes.

More sol. in $Na_2S_2O_3$+Aq than in pure H_2O.

Insol. in alcohol. (Hauser, Z. anorg. 1903, **35.** 5.)

$+H_2O$. Sol. in H_2O. Insol. in alcohol. (Carnot, C. R. **83.** 390.)

Bismuth rubidium thiosulphate, $Rb_3Bi(S_2O_3)_3+\frac{1}{2}H_2O$.

Sol. in H_2O.
Insol. in acid alcohol. (Hauser, Z. anorg. 1903, **35.** 7.)
$+H_2O$. Sol. in H_2O. (Hauser, Z. anorg. 1903, **35.** 8.)

Bismuth sodium thiosulphate,

Very sol. in H_2O, and also in alcohol. (Carnot, C. R. **83.** 338.)
$Na_3Bi(S_2O_3)_3$. Decomp. by H_2O. Easily sol. in 50% alcohol. (Hauser, Z. anorg. 1903, **35.** 3.)

Cadmium thiosulphate, $CdS_2O_3+2H_2O$.

Sol. in H_2O. Insol. in alcohol. (Vortmann and Padberg, B. **22.** 2638.)

Cadmium potassium thiosulphate, $3CdS_2O_3$, $5K_2S_2O_3$.

Cannot be recryst. without decomp. (Fock and Klüss, B. **23.** 1753.)
CdS_2O_3, $3K_2S_2O_3+2H_2O$. Can be crystallised from H_2O without decomp. (F. and K.)

Cadmium sodium thiosulphate, CdS_2O_3, $3Na_2S_2O_3+16H_2O$.

Not deliquescent. Sol. in H_2O. (Jochum, C. C. **1885,** 642.)
$+9H_2O$. (Vortmann and Padberg, B. **22.** 2639.)
$+3H_2O$. Deliquescent. (Fock and Klüss, B. **23.** 1157.)
$2CdS_2O_3$, $Na_2S_2O_3+7H_2O$. (V. and P.)
$3CdS_2O_3$, $Na_2S_2O_3+9H_2O$. (V. and P.)

Cadmium strontium thiosulphate, CdS_2O_3, $3SrS_2O_3+10H_2O$.

(Fock and Klüss, B. **23.** 1763.)

Cæsium thiosulphate, $Cs_2S_2O_3$.

Easily sol. in H_2O. (Chabrié, C. R. 1901, **133.** 297.)
$+2H_2O$. Very hydroscopic. (J. Meyer, B. 1907, **40.** 1360.)

Cæsium cuprous thiosulphate, $Cs_2S_2O_3$, $Cu_2S_2O_3+2H_2O$.

Easily sol. in H_2O with decomp. (J. Meyer, B. 1907, **40.** 1361.)

Cæsium lead thiosulphate, $Cs_2S_2O_3$, $PbS_2O_3+2H_2O$.

Not hydroscopic.
$2Cs_2S_2O_3$, $PbS_2O_3+3H_2O$. Hydroscopic. (J. Meyer.)

Cæsium magnesium thiosulphate, $Cs_2S_2O_3$, $MgS_2O_3+6H_2O$.

Easily sol. in H_2O. (Meyer.)

Cæsium silver thiosulphate, $2Cs_2S_2O_3$, $Ag_2S_2O_3+3H_2O$.

Not hydroscopic.
Decomp. by hot H_2O. (J. Meyer.)

Calcium thiosulphate, $CaS_2O_3+6H_2O$.

Sol. in 1 pt. H_2O at 3°.
Aqueous solution saturated at 10° has sp. gr. 1.300. Solution with sp. gr. 1.11437 at 15.5° contains 0.2081 of its weight in CaS_2O_3.
Decomp. on heating. Insol. in alcohol (sp. gr. 0.8234). (Herschel, A. ch. **14.** 355.)
100 g. sat. solution contains 29.4 g. CaS_2O_3 at 9°, and 34.7 g. CaS_2O_3 at 25°. (Kremann and Rodemund, M. 1914, **35.** 1065.)

Solubility of $CaS_2O_3+Na_2SO_3$ in H_2O.

t°	% $Na_2S_2O_3$	% CaS_2O_3	Solid phase
9	0	29.4	CaS_2O_3, $6H_2O$
	11.04	22.64	"
	25.21	15.84	" $+Na_2S_2O_3$, $5H_2O$
	31.01	7.70	$Na_2S_2O_3$, $5H_2O$
25	0	34.7	CaS_2O_3, $6H_2O$
	9.24	29.69	"
	15.67	21.41	"
	18.34	25.18	"
	28.24	21.14	"
	30.19	20.33	" $+Na_2S_2O_3$, $5H_2O$
	31.24	18.43	$Na_2S_2O_3$, $5H_2O$
	35.04	11.61	"

(Kremann and Rodemund, M. 1914, **35.** 1065.)

Calcium lead thiosulphate, $2CaS_2O_3$, $PbS_2O_3+4H_2O$.

Decomp. by H_2O. (Rammelsberg.)

Calcium potassium thiosulphate, CaS_2O_3, $3K_2S_2O_3+5H_2O$.

Sol. in H_2O. (Fock and Klüss, B. **24.** 3016.)

Calcium silver thiosulphate, $2CaS_2O_3$, $Ag_2S_2O_3+xH_2O$.

Easily sol. in H_2O; less sol. in alcohol.
CaS_2O_3, $Ag_2S_2O_3+xH_2O$. Sl. sol. in H_2O, abundantly in NH_4OH+Aq. (Herschel, **1819.**)

Calcium sodium thiosulphate nitrate, $CaNa_3(S_2O_3)_2NO_3+11H_2O$.

(Kremann and Rothemund, M. 1914, **35.** 1065.)

Cobaltous thiosulphate, $CoS_2O_3+6H_2O$.

Sol. in H_2O. (Rammelsberg.)

Cobaltous sodium thiosulphate, $2CoS_2O_3$, $5Na_2S_2O_3+25H_2O$.

Efflorescent. Sol. in H_2O. (Jochum.)
Could not be obtained by Vortmann and Padberg.

CoS_2O_3, $3Na_2S_2O_3+15H_2O$. Sol. in H_2O. (Vortmann and Padberg, B. **22.** 2641.)

Cuprous thiosulphate, $Cu_2O, 3S_2O_2+2H_2O = Cu_2H_4(S_2O_3)_2$.

Sl. sol. in H_2O. Abundantly sol. in $Na_2S_2O_3+Aq$, NH_4Cl+Aq, NH_4OH+Aq, or $(NH_4)_2CO_3+Aq$. Sol. in HCl or HNO_3+Aq. (v. Hauer, W. A. B. **13.** 443.)

Cuprous hydrazine thiosulphate, $Cu_2S_2O_3$, $(N_2H_4)_2H_2S_2O_3+\frac{1}{2}H_2O$.

Insol. in H_2O; sol. in NH_4OH+Aq and in dil. acids. (Ferratini, C. C. **1912,** I. 1281.)

Cupric lead thiosulphate, $Pb(CuS_2O_3)_2+3H_2O$. (?)

Very sol. in H_2O and quickly decomp. (Girard, C. C. **1904,** I. 253.)

Cuprous mercurous thiosulphate, $5Cu_2S_2O_3$, $3Hg_2S_2O_3$.

Insol. or sl. sol. in cold, decomp. by boiling H_2O. HNO_3+Aq dissolves out Cu. (Rammelsberg, Pogg. **56.** 319.)

Cuprous potassium thiosulphate, $Cu_2S_2O_3$, $K_2S_2O_3+2H_2O$.

Sl. sol. in H_2O; decomp. on heating with pptn. of CuS. Easily sol. in $K_2S_2O_3+Aq$. (Rammelsberg, Pogg. **56.** 321.)

$Cu_2S_2O_3$, $2K_2S_2O_3$. Very sol. in cold H_2O; insol. in $K_2S_2O_3+Aq$. (Cohen, Chem. Soc. **51.** 39.)

$+3H_2O$. Scarcely sol. in cold, sol. with sl. decomp. in hot H_2O. Sol. in HCl+Aq with evolution of SO_2.

$Cu_2S_2O_3$, $3K_2S_2O_3+3H_2O$. More sol. in H_2O than $Cu_2S_2O_3$, $K_2S_2O_3+2H_2O$. Solution is not decomp. by boiling. Sol. in excess of NH_4OH+Aq. (Rammelsberg.)

Cuprous rubidium thiosulphate, $Rb_2S_2O_3$, $Cu_2S_2O_3+2H_2O$.

Ppt. (J. Meyer, B. 1907, **40.** 1357.)

$2Rb_2S_2O_3$, $Cu_2S_2O_3+2H_2O$. Ppt. (J. Meyer.)

$3Rb_2S_2O_3$, $Cu_2S_2O_3+2H_2O$. Ppt. (J. Meyer.)

Cuprous silver sodium thiosulphate ammonia, $Cu_2S_2O_3$, $2Ag_2S_2O_3$, $5Na_2S_2O_3$, $6NH_3$.

Ppt. Becomes dark when exposed to light. Decomp. by H_2O. Sol. in NH_4OH+Aq. (Shinn, J. Am. Chem. Soc. 1904, **26.** 949.)

Cuprous sodium thiosulphate, $2Cu_2S_2O_3$, $7Na_2S_2O_3+2H_2O$.

Ppt. from aqueous solution by alcohol. (Jochum, C. C. **1885.** 642.)

$+12H_2O$. Sol. in very dil. HCl+Aq. (Jochum.)

$Cu_2S_2O_3$, $3Na_2S_2O_3+2H_2O$. Sol. in H_2O; insol. in alcohol. (Rammelsberg.)

$+6H_2O$. (Jochum.)

$3Cu_2S_2O_3$, $2Na_2S_2O_3+8H_2O$. Decomp. by H_2O. (Vortmann.)

$+5H_2O$. (Lenz A. **40.** 99.) Formula according to Jochum is—

$5Cu_2S_2O_3$, $4Na_2S_2O_3+8H_2O$. Insol. in H_2O or alcohol. Sol. in HCl+Aq without evolution of SO_2, also in dil. H_2SO_4 or HNO_3+Aq. Sol. in NH_4OH+Aq. (Jochum.)

$+6H_2O$. As above. (Jochum.)

$Cu_2S_2O_3$, $Na_2S_2O_3+H_2O$. Insol. in H_2O; sol. in $Na_2S_2O_3+Aq$. (Russell, Ch. Ztg. **9.** 233.)

$+2H_2O$. Insol. in H_2O and alcohol.

Decomp. by dil. acids. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 84.)

$+2\frac{1}{2}H_2O$. Sol. in H_2O. Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, **17.** 1.)

$+3H_2O$. Decomp. by H_2O. (Vortmann, M. 1888, **9.** 168.)

$3Cu_2S_2O_3$, $2Na_2S_2O_3$. (Gerard, C. C. **1904,** I. 253.)

$+5H_2O$. Sol. in 352 pts. H_2O. (Russell, Ch. Z. 1885, **9.** 223.)

100 cc. 5% $Na_2S_2O_3+Aq$	dissolve	12.28 g.
" " 7.5% "	"	17.46 g.
" " 10% "	"	22.54 g.

(Russell, Ch. Z. 1885, **9.** 223.)

$4Cu_2S_2O_3$, $3Na_2S_2O_3+6H_2O$. Insol. in H_2O and alcohol.

Decomp. by dil. acids. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 84.)

$+9H_2O$. Sol. in H_2O. Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, **17.** 1.)

$7Cu_2S_2O_3$, $5Na_2S_2O_3+16H_2O$. Decomp. by H_2O and by alcohol. (Bhaduri, Z. anorg. 1898, **17.** 1.)

It is impossible to determine whether any of these compds. are complex or double salts. As a class they are not easily sol. and decomp. in solution. They may therefore be mixtures whose comp. depended upon the temp. and conc. of the solution in which they were pptd. (Rosenheim, Z. anorg. 1900, **25.** 81.)

Cuprocupric sodium thiosulphate ammonia, $Cu_2S_2O_3$, CuS_2O_3, $2Na_2S_2O_3$, $4NH_3$.

Insol. in, but decomp. by hot H_2O. Sol. in $HC_2H_3O_2+Aq$. Sol. in NH_4OH+Aq or $Na_2S_2O_3+Aq$. (Schütte, C. R. **42.** 1267.)

Cuprous sodium thiosulphate cuprous chloride, $Cu_2S_2O_3$, $2Na_2S_2O_3$, 2CuCl.

(Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 86.)

Cupric sodium thiosulphate cupric sulphide, $Cu_2S_2O_3$, $Na_2S_2O_3$, $CuS+4H_2O$.

Sl. sol. in H_2O; easily sol. in $Na_2S_2O_3+Aq$, and NH_4OH+Aq; insol. in alcohol. (Lenz, A. **40.** 99.)

$Cu_2S_2O_3$, $Na_2S_2O_3$, 2CuS. Sol. in H_2O or dil. HCl+Aq. (Kessel, B. **11.** 1585.)

Cuprous sodium thiosulphate sodium chloride, $3Cu_2S_2O_3$, $2Na_2S_2O_3$, $4NaCl+8H_2O$.

Sol. in $Na_2S_2O_3$+Aq. (Siewert, Zeit. ges. Naturwiss. **26.** 486.)

Ppt. (Bhaduri, Z. anorg. 1898, **17.** 3.)

Cupric thiosulphate ammonia, CuS_2O_3, $4NH_3$.

100 pts. H_2O dissolve 21.79 pts. at 25°. (Pudschies, Dissert.)

Cuprocupric thiosulphate ammonium chloride, Cu_2O, CuO, $3S_2O_2$, $2NH_4Cl$.

Sol. in HNO_3+Aq with separation of S. (v. Hauer, W. A. B. **13.** 447.)

Glucinum thiosulphate, $GlS_2O_3+11H_2O$.

(Faktor, C. C. **1901,** II. 878.)

Gold (aurous) hydrogen thiosulphate, $Au_2S_2O_3$, $3H_2S_2O_3$.

Known only in solution. (Fordos and Gélis, A. ch. (3) **13.** 394.)

Gold (aurous) sodium thiosulphate, $Au_2S_2O_3$, $3Na_2S_2O_3+4H_2O$.

Sol. in H_2O; solution decomp. on heating. Insol. in absolute, sl. sol. in dil. alcohol. (Fordos and Gélis.)

$Au_2S_2O_3$, $6Na_2S_2O_3+10H_2O$. Very sol. in H_2O, but decomp. by boiling. (Jochum, C. C. **1885.** 642.)

Iron (ferrous) thiosulphate, $FeS_2O_3+5H_2O$.

Deliquescent. Very sol. in H_2O or alcohol. (Koene, Pogg. **63.** 241.)

Iron (ferrous) sodium thiosulphate, FeS_2O_3, $3Na_2S_2O_3+8H_2O$.

Very sol. in H_2O, and easily decomp. (Vortmann and Padberg, B. **22.** 2641.)

Lead thiosulphate, PbS_2O_3.

Sol. in 3266 pts. H_2O. Sol. in alkali thiosulphates +Aq. (Rammelsberg, Pogg. **56.** 308.)

Lead lithium thiosulphate, PbS_2O_3, $Li_2S_2O_3$.

Very hydroscopic.

Decomp. by H_2O with separation of PbS. (J. Meyer, B. 1907, **40.** 1355.)

Lead potassium thiosulphate, PbS_2O_3, $3K_2S_2O_3+2H_2O$.

Sol. in H_2O with partial separation of PbS_2O_3. Sol. in $K_2S_2O_3$+Aq. (Rammelsberg, Pogg. **56.** 310.)

Lead rubidium thiosulphate, $2Rb_2S_2O_3$, $PbS_2O_3+2H_2O$.

Difficultly sol. in cold H_2O.

Decomp. by H_2O. (J. Meyer, B. 1907, **40.** 1358.)

Lead sodium thiosulphate, PbS_2O_3, $2Na_2S_2O_3$.

Sl. sol. in H_2O. Very easily sol. in $NaC_2H_3O_2$ and $Na_2S_2O_3$+Aq. (Lenz, A. **40.** 98.)

Insol. in alcohol.

$2PbS_2O_3$, $5Na_2S_2O_3+60H_2O$. Easily decomp. (Jochum, C. C. **1885.** 642.)

PbS_2O_3, $3Na_2S_2O_3+12H_2O$. Decomp. in boiling aqueous solution. (Vortmann and Padberg, B. **22.** 2637.)

Lead strontium thiosulphate.

Sol. in H_2O. Precipitated as a syrup by alcohol. (Rammelsberg.)

Lithium thiosulphate, $Li_2S_2O_3+3H_2O$.

Very deliquescent, and sol. in H_2O and absolute alcohol. (Fock and Klüss, B. **22.** 3099.)

Lithium silver thiosulphate, $Li_2S_2O_3$, $Ag_2S_2O_3$ $+H_2O$.

Hygroscopic.

Decomp. by boiling H_2O and by acids. (Meyer and Eggeling, B. 1907, **40.** 1355.)

Magnesium thiosulphate, $MgS_2O_3+6H_2O$.

Very easily sol. in H_2O. Precipitated from conc. solution by alcohol. (Rammelsberg, Pogg. **56.** 303.)

Magnesium potassium thiosulphate, $MgK_2(S_2O_3)_2+6H_2O$.

Deliquescent, and sol. in H_2O. Less sol. than $K_2S_2O_3$. (Rammelsberg, Pogg. **56.** 304.)

Not deliquescent. (Fock and Klüss, B. **23.** 539.)

Magnesium rubidium thiosulphate, MgS_2O_3, $Rb_2S_2O_3+6H_2O$.

Easily sol. in H_2O. (Meyer, B. 1907, **40.** 1358.)

Manganous thiosulphate, MnS_2O_3.

Sol. in H_2O, from which it is pptd. by alcohol. (Rammelsberg, Pogg. **56.** 305.)

$+5H_2O$. Decomp. very easily. (Vortmann and Padberg, B. **322.** 2641.)

Manganous sodium thiosulphate, MnS_2O_3, $2Na_2S_2O_3+16H_2O$.

Sol. in H_2O. Insol. or but sl. sol. in alcohol. (Jochum, C. C. **1885.** 642.)

Mercuric potassium thiosulphate, $3HgS_2O_3$, $5K_2S_2O_3$.

Sol. in 10 pts. H_2O at 15°, and ½ pt. at 100°. Aqueous solution decomp. on standing or heating.

Insol. in alcohlol. (Kirchhoff, Scher. J. **2.** 30.)

HgS_2O_3, $3K_2S_2O_3+3H_2O$. (Fock and Klüss, B. **24.** 1353.)

HgS_2O_3, $5K_2S_2O_3+H_2O$. (F. and K.)

Nickel thiosulphate, $NiS_2O_3+6H_2O$.

Permanent. Sol. in H_2O. (Rammelsberg, Pogg. **56.** 306.)

Nickel sodium thiosulphate, $2NiS_2O_3$, $5Na_2S_2O_3+25H_2O$.

Efflorescent. Sol. in H_2O. (Jochum.)

Nickel thiosulphate ammonia, NiS_2O_3, $4NH_3$ $+6H_2O$.

Decomp. on air. Sol. in NH_4OH+Aq. (Rammelsberg, Pogg. **56.** 306.)
NiS_2O_3, $5NH_3+H_2O$. (Ephraim, B. 1913, **46.** 3108.)
NiS_2O_3, $6NH_3+3H_2O$. (Vortmann and Padberg, B. **22.** 2641.)

Platinous sodium thiosulphate.

See **Platothiosulphate, sodium.**

Potassium thiosulphate, $K_2S_2O_3+{}^1/_3$, 1, $1^2/_3H_2O$, and $2H_2O$.

Very deliquescent. Very sol. in H_2O with absorption of heat. Solution is stable on the air. Insol. in alcohol.

100 pts. H_2O dissolve pts. $K_2S_2O_3$ at t°.

t°	Pts. $K_2S_2O_3$	Solid phase
0	96.1	$K_2S_2O_3.2H_2O$
17	150.5	$3K_2S_2O_3.5H_2O$
20	155.4	"
25	165.0	"
30	175.7	"
35	202.4	$3K_2S_2O_3.5H_2O+K_2S_2O_3.H_2O$
40	204.7	$K_2S_2O_3.H_2O$
45	208.7	"
50	215.2	"
55	227.7	"
60	238.3	"
56.1	234.5	$K_2S_2O_3.H_2O+3K_2S_2O_3.H_2O$
65	245.8	$3K_2S_2O_3\ H_2O$
70	255.2	"
75	268.0	"
78.3	292.0	$3K_2S_2O_3.H_2O+K_2S_2O_3$
80	293.1	$K_2S_2O_3$
85	298.5	"
90	312.0	"

(Inohiko Io, Mem. Coll. Sc. Kioto, 1911, **3.** 212.)

Sol. in dil. $HC_2H_3O_2+Aq$ without decomp. (Mathieu-Plessy, C. R. **101.** 59.)
Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Potassium silver thiosulphate, $2K_2S_2O_3$, $Ag_2S_2O_3$.

Sol. in H_2O. (Cohen.)
$K_2S_2O_3$, $Ag_2S_2O_3$. Sl. sol. in H_2O. (Herschel.)
$3K_2S_2O_3$, $Ag_2S_2O_3+2H_2O$. Rather sl. sol. in H_2O. (Rosenheim and Steinhäuser, Z. anorg. 1900, **25.** 76.)
Sl. sol. in H_2O. (Rosenheim.)

Potassium silver thiosulphate ammonia, $KAgS_2O_3$, $2NH_3$.

Very sl. sol. in H_2O. Easily sol. in hot NH_4OH+Aq. (Schwicker, B. **22.** 1735.)
$5K_2S_2O_3$, $3Ag_2S_2O_3$, NH_3. Difficultly sol. in H_2O with decomp.
Sol. in hot NH_4OH+Aq with partial decomp. (J. Meyer, B. 1907, **40.** 1359.)

Potassium sodium thiosulphate.

(*a*) $KNaS_2O_3+2H_2O$. Very sol. in H_2O. 100 pts. H_2O dissolve 215.7 pts. salt at 15°. (Schwicker, B. **22.** 1733.)
(*b*) $NaKS_2O_3+2H_2O$. 100 pts. H_2O dissolve 205.3 pts. salt at 15°. (Schwicker.)

Potassium strontium thiosulphate, $K_2S_2O_3$, $SrS_2O_3+5H_2O$.

Sol. in H_2O. (Fock and Klüss, B. **24.** 3017.)

Potassium zinc thiosulphate, $K_2S_2O_3$, $ZnS_2O_3+H_2O$.

Very sol. in H_2O. (Rosenheim and Davidsohn, Z. anorg. 1904, **41.** 238.)

Potassium thiosulphate sodium chloride, $K_2S_2O_3$, $NaCl$.

Sol. in H_2O. (Pape, Pogg. **139.** 238.)

Rubidium thiosulphate, $Rb_2S_2O_3+2H_2O$.

Very hydroscopic; easily sol. in H_2O. (J. Meyer, B. 1907, **40.** 1356.)

Rubidium silver thiosulphate, $2Rb_2S_2O_3$, $Ag_2S_2O_3+2H_2O$.

Ppt. Not hydroscopic. Difficultly sol. in cold H_2O. Decomp. by warm H_2O. (J. Meyer.)

Rubidium silver thiosulphate ammonia, $Rb_2S_2O_3$, $Ag_2S_2O_3$, NH_3.

Ppt. (J. Meyer.)
$3Rb_2S_2O_3$, $4Ag_2S_2O_3$, NH_3. Ppt. Decomp. in the air. (J. Meyer.)

Samarium thiosulphate.

(Cleve.)

Scandium thiosulphate, basic, $Sc(OH)S_2O_3$.

Ppt. (R. J. Meyer, Z. anorg. 1914, **86.** 282.)

Silver thiosulphate, $Ag_2S_2O_3$.

Sl. sol. in H_2O. Sol. in NH_4OH or alkali thiosulphates+Aq. (Herschel, Edinb. Phil. J. **1.** 26.)

Silver sodium thiosulphate, $Ag_2S_2O_3$, $Na_2S_2O_3+H_2O$.

Sl. sol. in H_2O. Easily sol. in NH_4OH+Aq, also in $Na_2S_2O_3+Aq$ to form—
$Ag_2S_2O_3$, $2Na_2S_2O_3+2H_2O$. Easily sol. in H_2O or NH_4OH+Aq; somwehat sol. in al-

cohol, especially if warm or dilute. (Lenz, A. **40.** 94.)

$Ag_2S_2O_3$, $6Na_2S_2O_3+21H_2O$. Sol. in H_2O. (Jochum, C. C. **1885.** 642.)

Silver sodium thiosulphate acetylide acetylene, $2Na_2S_2O_3$, $7Ag_2S_2O_3$, $18Ag_2C_2$, $32C_2H_2$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. Insol. in alkalies. (Bhaduri, Z. anorg. 1913, **79.** 356.)

$7Na_2S_2O_3$, $5Ag_2S_2O_3$, $86Ag_2C_2$, $13C_2H_2$. (Bhaduri.)

Silver sodium thiosulphate ammonia, $NaAgS_2O_3$, NH_3.

Very unstable. (Schwicker, B. **22.** 1736.)

Silver strontium thiosulphate, $Ag_2S_2O_3$, SrS_2O_3.

Nearly insol. in H_2O. Very sl. sol. in SrS_2O_3+Aq; easily sol. in NH_4OH+Aq. (Herschel.)

Sodium thiosulphate, $Na_2S_2O_3$ and +1, 2 and $5H_2O$.

100 pts. H_2O dissolve:

At 16°, 65 pts. $Na_2S_2O_3$.
" 20°, 69 " "
" 25°, 75 " "
" 30°, 82 " "
" 35°, 89 " "
" 40°, 98 " "
" 45°, 109 " "
" 47°, 114 " "

(Mulder.)

100 pts. H_2O dissolve at 0°, 47.6 pts. $Na_2S_2O_3$; at 20°, 69.5 pts. ; at 40°, 104 pts. ; at 60°, 192.3 pts. (Kremers, Pogg. **99.** 50)

100 pts. H_2O dissolve 171 pts. cryst. (=108.9 pts. anhydrous)salt at 19.5° to form a solution of 1.3875 sp. gr. (Schiff, A. **113.** 350.)

By supersaturation 100 pts. H_2O may dissolve 217.4 pts. $Na_2S_2O_3$ at 0°. (Kremers.)

Solubility in H_2O.

t°	% $Na_2S_2O_3$	Solid phase
0	34.43	$Na_2S_2O_3+5H_2O$
10	37.89	"
20	41.17	"
30	45.86	"
40	50.65	"
45	54.49	"
50	62.92	$Na_2S_2O_3+2H_2O$
60	67.39	"
72	70.39	"
80.5	71.33	"
90.5	71.76	"
100	72.68	"

(Taylor, Proc. Edinburgh Soc. 1898, **22.** 49.)

Solubility of anhydrous $Na_2S_2O_3$ in H_2O at t°.

t°	g. Na S_2O_3 per 100 g.	
	Solution	H O
40	67.40	206.70
45	67.60	208.60
50	67.76	210.20
55	68.15	214.00
60	68.48	217.30
65	68.80	220.50
70	69.05	223.10
75	69.35	226.30
80	69.80	231.80

(Young and Burke, J. Am. Chem. Soc. 1906, **28.** 327.)

The solubility of the hydrates of $Na_2S_2O_3$ are exceedingly complicated. There are five groups of hydrates, (I) primary, (II) secondary, (III) tertiary, (IV) quaternary, and (V), quintary, and transitions occur between members of the same and different groups. $Na_2S_2O_3+5H_2O$(I) is the commercial thiosulphate. The relations and solubility of the various hydrates is shown in the following table.

Solubility of $Na_2S_2O_3$ in H_2O at t°.

I. Primary hydrates.

t°	g. $Na_2S_2O_3$ per 100 g.		Solid phase
	Solution	H_2O	
0	33.40	50.15	$Na_2S_2O_3$, $5H_2O$(I)
5	35.33	54.64	"
10	37.37	59.69	"
15	39.11	64.22	"
20	41.20	70.07	"
25	43.15	75.90	"
30	45.19	82.45	"
35	47.71	91.24	"
40	50.83	105.37	"
45	55.33	123.87	"
48.17	...	....	" +$Na_2S_2O_3$, $2H_2O$(I)
0	52.73	111.60	$Na_2S_2O_3$, $2H_2O$(I)
5	53.45	114.90	"
10	53.94	117.10	"
20	55.15	122.68	"
25	56.03	127.43	"
30	57.13	133.27	"
40	59.38	146.20	"
45	60.73	154.70	"
50	62.28	165.11	"
55	63.85	176.60	"
60	65.68	191.30	"
65	68.04	212.90	"
66.5	...	....	" +$Na_2S_2O_3$

Solubility of $Na_2S_2O_3$ in H_2O at t°.—*Continued.*

II. Secondary hydrates.

t°	g. $Na_2S_2O_3$ per 100 g. Solution	g. $Na_2S_2O_3$ per 100 g. H_2O	Solid phase
0	41.96	72.30	$Na_2S_2O_3$, $5H_2O$(II)
5	43.56	77.17	"
10	45.25	82.65	"
15	47.27	89.36	"
20	49.38	97.55	"
25	52.15	108.98	"
30	56.57	130.26	"
30.22	...	....	" $Na_2S_2O_3$, $4H_2O$(II)
33.5	58.59	141.48	$Na_2S_2O_3$, $4H_2O$(II)
36.2	60.51	153.23	"
38.6	62.80	168.82	"
40.65	...	....	" $+Na_2S_2O_3$, H_2O(II)
0	60.47	153.00	$Na_2S_2O_3$, H_2O(II)
5	60.74	154.70	"
10	61.04	156.70	"
15	61.57	160.20	"
20	62.11	163.90	"
25	62.73	168.30	"
30	63.56	174.40	"
35	64.32	180.20	"
40	65.22	187.60	"
45	66.02	194.30	"
50	66.82	201.40	"
55	67.90	211.50	"
56.5	...	....	" $+Na_2S_2O_3$

III. Tertiary hydrates.

t°	g. $Na_2S_2O_3$ per 100 g. Solution	g. $Na_2S_2O_3$ per 100 g. H_2O	Solid phase
0	46.14	85.67	$Na_2S_2O_3$, $6H_2O$ (III and IV)
5	48.44	93.95	"
10	51.66	106.80	"
13	54.96	122.00	"
14.35	...	....	"$+Na_2S_2O_3$, $^4/_3H_2O$(IV)
14.3	...	....	"$+Na_2S_2O_3$, $^3/_2H_2O$(III)
0	57.42	134.80	$Na_2S_2O_3$, $^3/_2H_2O$(III)
5	57.84	137.20	"
10	58.28	139.70	"
15	58.80	142.70	"
20	59.28	145.60	"
25	60.18	151.10	"
30	60.78	155.00	"
35	61.57	160.20	"
40	62.60	167.40	"
45	63.97	177.50	"
47.5	64.68	183.00	"
48.5	...	....	" $+Na_2S_2O_3$, H_2O(III)
47.5	64.78	183.90	$Na_2S_2O_3$, H_2O(III)
50	65.30	188.20	"
52.5	65.89	193.20	"
55	66.45	198.10	"
60	68.07	213.10	"
61	...	....	" $+Na_2S_2O_3$

Solubility of $Na_2S_2O_3$ in H_2O at t°.—*Continued.*

IV. Quaternary hydrate.

t°	g. $Na_2S_2O_3$ per 100 g. Solution	g. $Na_2S_2O_3$ per 100 g. H_2O	Solid phase
0	57.63	136.00	$Na_2S_2O_3$, $^4/_3H_2O$(IV)
5	58.08	138.60	"
10	58.49	140.90	"
15	59.00	143.90	"
20	59.57	147.30	"
25	60.35	152.30	"
30	61.03	156.60	"
35	61.94	162.80	"
40	62.95	169.90	"
45	64.22	179.50	"
50	65.45	189.50	"
55	67.07	203.70	"
58	...	....	" $+Na_2S_2O_3$

V. Quintary hydrates.

t°	g. $Na_2S_2O_3$ per 100 g. Solution	g. $Na_2S_2O_3$ per 100 g. H_2O	Solid phase
0	57.63	136.00	$Na_2S_2O_3$, $2H_2O$(V)
5	58.23	139.40	"
10	59.05	144.20	"
15	60.02	150.10	"
20	61.02	156.50	"
25	62.30	165.30	"
30	63.56	174.40	"
35	65.27	188.00	"
27.5	...	....	" $+Na_2S_2O_3$, H_2O(V)
30	63.34	172.80	$Na_2S_2O_3$, H_2O(V)
35	64.07	178.40	"
40	64.75	183.70	"
45	65.58	190.50	"
50	66.58	199.20	"
55	67.59	208.50	"
43	...	....	"$+Na_2S_2O_3$, $^1/_2H_2O$(V)
25	64.21	179.40	$Na_2S_2O_3$, $\frac{1}{2}H_2O$(V)
35	64.60	182.50	"
40	64.99	185.60	"
45	65.61	190.82	"
50	66.02	194.30	"
55	66.57	199.10	"
60	67.40	206.70	"
65	68.24	214.90	"
70	69.06	....	"
70	...	....	" $Na_2S_2O_3$

(Young and Burke, J. Am. Chem. Soc. **1906**, **28**. 321.)

Heat is absorbed by dissolving in H_2O. 110 pts. $Na_2S_2O_3+5H_2O+100$ pts. H_2O lower temp. from 10.7° to 8°. (Rüdorff, B. **2.** 68.)

$+\frac{1}{2}H_2O$. (Young and Burke, J. Am. Chem. Soc. **1906**, **28**. 321.)

$+H_2O$.

$+^4/_3H_2O$. (Young and Burke.)

$+^3/_2H_2O$. (Young and Burke.)

$+2H_2O$.

$+4H_2O$. M.-pt. 41.60°. (Young and Burke.)

$+5H_2O$. M.-pt. 45° (Kopp); 48° (Kremers), 50° (Mulder); 48.5° (Tilden, Chem. Soc. **45.** 409); 47.9° (Taylor, Proc. Edinburgh Soc. 1898, **22.** 249); 48.09° (Richards and Churchill, Z. phys. Ch. 1899, **28.** 314); 48.45° (Young and Burke, J. Am. Chem. Soc. 1906, **28.** 324.)

Labile modification melts at 32°. (Parmentier and Amat, C. R. **98.** 735.)

Sp. gr. of $Na_2S_2O_3$+Aq at 19°.
% = % $Na_2S_2O_3+5H_2O$.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0052	18	1.0975	35	1.1986
2	1.0105	19	1.1031	36	1.2048
3	1.0158	20	1.1087	37	1.2110
4	1.0211	21	1.1145	38	1.2172
5	1.0264	22	1.1204	39	1.2234
6	1.0317	23	1.1263	40	1.2297
7	1.0370	24	1.1322	41	1.2362
8	1.0423	25	1.1381	42	1.2427
9	1.0476	26	1.1440	43	1.2492
10	1.0529	27	1.1499	44	1.2558
11	1.0584	28	1.1558	45	1.2624
12	1.0639	29	1.1617	46	1.2690
13	1.0695	30	1.1676	47	1.2756
14	1.0751	31	1.1738	48	1.2822
15	1.0807	32	1.1800	49	1.2888
16	1.0863	33	1.1862	50	1.2954
17	1.0919	34	1.1924	..	...

(Schiff, A. **113.** 118.)

B.-pt. of $Na_2S_2O_3$+Aq. P = pts. $Na_2S_2O_3$ to 100 pts. H_2O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	14	110°	104	119°	201
102	27	111	113	120	214.5
103	39	112	122	121	229
104	49.5	113	131.5	122	244
105	59	114	141.5	123	262
106	68	115	152	124	283
107	77	116	164	125	311
108	86	117	175.75	126	348
109	95	118	188	...	...

(Gerlach, Z. anal. **26.** 436.)

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

100 pts. absolute ethyl alcohol dissolve at room temperature 2.5 mg. $Na_2S_2O_3$. (Bödtker, Z. phys. Ch. 1897, **22.** 410.)

100 pts. absolute ethyl alcohol dissolve at room temperature 3.4 mg. $Na_2S_2O_3+5H_2O$. (Bödtker, Z. phys. Ch. 1897, **22.** 510.)

Sol. in oil of turpentine (Edison, Am. Chemist, **7.** 127). Insol. therein (Techn. J. B. **27.** 1003).

Insol. in ethyl acetate. (Casaseca, C. R. **30.** 821.)

Sodium thallous thiosulphate, $3Na_2S_2O_3$, $2Tl_2S_2O_3+10H_2O$.

Sol. in H_2O. (Werther.)

$+8H_2O$. (Jochum.)

$2Na_2S_2O_3$, $Tl_2S_2O_3+8H_2O$. (Vortmann and Padberg, B. **22.** 2638.)

Sodium zinc thiosulphate, $Na_2S_2O_3$, $2ZnS_2O_3$ $+23H_2O$.

Sol. in H_2O. (Jochum, C. C. **1885.** 642.)

$3Na_2S_2O_3$, $2ZnS_2O_3+10H_2O$. Deliquescent. (Vortmann and Padberg, B. **22.** 2640.)

Sodium thiosulphate mercuric iodide, $2Na_2S_2O_3$, HgI_2.

Decomp. by H_2O and by alcohol. (Eder and Ulm, M. 1882, **3.** 197.)

Strontium thiosulphate, $SrS_2O_3+5H_2O$.

Permanent. Sol. in 6 pts. cold H_2O (Gay-Lussac); in 4 pts. H_2O at 13°, and 1.75 pts. boiling H_2O (Herschel, **1819**).

1 g. is sol. in 3.7 cc. H_2O at room temp. (Antenrieth, Z. anal. 1898, **37.** 293.)

Gradually efflorescent. Insol. in alcohol. (Herschel.)

Thallous thiosulphate.

Ppt. Sl. sol. in cold, easily sol. in hot H_2O. (Crookes.)

Easily sol. in $Na_2S_2O_3$+Aq. (Jochum.)

Tin thiosulphate (?).

Sol. in H_2O.

Uranyl thiosulphate, $(UO_2)S_2O_3$.

Ppt. (Faktor, C. C. **1901,** II. 878.)

Zinc thiosulphate, $ZnS_2O_3+xH_2O$.

Very deliquescent, and very sol. in H_2O and alcohol. (Rammelsberg.)

Zinc thiosulphate ammonia, ZnS_2O_3, $2NH_3$.

Decomp. by H_2O. Sol. in NH_4OH+Aq, from which it is pptd. by alcohol. (Rammelsberg, Pogg. **56.** 62.)

Thio*tri*thiazyl bromide, N_3S_4Br.

Decomp. H_2O and alkalies.

Stable in the air. (Muthmann, B. 1897, **30.** 630.)

Thio*di*thiazyl *di*chloride, $S_3N_2Cl_2$.

See **Nitrogen sulphochloride.**

Thio*tri*thiazyl chloride, S_4N_3Cl.

See **Nitrogen sulphochloride.**

Thio*tri*thiazyl iodide, N_3S_4I.

Decomp. spontaneously in the air. Very unstable. (Muthmann, B. 1897, **30.** 631.)

Thio*tri*thiazyl nitrate, $S_4N_3NO_3$.

Sol. in H_2O with decomp. Sol. in HNO_3+Aq. (Demarçay, C. R. **91.** 1066.)

Sol. in cold H_2O with decomp.

Completely insol. in organic solvents, as CS_2, $CHCl_3$, acetone, and acetic ether. (Muthmann and Seitter, B. 1897, **30.** 629.)

Thio*tri*thiazyl sulphate $(S_4N_3)HSO_4$.

Stable on air. Sol. in H_2O with decomp. (Demarçay, C. R. 91 **854.** 1066.)

Thio*tri*thiazyl sulphocyanide, N_3S_4CNS

Stable in the air.

Sol. in benzene and chloroform. (Muthmann and Seitter, B. 1897, **30.** 631.)

***Di*thio*tetra*thiazyl *di*chloride,** $S_6N_4Cl_2$.

See **Nitrogen sulphochloride.**

Thorium, Th.

Not oxidised by boiling H_2O.

Quickly sol. (Chydenius, Pogg. **119.** 43), very slowly sol. by long boiling (Berzelius, Pogg. **16.** 385) in HNO_3+Aq. Insol. in cold, easily sol. in warm dil. H_2SO_4+Aq. Slowly sol. in cold, rapidly in hot HCl+Aq. Easily oxidised by aqua regia. Insol. in KOH+Aq or HF+Aq.

Sl. sol. in dil. H_2SO_4+Aq; decomp. by conc. H_2SO_4. Very sl. sol. in dil., and less in conc. HNO_3+Aq. Easily sol. in conc. HCl+Aq, and aqua regia. (Nilson, B. **15.** 2521.)

Thorium B.

Somewhat sol. in hot H_2O, which dissolves 70% in an hour. More rapidly sol. in dil. acids or hot KI+Aq. Somewhat sol. in organic solvents. Insol. in CS_2 and in methylene iodide. (Hogley, Phil. Mag. 1913, (6) **25.** 331.)

Thorium C.

Somewhat sol. in hot H_2O. More rapidly sol. in hot KI+Aq. and in dil. acids. More sol. in organic solvents than thorium B. 20% sol. in CS_2 or methylene iodide in 10 minutes. (Hogley, Phil. Mag. 1913, (6) **25.** 331.)

Thorium *tetra*boride, ThB_4.

Sol. in cold conc. HNO_3 and HCl and in hot conc. H_2SO_4. (Jassonneix, C. R. 1905, **141.** 192.)

Thorium *hexa*boride, $ThBr_6$.

Sol. in hot dil. or conc. HNO_3; insol. in H_2SO_4, HCl, HF and aq. alkalies. (Jassonneix, C. R. 1905, **141.** 193.)

Thorium *di*bromide, $ThBr_2$.

Sol. in H_2O with partial decomp. (Troost and Ouvrard, A. ch. (6) **17.** 227.)

Thorium *tetra*bromide, $ThBr_4$.

Sol. in H_2O. (Berzelius.)

Very hygroscopic, and sol. in H_2O with partial decomp. (Troost and Ouvrard, A. ch. (6) **17.** 229.)

Sl. sol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, **20.** 840.)

$+7H_2O$. Sol. in alcohol. (Rosenheim, B. 1900, **33.** 979.)

$+8H_2O$. Very sol. in alcohol and H_2O. Insol. in chloroform and light petroleum. (Lesinsky, Z. anorg. 1897, **15.** 82.)

Thorium *tetra*bromide ammonia, $ThBr_4$, $3NH_3$.

Insol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, **20.** 840.)

Thorium carbide, ThC_2.

Almost insol. in conc. acids; decomp. by H_2O and by dil. acids. (Moissan, C. R. 1896, **122.** 577.)

Thorium *tetra*chloride. $ThCl_4$.

Anhydrous. Extremely deliquescent, and sol. in H_2O with evolution of heat. Sol. in alcohol.

Sol. in ether. (Matthews, J. Am. Chem. Soc. 1898, **20.** 824.)

$+7H_2O$. Deliquesces in the air. Very sol. in H_2O and alcohol. Insol. in ether. (Krüss, Z. anorg. 1897, **14.** 368.)

$+8H_2O$. Hydroscopic. Easily sol. in H_2O and absolute alcohol. Not pptd. from solution in alcohol by ether.

$+9H_2O$. As above. (Rosenheim, Z. anorg. 1903, **35.** 426.)

Thorium *tetra*chloride ammonia, $ThCl_4$, $6NH_3$.

Insol. in ether. Decomp. by H_2O.

$ThCl_4$, $8NH_3$. Fumes in moist air. Decomp. by H_2O. (Matthews, J. Am. Chem. Soc. 1898, **20.** 824.)

The compds. of $ThCl_4$ with NH_3 are of the type $ThCl_4$, nNH_3 and may be classified into three groups.

(1) n=4, 6, 7, 12, 18. Compds. are decomp. by H_2O.

(2) n=4, 6, 7. Compds. are not decomp. by H_2O.

(3) n=6, 7, 12, 18. The first two compds. of this series are identical with the last two of group (2).

$ThCl_4$, $4NH_3$ of group (2) is the only one in the whole series stable above 120°. (Chauvenet, C. R. 1910, **151.** 387.)

Thorium fluoride, ThF_4+4H_2O.

Insol. in H_2O or HF+Aq.

Thorium hydride, ThH_2.

Decomp. by dil. HCl+Aq. (Winkler, B. **24.** 873.)

Thorium hydroxide, $Th(OH)_4$.

Insol. in H_2O.

Sol. in acids, except oxalic, molybdic, and hydrofluoric acids.

Insol. in alkali hydroxides, but easily sol. in alkali carbonates+Aq. More sol. in $NH_4OH+(NH_4)_2CO_3$+Aq than in $(NH_4)_2CO_3$ +Aq. alone. (Berzelius.) Not pptd. in presence of tartaric and citric acids. (Chydenius, Pogg. **119.** 43.)

$4ThO_2, H_2O$. Insol. in water and acids at boiling temp.

Thorium hydroxybromide, $Th(OH)_2Br_2+11H_2O$.

Sol. in alcohol. (Rosenheim, B. 1900, **33.** **979.**)

Thorium hydroxychloride, $(OH)ThCl_3+11H_2O$.

Sol. in alcohol. (Rosenheim, B. 1900, 33. 978.)

$Th(OH)_2Cl_2+5H_2O$. Slowly takes up H_2O from the air.

Sol. in H_2O without decomp.

Sol. in alcohol. Pptd. from solution in alcohol by ether. (Rosenheim, Z. anorg. 1903, **35.** 425.)

$+8H_2O$. Hydroscopic; sol. in alcohol. (Rosenheim, B. 1900, **33.** 978.)

Thorium hydroxyiodide, $Th(OH)I_3+10H_2O$.

Evolves iodine in the light. (Rosenheim, Z. anorg. 1903, **35.** 430.)

Thorium iodide.

Sol. in H_2O.

Thorium nitride, Th_3N_4.

Decomp. by H_2O. (Matignon, C. R. 1901, **132.** 37.)

Thorium oxide, ThO_2.

When ignited is insol. in HCl, and HNO_3+Aq. Sol. in H_2SO_4 by heating to boiling and subsequent addition of H_2O. Insol. in alkali hydrates or carbonates+Aq.

Thorium *met*oxide, $Th_3O_5+H_2O$.

Sl. sol. in HCl. (Locke, Z. anorg. 1894, **7.** 348.)

$+2H_2O$. Loses 1 H_2O at 100°. Sol. in H_2O; insol. in NH_4OH+Aq. (Locke.)

***Meta*thorium oxide.**

Sol. in H_2O after having been treated with conc. HNO_3 or HCl+Aq, even if previously ignited.

$ThO_2, xTh(OH)_4$. Compare Th_3O_5. (Locke) (Stevens, Z. anorg. 1901, **27.** 42.)

Thorium *per*oxide, Th_2O_7.

Precipitate. (Cleve, C. R. **100.** 605.)

Thorium oxychloride.

Decomp. by H_2O into $ThCl_4$ and ThO_2. $ThOCl_2$. Sol. in H_2O.

Insol. in abs. alcohol. (Matignon, A. ch. 1907, (8) **10.** 133.)

$+3H_2O$.

$+5H_2O$. (Matignon, A. ch. 1907, (8) **10.** 135.)

***Meta*thorium oxychloride,** $ThO_2; xThCl_4$.

Hydroscopic; sol. in H_2O; insol. in abs. alcohol. (Stevens, Z. anorg. 1901, **27.** 47.)

Thorium oxyfluoride, $ThOF_2$.

Insol. in H_2O.

Sol. in H_2SO_4 with decomp. (Chauvenet, C. R. 1908, **146.** 974.)

Thorium oxysulphide, $ThS_2, 2ThO_2$.

(Chydenius.)

Thorium phosphide.

Insol. in H_2O. (Berzelius.)

Thorium silicide, $ThSi_2$.

Sol. in aq. min. acids; insol. in aq. alkalies. Decomp. by fusion with NaOH or KOH. (Hönigschmid, C. R. 1906, **142.** 158.)

Thorium sulphide, ThS_2.

Insol. in warm H_2SO_4. Very slightly attacked by HNO_3 or HCl+Aq. Sol. in hot aqua regia. (Berzelius.)

Thoromolybdic acid.

Ammonium thoromolybdate, $(NH_4)_8Th(Mo_2O_7)_6+8H_2O$.

Insol. in H_2O; sol. in dil. acids. (Barbieri, C. A. **1913.** 3724.)

$(NH_4)_6H_2Th(Mo_2O_7)_6+11H_2O$. Insol. in H_2O; sol. in dil. acids. (Barbieri.)

Silver thoromolybdate, $Ag_8Th(Mo_2O_7)_6$.

Insol. in H_2O; sl. sol. in HNO_3+Aq, but nearly insol. in presence of $AgNO_3$. (Barbieri.)

Sodium thoromolybdate, $Na_8Th(Mo_2O_7)_6+15H_2O$.

Insol. in H_2O; sol. in dil. acids. (Barbieri.)

$Na_6H_2Th(Mo_2O_7)_6+17H_2O$. Insol. in H_2O; sol. in dil. acids. (Barbieri.)

Thulium, Tm.

Thulium chloride, $Tm_2Cl_6+14H_2O$.

Very sol. in H_2O and in alcohol. (James, J. Am. Chem. Soc. 1911, **33.** 1342.)

Thulium hydroxide.

Easily sol. in dil. acids. (James, J. Am. Chem. Soc. 1911, **33.** 1342.)

Thulium oxide, Tm_2O_3.

Slowly sol. in hot conc. acids. (James, J. Am. Chem. Soc. 1911, **33.** 1342.)

Tin, Sn.

Insol. in H_2O. Tin is not attacked by distilled H_2O when air is passed through it for a week.

Slowly sol. in dil. cold HCl+Aq, but rapidly sol. if hot and conc. Slowly sol. in hot dil. H_2SO_4+Aq, but decomp. by hot conc. H_2SO_4.

Readily sol. in cold aqua regia. Attacked violently by conc. HNO_3+Aq with pptn. of SnO_2. Completely sol. in dil. cold HNO_3+Aq (1 pt. HNO_3: 1 pt. H_2O) at 22°. (Hay, C. N. **22.** 298.) Not attacked by pure conc. HNO_3+Aq of 1.512-1.419 sp. gr., but violently attacked by less conc. acid. Also attacked by most conc. acid if it contains NO_2. (Millon, A. ch. (3) **6.** 95.)

If Sn is placed in dil. HNO_3+Aq of 1.35 sp. gr. it is sl. dissolved, but soon pptd. again as SnO_2. If a small amt. of NH_4Cl is added, the Sn remains permanently in solution; HCl+Aq has a similar action. (Ordway, Am. J. Sci. (2) **23.** 220.) Easily sol. in the cold in mixture of 1 vol. H_2SO_4, 2 vols. HNO_3, and 3 vols. H_2O. (Basset, C. N. **53.** 172.)

HNO_3+Aq containing less than 12% HNO_3 attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution. HNO_3+Aq (12–45% HNO_3) completely dissolves Sn, but solution becomes turbid on standing. HNO_3+Aq containing more than 45% HNO_3 does not dissolve Sn, but forms a white substance, which is sol. in H_2O if over 70% acid is used; this solution soon becomes turbid. (Montemartini, Gazz. ch. it. **22.** 381.)

Sn dissolves in HNO_3+Aq at low temps. (0–21°). When very dil. HNO_3+Aq (14% HNO_3) is used, the amount of stannous salt formed decreases only slightly with increase of temp. while with 30–40% acid it falls to zero at 21°. (Walker, J. Soc. Chem. Ind. **1893.** 845.)

In presence of Fe, Cr or Al, HNO_3+Aq acts on Sn to form soluble products, from which conc. HNO_3 ppts. all Sn as metastannic acid. (van Leent, C. C. **1899,** I. 101.)

Much more sol. in acids when small quantities of metallic salts have been added. This is most noticeable when $PtCl_4$ or tartar emetic is added to HCl+Aq. HCl+Aq with tartar emetic exerts 11 times, and with $PtCl_4$ 13 times the action exhibited by pure acid. (Millon, C. R. **21.** 47.)

Sol. in 2N $HClO_3$+Aq. (Hendrixson, J. Am. Chem. Soc. 1904, **26.** 755.)

Pyrosulphuric acid dissolves Sn on warming. (Divers, Chem. Soc. 1885, **47.** 639.)

Hot telluric acid attacks Sn. (Hutchins, J. Am. Chem. Soc. 1905, **27.** 1183.)

Sn is attacked by 17% HN_3+Aq. (Curtius and Rissom, J. pr. 1898, (2) **58.** 299.)

Sol. in a solution of Na in liquid NH_3. (Kraus, J. Am. Chem. Soc. 1907, **29.** 1562.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Sol. in boiling alum+Aq (1 pt. alum to 4 pts. H_2O).

Sol. in $KHSO_3$, NH_4Cl (1:4), and $K_2C_4H_4O_6$+Aq. Sl. sol. in $KC_2H_3O_2$+Aq, but not attacked by $MgSO_4$, K_2SO_4, KNO_3, or Na_2SO_4+Aq. (Cludius, J. pr. **9.** 161.)

Sol. in alkalies+Aq.

Attacked easily by conc. NaCl, KCl, or NH_4NO_3+Aq; not attacked by NH_4Cl+Aq. (Hallock, Am. Ch. J. **6.** 52.)

Sol. in $Fe(NO_3)_2$+Aq in presence of HNO_3+Aq in proportion of 1 atom Sn to 1 atom Fe. (Lepéz and Storch, W. A. B. **98, 2b.** 268.)

Solubility in dil. saline solutions.

100 ccm. H_2O containing 0.5 g. NaCl or KCl dissolve 6 mg. Sn from 11.8 sq. cm. in one week when air without CO_2 is passed through the solution, but none at all when the air contains CO_2.

100 ccm. H_2O containing 1 g. NH_4Cl dissolve 5 mg. Sn under above conditions without CO_2, and none with CO_2.

With 1 g. $MgCl_2$, 1 mg. Sn was dissolved without CO_2, and none with CO_2.

With 1 g. K_2SO_4, 2 mg. Sn were dissolved without CO_2, and none with CO_2.

With 1 g. KNO_3, 3 mg. Sn were dissolved without CO_2, and 1 mg. with CO_2.

With 1 g. Na_2CO_3, 7 mg. Sn were dissolved without CO_2.

With 1 g. NaOH, 220 mg. Sn were dissolved without CO_2.

CaO_2H_2+Aq did not dissolve. (Wagner, Dingl. **221.** 260.)

Not attacked by sugar+Aq. (Klein, C. R. **102.** 1170.)

½ ccm. oleic acid dissolves 0.0134 g. Sn in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Tin antimonide, SnSb.

(Stead, J. Soc. Chem. Ind. **1897, 16.** 205.)

Tin arsenide, Sn_3As_2.

(Stead, J. Soc. Chem. Ind. **1897, 16.** 206.)

Tin (stannous) bromide, $SnBr_2$.

Sol. in H_2O.

Sol. in pyridine. (Naumann, B. 1904, **37.** 4609.)

Mol. weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, **15.** 23.)

Tin (stannic) bromide, basic, $SrBr_3OH$+$3H_2O$.

Sol. in H_2O. Decomp. in aq. solution when warmed.

Sol. in ether, methyl alcohol, ethyl alcohol, acetone, acetic acid and esters of organic acids. Nearly insol. in benzene, ligroin and $CHCl_3$. (Pfeiffer, Z. anorg. 1914, **87.** 242.)

Tin (stannic) bromide, $SnBr_4$.

Deliquescent. Sol. in H_2O without evolution of heat. (Balard.)

Decomp. by H_2O much more quickly than $SnCl_4$. (Lorenz, Z. anorg. 1895, **9.** 378.)

Easily sol. in $AsBr_3$. (Walden, Z. anorg. 1902, **29.** 374.); PCl_3, PBr_3 and S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

$+4H_2O$. (Preis and Raymann, C. C. **1882.** 773.)

Stannic hydrogen bromide, $SnBr_4$, 2HBr.

See **Bromostannic acid.**

Stannic bromide *with* **MBr.**

See **Bromostannate, M.**

Tin (stannic) bromochloride, $SnClBr_3$.

Fumes in moist air; decomp. by H_2O. (Besson, C. R. 1897, **124.** 685.)

$SnCl_2Br_2$. Fumes in moist air. Decomp. by H_2O. (Besson.)

$SnCl_3Br$. Fumes in moist air. Decomp. by H_2O. (Besson.)

Tin (stannic) bromoiodide, $SnBr_2I_2$.

Sol. in cold H_2O. Decomp. in aq. solution at 80°.

$SnBr_3I$.

$SnBrI_3$. (Lenormand, C. C. **1899,** II. 521; J. Pharm. 1899, **10.** 114.)

Tin (stannous) chloride, $SnCl_2$, and $+2H_2O$.

Not deliquescent. 100 pts. H_2O dissolve 83.9 pts. $SnCl_2$ at 0°. (Engel, A. ch. (6) **17.** 347.) 100 pts. H_2O dissolve 269.8 pts. $SnCl_2$ at 15°, and sat. solution has sp. gr. 1.827. (Michel and Krafft, A. ch. (3) **41.** 478.) Sol. in a certain amount of H_2O without decomp., but more H_2O causes pptn. of SnO, $SnCl_2$.

$SnCl_2$+Aq absorbs O from air.

Melts in crystal H_2O at 46°. (Ordway.)

Sat. solution boils at 121.7°.

Sp. gr. of $SnCl_2$+Aq at 15° containing:

5	10	15	20	% $SnCl_2+2H_2O$,
1.0331	1.0684	1.1050	1.1442	
25	30	35	40	% $SnCl_2+2H_2O$,
1.1855	1.2300	1.2779	1.3298	
45	50	55	60	% $SnCl_2+2H_2O$,
1.3850	1.4451	1.5106	1.5823	
65	70	75		% $SnCl_2+2H_2O$.
1.6598	1.7452	1.8399		

(Gerlach, Dingl. **186.** 131.)

Solubility of $SnCl_2$ in HCl+Aq. $\frac{SnCl_2}{2}$ = ½ molecules $SnCl_2$ in milligrammes in 10 ccm. solution; HCl = molecules HCl in milligrammes in ditto; H_2O = amt. H_2O present in grammes.

$\frac{SnCl_2}{2}$	HCl	Sum of equiv.	Sp. gr. of solution	H_2O
74	0	74	1.532	8.33
66.7	6.6	73.3	1.489	8.35
63.75	13.54	77.29	1.472	8.198
68.4	24.8	93.2	1.524	7.869
81.2	34.9	116.1	1.625	7.305
94.2	40.0	134.2	1.724	6.880
117.6	44	161.6	1.883	6.108
147.6	49.4	197.0	2.114	5.387
156.4	66	222.4	2.190	4.715
157·	78	235	2.199	4.309

(Engel, A. ch. (6) **17.** 347.)

Solubility is thus diminished by HCl+Aq, while there are less than 8-10 mols. HCl for 1 mol. $SnCl_2$. When that limit is passed the solubility rapidly increases. (Engel.)

Sol. in very dil. HCl or tartaric acid +Aq. Sol. in KOH+Aq. Sol. in conc. $SnOCl_2$+Aq. (Gerlach.) Sol. in NH_4Cl+Aq.

Anhydrous $SnCl_2$ is partially sol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Sol. in absolute alcohol. Insol. in oil of turpentine.

11.41 pts. $SnCl_2$ are sol. in 100 pts. ether at 0°.

11.38 pts. $SnCl_2$ are sol. in 100 pts. ether at 16°.

11.38 pts. $SnCl_2$ are sol. in 100 pts. ether at 35.5°. (Laszczynski, B. 1894, **27.** 2286.)

Anhydrous $SnCl_2$ is sol. in ether. (de Jong, Z. anal. 1902, **41.** 596.)

1 g. anhydrous $SnCl_2$ is sol. in 1.8 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 1.6. (Naumann, B. 1904, **37.** 4336.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Anhydrous $SnCl_2$ is sol. in methyl acetate to the extent of 15.7%. (Schröder and Steiner, J. pr. 1909, (2) **79.** 63.)

31.20 pts. $SnCl_2+2H_2O$ are sol. in 100 pts. ethyl acetate at—2°.

35.53 pts. $SnCl_2+2H_2O$ are sol. in 100 pts. ethyl acetate at +22°.

73.44 pts. $SnCl_2+2H_2O$ are sol. in 100 pts. ethyl acetate at 82°. (Laszczynski, B. 1894, **27.** 2286.)

1 pt. anhydrous $SnCl_2$ is sol. in 22.40 pts. ethyl acetate at 18°. D18°/4° = 0.9215. (Naumann, B. 1910, **43.** 319.)

Insol. in ethyl amine (Shinn, J. phys. Ch. 1907, **11.** 538); pyridine (Naumann, B. 1904, **37.** 4609); benzonitrile (Naumann, B. 1914, **47.** 1369.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

Mol. weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, **15.** 22.)

Tin (stannic) chloride, basic, $SnCl_3OH+3H_2O$.

Hydroscopic.

Sol. in H_2O.

Sol. in ether, alcohol, acetone, acetic acid. Nearly insol. in ligroin and benzene. (Pfeiffer Z. anorg, 1914, **87.** 241.)

Tin (stannic) chloride, $SnCl_4$.

(*a*) *Ordinary modification.* —Deliquescent. Sol. in H_2O. On diluting $SnCl_4$+Aq and boiling, SnO_2 separates out. $SnCl_4$+Aq is not pptd. by HNO_3, HCl, or H_2SO_4+Aq; H_3PO_4+Aq ppts. in a few days, and H_3AsO_4+Aq in a short time. No ppt. is formed by K_2SO_4, Na_2SO_4, KCl, NaCl, NH_4Cl, KNO_3, etc. + Aq.

Sp. gr. of $SnCl_4$+Aq at 15°.

% $SnCl_4+5H_2O$	Sp. gr.	% $SnCl_4+5H_2O$	Sp. gr.	% $SnCl_4+5H_2O$	Sp. gr.
2	1.012	34	1.226	66	1.538
4	1.024	36	1.242	68	1.563
6	1.036	38	1.259	70	1.587
8	1.048	40	1.276	72	1.614
10	1.059	42	1.293	74	1.641
12	1.072	44	1.310	76	1.669
14	1.084	46	1.329	78	1.698
16	1.097	48	1.347	80	1.727
18	1.110	50	1.366	82	1.759
20	1.124	52	1.386	84	1.791
22	1.137	54	1.406	86	1.824
24	1.151	56	1.426	88	1.859
26	1.165	58	1.447	90	1.894
28	1.180	60	1.468	92	1.932
30	1.195	62	1.491	94	1.969
32	1.210	64	1.514	95	1.988

(Gerlach, Dingl. **178.** 49.)

Sp. gr. of $SnCl_4$+Aq.

Deg. Baumé	% Sn	Deg. Baumé	% Sn	Deg. Baumé	% Sn
65.7	29.45	55	24.47	34	14.90
65	29.12	54	24.02	33	14.45
64	28.64	53	23.56	32	14.00
63	28.17	52	23.11	31	13.56
62	27.70	51	22.65	30	13.11
61	27.24	50	22.20	29	12.67
60	26.77	49	21.74	28	12.23
59	26.30	48	21.29	27	11.79
58	25.84	47	20.83	26	11.35
57	25.38	46	20.38	25	10.91
56	24.93				

(Heermann, Ch. Z. 1907, **31.** 680.)

Sol. in S_2Cl_2. (Walden, Z. anorg. 1900, **25.** 217.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Very sol. in liquid NH_3. (Gore, Am. Ch. J. 1899, **20.** 830.)

Very sol. in absolute alcohol, from which it is pptd. by H_2O. Easily sol. in ether; decomp. by oil of turpentine. Miscible with CS_2 and Br_2.

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in ethyl acetone. (Naumann, B. 1904, **37.** 3601.)

Distribution of $SnCl_4$ between H_2O and xylene.

n = pts. by wt. of Cl in 100 pts. of H_2O layer.

m = pts. by wt. of Cl in 100 pts. of xylene layer.

k = partition coefficient.

50 cc. xylene+60 g. $SnCl_4.5H_2O$.

t°	n	m	k
66°	40.35	0.08	504.4
80°	39.95	0.175	228.5
97.5°	40.24	0.33	122.1
111°	40.27	0.68	59.3

(Smirnoff, Z. phys. Ch. 1907, **58.** 377.)

50 cc. xylene+60 g. $SnCl_4.4H_2O$.

t°	n	m	k
66°	41.905	0.925	45.3
80°	41.915	1.555	27.0
100°	41.845	2.515	16.7
111°	41.68	3.235	12.9

(Smirnoff.)

50 cc. xylene+60 g. $SnCl_4.3H_2O$.

t°	n	m	k
80°	43.205	9.95	4.4
94°	42.545	9.325	4.6
100°	42.645	10.56	5.1
111°	42.31	10.03	4.2

(Smirnoff.)

$+2H_2O$. Sol. in H_2O.

$+3H_2O$. Tr. pt. 83°. (Meyerhoffer, Bull. Soc. 1891 (3) **6,** 85.)

$+4H_2O$. Tr. pt. 63°. (Meyerhoffer.)

$+5H_2O$. Very deliquescent, and sol. in H_2O. Decomp. by alcohol. Sol. in HCl+Aq. Tr. pt. 56°. (Meyerhoffer.)

$+8H_2O$. More deliquescent than the $5H_2O$ salt. Tr. pt. 19°. (Meyerhoffer.)

$+9H_2O$. (Nöllner, Z. Ch. **1865.** 45.)

(b) *Metastannic chloride.*—Sol. in cold H_2O; solution coagulates on boiling. Conc. HCl+Aq ppts. from $SnCl_4$+Aq. When solution does not contain HCl, the addition of HCl+Aq causes a ppt., which dissolves in H_2O. HNO_3, and H_2SO_4+Aq also ppt. K_2SO_4, Na_2SO_4, and NaCl+Aq produce ppts., insol. in H_2O, but sol. in HCl+Aq. NH_4Cl or KCl+Aq do not ppt. KNO_3+Aq ppts. slowly. (Rose.)

Tin (stannous) hydrogen chloride, $SnCl_2$, $HCl+3H_2O$.

Decomp. by H_2O.
Melts at −25°. (Engel, C. R. **106.** 1398.)

Tin (stannic) hydrogen chloride.
See **Chlorostannic acid.**

Tin (stannous) hydrazine chloride, $SnCl_2$, $2N_2H_4$, HCl.

Very hydroscopic.
Sol. in H_2O and abs. alcohol. (Curtius, J. pr. 1894, (2) **50.** 341.)

Tin (stannic) chloride *with* **MCl.**
See **Chlorostannate, M.**

Tin (stannous) chloride ammonia, $SnCl_2$, NH_3.

(Berzelius.)
$SnCl_2$, $4NH_3$. Ppt. (Naumann, B. 1904, **37.** 4336.)

Tin (stannic) chloride ammonia, $SnCl_4$, $2NH_3$.

Sol. in cold H_2O without decomp., but decomposes by heating.

Tin (stannous) chloride arsenate.
See **Arsenate chloride, stannous.**

Tin (stannic) chloride cyanhydric acid, $SnCl_4$, 2HCN.

Decomp. on moist air or with H_2O. (Klein, A. **74.** 85.)

Tin (stannous) chloride hydrazine, $SnCl_2$, $2N_2H_4$.

Decomp. by H_2O.
Insol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 286.)

Tin (stannic) chloride nitrogen sulphide, $SnCl_4$, $2N_4S_4$.

Insol. in most solvents.
Decomp. by warm NH_4OH+Aq.
Decomposes in the air. (Wölbling, Z. anorg. 1908, **57.** 284.)
Decomp. by H_2O. (Davis, Chem. Soc, 1906, **89.** 1576.)

Tin (stannic) chloride phosphine, $3SnCl_4$, $2PH_3$.

Decomp. by H_2O. (Rose, Pogg. **24.** 159.)

Tin (stannous) chloride potassium stannous sulphate.

See **Sulphate, potassium stannous stannous chloride.**

Tin (stannic) chloride sulphur *tetra***chloride,** $SnCl_4$, $2SCl_4$.

Very hygroscopic.
Sol. in $CHCl_3$, ligroin, petroleum ether, CS_2, $POCl_3$; very sol. in completely dry absolute ether, in benzene, acetacetic ester and in SCl_2. (Ruff, B. 1904, **37.** 4517.)

Tin (stannic) chloride sulphide, $2SnCl_4$, SnS_2.
See **Stannic sulphochloride.**

Tin (stannic) chlorobromide, $SnClBr_3$.

Decomp. by H_2O. (Ladenburg, A. suppl. **8.** 60.)
$SnCl_2Br_2$. Decomp. by H_2O. (Ladenburg.)

Tin (stannous) chloroiodide, SnClI.

Decomp. immediately by H_2O. (Henry, Phil. Trans. **1845.** 363.)

Tin (stannic) chloroiodide, $SrCl_2I_2$.

Fumes in the air.
Decomp. by H_2O. (Lenormand, J. Pharm. **1898.** 8.)
$SnClI_3$. (Lenormand, J. Pharm. 1899, **10.** 114.)

Tin (stannous) fluoride, SnF_2.

Easily sol. in H_2O. (Berzelius, Pogg. **1.** 34.)

Tin (stannic) fluoride, SnF_4.

Very hydroscopic.
Sol. in H_2O. Slowly decomp. in aq. solution with separation of SnO_2. (Ruff, B. 1904, **37.** 681.)

Tin (stannic) fluoride *with* **MF.**
See **Fluostannate, M.**

Tin (stannous) hydroxide, $2SnO$, H_2O.

Decomp. to SnO when boiled with H_2O. More easily sol. in acids than Sn or SnO. Sol. in NaOH, and KOH+Aq, even when dil. Insol. or very sl. sol. in NH_4OH, $(NH_4)_2CO_3$, and K_2CO_3+Aq; sol. in cold CaO_2H_2, and BaO_2H_2 with decomposition on boiling. (Fremy, A. ch. (3) **12.** 460.) Only sl. sol. in NH_4Cl+Aq hot or cold. (Brett.) Sl. sol. in $NaC_2H_3O_2$+Aq. (Mercer.)

Solubility in NaOH+Aq.

G. Na in 20 ccm.	G. Sn in 20 ccm.
0.2480	0.1904
0.3680	0.2614
0.6394	0.4304
0.8326	0.5560
0.9661	0.7849
2.1234	1.8934

(Rubenbauer, Z. anorg. 1902, **30.** 335.)

Not pptd. in presence of Na citrate (Spiller.)

Sol. in water-glass +Aq. (Ordway.)

SnO_2H_2. Solubility in 1 l. H_2O = 0.0000135 g. mol. at 25°. (Goldschmidt, Z. phys. Ch. 1906, **56.** 389.)

Tin hydroxide, SnO, $6SnO_2+5H_2O$.

$+9H_2O$. (Schiff, A. **120.** 153.

Tin *sesqui***hydroxide,** Sn_2O_3, xH_2O.

Insol. in H_2O. Sol. in NH_4OH+Aq. (Fuchs, J. pr. **5.** 318.)

Tin (stannic) hydroxide.

"α" modification.

Obtained by pptn. by alkali in stannic chloride solution.

Freshly pptd. substance when air dried contains 73.5% H_2O; when dried over H_2SO_4 or in a vaccum for 1 month 12.6% H_2O. Heated to glowing loses all H_2O and passes into the anhydride. The "α" form is capable of existing in all degrees of hydration. (Lorenz, Z. anorg. 1895, **9.** 372-375.)

"α" stannic hydrate is a white amorphous substance which is very sol. in HNO_3 when moist; sol. in H_2SO_4 even dil.; sol. in HCl and not pptd. by an excess. Very sol. in NaOH+Aq. and is not pptd. by an excess.

A solution of α stannic acid in HCl is identical with a solution of freshly prepared aqueous stannic chloride and gives no ppt. with dil. HCl, H_2SO_4, HNO_3 or arsenic acid even on long standing.

"β" modification.

Obtained by oxiding and dissolving Sn in HNO_3, and from solution of sodium stannate by pptn. Freshly pptd. from HNO_3 when air dried contains 21.3% H_2O, and when dried over H_2SO_4 or in a vacuum 11.3%,—corresponding to $Sn(OH)_4$ and $SnO(OH)_2$ respectively.

Freshly pptd. from sodium stannate solution and air dried contains 22.5% H_2O and when dried over H_2SO_4 or in a vacuum contains 12.1%,—corresponding to $Sn(OH)_4$ and $SnO(OH)_2$. Passes into the anhydride when heated to glowing.

The "β" form is capable of existing in all degrees of hydration. It is a white amorphous substance which is insol. in HNO_3; insol in H_2SO_4 even when conc.; insol. in HCl but changed by contact with the acid in that when the acid has been removed the ppt. is readily sol. in H_2O, though pptd. again from solution by addition of HCl. When freshly prepared the "β" form is sol. in NaOH+Aq. but is pptd. by an excess of NaOH.

A solution of "β" stannic acid in HCl behaves quite differently from an aq. solution of stannic chloride in that it ppts. metastannic sulphate when treated with H_2SO_4. This ppt. dissolves when heated with dilute HNO_3 or HCl, but the solution on standing spontaneously forms another ppt. A solution of "β" stannic acid in HCl gives a ppt. when treated with arsenic acid. (Lorenz, Z. anorg. 1895, **9.** 372.)

See also **Stannic acid.**

Tin hydroxyl chloride, SnO(OH)Cl.

See **Chlorostannic acid.**

Tin (stannous) iodide, SnI_2, and $+2H_2O$.

Sl. sol. in cold, more abundantly in hot H_2O, without decomp.

Solubility in H_2O.

t°	Pts. SnI_2 in 100 pts. solution	t°	Pts. SnI_2 in 100 pts. solution
98.5	3.43	97.3	3.70
84.9	3.05	87.4	3.24
73.9	2.56	77.6	2.75
60.1	2.09	67.5	2.34
51.5	1.79	59.7	2.03
41.0	1.50	49.5	1.72
30.5	1.21	39.4	1.38
20.8	1.03	29.6	1.11
...	...	19.8	0.96

(Young, J. Am. Chem. Soc. 1897, **19.** 846.)

Solubility of SnI_2 in HI+Aq at t°.
Pts. SnI_2 per 100 pts. solvent.

t°	5.83% HI	9.60% HI	15.20% HI	20.44% HI	24.80% HI	30.40% HI	36.82% HI
20	0.98	0.20	0.60	1.81	4.20	10.86	25.31
30	1.16	0.23	0.64	1.81	4.06	10.28	23.46
40	1.40	0.33	0.71	1.90	4.12	10.06	23.15
50	1.69	0.46	0.82	2.12	4.34	10.35	23.76
60	2.07	0.66	1.11	2.51	4.78	11.03	24.64
70	2.48	0.91	1.37	2.92	5.43	11.97	25.72
80	2.95	1.23	1.83	3.70	6.38	13.30	27.23
90	3.46	1.65	2.40	4.58	7.82	15.52	29.84
100	4.03	2.23	3.63	5.82	9.60	...	34.05

(Young, J. Am. Chem. Soc. 1897, **19.** 851.)

Solubility of SnI_2 at low temp. in 29.95% HI+Aq.

Temp.	Pts. in 100 pts. solution	Pts. in 100 pts. solvent
1.5	12.96	14.89
1.5	13.15	15.14
6.0	12.35	14.09
10.5	11.01	12.36
15.2	10.48	11.70
24.8	9.36	10.33
30.7	8.78	9.62
34.8	8.70	9.50
40.3	9.51	10.50

(Young, J. Am. Chem. Soc. 1897, **19.** 854.)

Solubility of SnI_2 at low temp. in 39.6% HI+Aq.

Temp.	Pts. in 100 pts. of solution		Pts. in 100 pts. of solvent
	I	II	
0°	13.52	13.56	15.66
5.7°	16.44	16.37	19.71
10.5°	19.47	19.60	24.27
15.7°	23.56	23.68	30.92
20.3°	25.50	25.60	34.30

(Young, J. Am. Chem. Soc. 1897, **19.** 852–853.)

Sol. in $SnCl_2$+Aq. Sol. in warm alkali chlorides or iodides + Aq; also in dil. HCl+Aq. Very sl. sol. in $CHCl_3$, CS_2, or C_6H_6. (Personne, C. R. **54.** 216.)

Sol. in KOH+Aq. (Rose.)

Sol. in acetone. (Naumann, B. 1904, **37.** 4328.)

Tin (stannic) iodide, SnI_4.

Decomp. by H_2O into SnO_2 and HI.

Very sol. in PCl_3. (Beckmann, Z. anorg. 1906, **51.** 110.)

Sol. in $POCl_3$. (Walden, Z. anorg. 1900, **25.** 212.)

Easily sol. in PCl_3 and PBr_3. (Walden, Z. anorg. 1900, **25.** 211.)

Sol. in liquid $AsBr_3$ forming a solution with sp. gr.=3.731 at 15°. (Retgers, Z. phys. Ch. 1893, **11.** 342.)

Sol. in $SOCl_2$, S_2Cl_2 and SO_2Cl_2. (Walden, Z. anorg. 1900, **25.** 215.)

Sol. in $SnCl_4$. (Walden.)

Sol. in anhydrous alcohol, ether, and benzene. 1 pt. CS_2 dissolves 1.45 pts. SnI_4 at ordinary temp. (Schneider, Pogg. **127.** 624.)

100 pts. methylene iodide, CH_2I_2, dissolve 22.9 pts. SnI_4 at 10°. Sp. gr. of solution = 3.481. (Retgers, Z. anorg. **3.** 343.)

Solubility in organic solvents at t°.

Solvent	t°	G. SnI_4 in 100 g. of the sat. solution	Sp. gr. of the sat. solution
CCl_4	22.4	5.25	1.59
CCl_4	50.0	12.50	1.63
$CHCl_3$	28.0	8.21	1.50
C_6H_6	20.2	12.65	0.95

(McDermott, J. Am. Chem. Soc. 1911, **33.** 1964.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in acetone. (Eidman, C. C. **1899,** II. 1014.)

Solubility in CS_2.

100 g. of the sat. solution contain at:

−58°	−84°	−89°	−94°	−114.5°
16.27	10.22	9.68	10.65	9.41 g. SnI_4.

(Arctowski, Z. anorg. 1896, **11.** 274.)

Sol. in allyl mustard oil. (Mathews, J. phys. Ch. 1905, **9.** 647.)

Tin (stannous) hydrogen iodide, SnI_2, HI.

Not obtained in pure state. (Young, J. Am. Chem. Soc. 1897, **19.** 856.)

Tin (stannous) iodide ammonia, SnI_2, $2NH_3$.

(Ephraim and Schmidt, B. 1909, **42.** 3857.)

SnI_4, $8NH_3$. (Ephraim and Schmidt.)

Tin (stannic) iodide ammonia, SnI_4, $3NH_3$.

(Personne, C. R. **54.** 218.)

SnI_4, $4NH_3$. (Personne.)

SnI_4, $8NH_3$. (Rammelsberg, Pogg. **48.** 169.)

Tin iodosulphide,

See **Tin sulphoidide.**

Tin *mon*oxide (Stannous oxide), SnO.

Insol. in H_2O. Sol. in acids. Very sl. sol. in boiling NH_4Cl+Aq. (Rose.) Insol. in NaOH or KOH+Aq.

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329.)

Tin *di*oxide (Stannic oxide), SnO_2.

Insol. in H_2O or conc. acids except conc H_2SO_4. Insol. in conc. alkalies or NH_4OH+Aq.

Not absolutely insol. in dil. HNO_3+Aq. (Mulder.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Min. *Cassiterite* (*Tin stone*). Not attacked by acids.

Tin *sesqui*oxide, Sn_2O_3.

While moist, easily sol. in NH_4OH+Aq. Sl. sol. in dil., more easily in conc. HCl+Aq. (Berzelius.)

Tin (stannic) oxybromide, $Sn_3Br_6O+12H_2O$.

Decomp. by H_2O into $SnBr_2$ and H_2SnO_3.

$Sn_3Br_8O_2$. As above. (Preis and Raymann, C. C. **1882.** 773.)

Tin (stannic) oxybromide nitrogen *pent*oxide, SnO_2, $3Br_2$, N_2O_5.

Decomp. by H_2O. (Thomas, C. R. 1896, **122.** 33.)

Tin (stannous) oxychloride, SnO, $SnCl_2+3H_2O$.

Insol. in H_2O. Sol. in HCl, $HC_2H_3O_2$, and dil. HNO_3, or H_2SO_4+Aq. (J. Davy, Schw J. **10.** 325.)

$Sn_8Cl_{14}O_8+10H_2O$. Easily sol. in H_2O or alcohol.

Can be recrystallized from alcohol but not from H_2O. (Tschermak, W. A. B. **44.** **2.** 736.)

$3SnO_2$, $2SnCl_2+6H_2O$. Very sl. sol. in H_2O. Sol. in dil. acids. (Ditte, A. ch. 1882, (5) **27.** 146.)

$4SnO$, $SnCl_2+6H_2O$. (Ditte.)

Tin (stannic) oxychloride, SnO_2, $SnCl_4$.

Sol. in H_2O. (Scheurer-Kestner, A. ch. (3) **47.** 6.)

Tin (*meta*stannic) oxychloride, $3SnO_2$, $SnCl_4+3H_2O$.

Sol. in little, decomp. by much H_2O. (Weber, Pogg. **122.** 368.)

$4SnO_2$, $SnCl_4+7H_2O$. (Weber.)

"*Metastannyl chloride β,*" $Sn_5O_9Cl_2$. Deliquescent. Sol. without decomp. in a small amount of H_2O or in a large amount of H_2O containing a few drops HCl.

Sol. in abs. alcohol. (Engel, C. R. 1897, **124.** 767.)

$+4H_2O$ and $+9H_2O$. Sol. in H_2O acidified with one drop of HCl. Pptd. by excess HCl. (Engel, C. R. 1897, **124.** 768.)

"*Parastannyl chloride,*" $Sn_5O_9Cl_2+2H_2O$. Decomp. by excess H_2O.

Sol. in H_2O; pptd. by HCl. (Engel, C. R. 1897, **125.** 465.)

Tin (stannic) oxychloride nitrogen *pent*oxide, $SnOCl_2$, $3SnCl_4$, N_2O_5.

Hydroscopic; sol. in H_2O.

Decomp. by heat. (Thomas, C. R. 1896, **122.** 32.)

Tin (stannous) oxyiodide, SnO, $3SnI_2$; $2SnO$, $3SnI_2$; SnO, SnI_2; and $2SnO$, SnI_2.

Decomp. by much H_2O. (Personne, C. R. **54.** 216.)

Tin oxysulphide, $Sn_2S_3O+11H_2O$.

Very sol. in $(NH_4)_2CO_3$+Aq; slowly sol. in H_2O. (Schmidt, B. 1894, **27.** 2739.)

Tin phosphide, Sn_2P.

(Ragg, C. C. **1898** II. 170.)

SnP Sol. in HCl+Aq. Insol. in HNO_3+Aq.

SnP_2. Not attacked by HCl. Easily attacked by aqua regia. (Emmerling, B. 1879, **12.** 155.)

SnP_3. Insol. in HCl. Slowly attacked by dil. HNO_3 at 50°. Oxidized by fuming HNO_3 with ignition. (Jolibois, C. R. 1909, **148.** 638.)

Sn_3P_2. Insol. in mercury.

Decomp. by HCl. (Stead, J. Soc. Chem. Ind. 1897, **16.** 206.)

Sn_4P_3. Attacked by HCl, HNO_3 and alkalies. (Jobilois, C. R. 1909, **148.** 637.)

The only true compounds are Sn_4P_3 and SnP_3. (Jolibois, C. R. 1909, **148.** 637.)

Tin phosphochloride, $Sn_3P_2Cl_6$.

(Mahn, Jena. Zeit. **5.** 1660.)

Tin (stannous) selenide, SnSe.

Decomp. by boiling HCl+Aq. Slowly oxidised by boiling HNO_3+Aq, and easily dissolved in aqua regia (Schneider, Pogg. **127.** 624.) Easily sol. in alkalies+Aq (Uelsmann, A. **116.** 122), or scarcely even on boiling (Schneider), according to method of preparation. Sol. in alkali sulphides or selenides +Aq.

Tin (stannic) selenide, $SnSe_2$.

Not attacked by H_2O or dil. acids; scarcely attacked by boiling conc. HCl+Aq; gradually decomp. by hot HNO_3+Aq; easily dissolved by warm aqua regia, and hot conc. H_2SO_4.

Sol. in cold, more easily in warm KOH, NaOH, or NH_4OH+Aq. (Uelsmann, A. **116.** 122.)

Tin (stannous) sulphide, SnS.

1 l. H_2O dissolves 0.14×10^{-6} mols. SnS at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in dil., sol. in conc. HCl+Aq. Sl. sol. in hot conc. HNO_3+Aq. Insol. in KOH +Aq.

$+H_2O$. Insol. in H_2O, H_2S+Aq, or dil. acids; sol. with decomp. in conc. acids; easily sol. in hot conc. HCl+Aq. Insol. in H_2SO_3+Aq. Insol. in NH_4OH+Aq. Insol. in NH_4Cl, or NH_4NO_3+Aq. Scarcely sol. in $(NH_4)_2S$+Aq, but easily sol. in the same on addition of S. (Rose.)

10% NaOH+Aq dissolves SnS by violent boiling.

Insol. in cold, sl. sol. in hot Na_2SO_3+Aq. (Materne, C. C. **1906,** II. 557.)

Sol. in alkali polysulphides+Aq.

Insol. in acetone. (Eidmann, C. C. **1899.**

II. 1014); (Naumann, B. 1904, **37.** 4329.); ethyl acetate. (Naumann, B. 1910, **43.** 314.)

Tin (stannic) sulphide, SnS_2.

Anhydrous. (*Mosaic gold.*) Insol. in HCl or HNO_3+Aq, but decomp. by aqua regia. Sol. in hot KOH+Aq or K_2CO_3+Aq; also in hot K_2S, Na_2S+Aq, and $(NH_4)_2S$+Aq.

1 l. H_2O dissolves 1.13×10^{-6} mols. SnS_2 at 18°. (Weigel, Z. phys. Ch. 1907, **58.** 294.)

+xH_2O. Sl. sol. in NH_4OH+Aq, but readily in KOH, K_2S, or Na_2S+Aq; also in hot conc. HCl+Aq. Decomp. by hot HNO_3+Aq. Insol. in $KHSO_3$+Aq. Sol. in K_2CO_3+Aq. Insol. in NH_4Cl, and NH_4NO_3+Aq. (Brett.)

Pptd. SnS_2 is insol. in cold, sol. in hot $Na_2B_4O_7$+Aq. Sol. in Na_2CO_3+Aq. Very sol. in NaOH+Aq. (Materne, C. C. **1906,** II. 557.)

Sol. in boiling conc. $H_2C_2O_4$+Aq. (Clarke, C. N. **21.** 124.)

Insol. in methyl acetate (Naumann, B. **1909, 42.** 3790); ethyl acetate (Naumann, B. 1910, **43.** 314.); acetone (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Tin *sesqui*sulphide, Sn_2S_3.

Sol. in moderately conc. HCl. (Antony and Niccoli, Gazz. ch. it. 1892, **22.** (2) 408.)

Tin sulphochloride, SnS_2, $2SnCl_4$.

H_2O dissolves out $SnCl_4$. (Dumas, Schw. J. **66.** 409.)

SnS_2Cl_{12}=$SnCl_4$, $2SCl_4$. Sol. in H_2O with separation of S.

Gradually sol. in dil. HNO_3+Aq.

Sol. in $POCl_3$. (Casselmann, A. **83.** 267.)

Tin sulphoiodide, SnS_2I_4.

Decomp. by H_2O into SnO_2, S, and HI; by cold conc. HCl+Aq with separation of S, also by aqua regia, and HNO_3+Aq.

Cold KOH+Aq separates S and SnO_2.

Completely sol. in hot KOH+Aq.

Sol. in cold, more easily in hot CS_2 or $CHCl_3$.

Decomp. by alcohol. (Schneider, Pogg. **111.** 249.)

Tin sulphophosphide, Sn_3P_2S.

Insol. in HCl, HNO_3 and aqua regia.

Sol. in aq. alkali hydroxides, containing Cl_2 or Br_2 in solution. (Granger, C. R. 1896, **122.** 322.)

Tin (stannous) telluride, SnTe.

Not attacked by conc. HCl+Aq. (Ditte, C. R. **97.** 42.)

Titanic acid, TiO_2, xH_2O.

α-Titanic acid.—Insol. in H_2O or alcohol. When dried in the cold, is completely sol. in acids, especially HCl, or dil. H_2SO_4+Aq, but when the solution in acids is boiled, it is converted into β-titanic acid. Very sl. sol. even when moist in H_2SO_3+Aq. (Berthier.) Sl. sol. in alkali carbonates +Aq. A complete solution in an alkali carbonate +Aq can only be obtained by adding a Ti salt drop by drop to the alkaline solution, and allowing the ppt. to dissolve entirely before adding more Ti salt. On boiling the solution in $(NH_4)_2CO_3$+Aq (or in K_2CO_3 or Na_2CO_3+Aq with NH_4Cl) the titanic acid is pptd.

Relatively easily sol. in mineral acids, decreasing in the following order HCl, HNO_3, H_2SO_4. Insol. in perchloric acid. (Landecker, Z. anorg. 1909, **64.** 67.)

Sol. in dil. H_2SO_4. 40 g. H_2O + 70 g. H_2SO_4 (sp. gr. 1.145) dissolves 0.33 g. TiO_2 in 15 min. (Hall and Smith, Proc. Am. Phil. Soc. 1905, **44.** 193.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

β-Titanic acid, Metatitanic acid.—Insol. in H_2O, acids except HF, or alkali hydrates or carbonates +Aq. When digested with conc. H_2SO_4 until acid is evaporated, the residue is sol. in H_2O. (Berzelius.)

γ-Titanic acid.—Sol. in pure H_2O, but β-acid is pptd. by boiling. (Knop, A. **123** 351.)

Colloidal TiO_2 xH_2O+Aq has been prepared by Graham (Chem. Soc. **17.** 325.)

Barium titanate, 2BaO, $3TiO_2$.

(Bourgeois, C. R. **103.** 141.)

Barium *per*titanate *per*oxide.

See **Pertitanate, barium *per*oxide.**

Calcium titanate, $CaTiO_3$.

(Ebelmen, C. R. **32.** 711.)

Min. *Perofskite.* Scarcely attacked by HCl +Aq or other acids, except hot H_2SO_4, which decomposes it.

CaO, $2TiO_2$. Min. *Titanomorphite.* Partially decomp. by HCl+Aq, completely by H_2SO_4.

Cobaltous titanate, $CoTiO_3$.

(Bourgeois, C. C. **1893,** I. 226.)

Ferrous *ortho*titanate, Fe_2TiO_4.

(Hautefeuille, C. R. **59.** 733.)

Ferroferric titanate, $FeTiO_3$, xFe_2O_3.

Min. *Menaccanite.* Very sl. sol. in HCl or aqua regia with separation of TiO_2.

Ferric titanate.

Not attacked by boiling H_2SO_4 or conc. HCl+Aq. (Wöhler and Liebig, Pogg. 21. 578.)

Magnesium titanate, $MgTiO_3$.

Insol. in H_2O and acids. (Hautefeuille, A. ch. (4) **4.** 169.)

Min. *Geikielite.*

When finely powdered, is easily sol. in hot HCl, or in cold HF in a few hours. (Dick, Miner, Mag. 1894, **10.** 146.)

Mg_2TiO_4. Slowly decomp. by boiling with HNO_3+Aq. (Hautefeuille, A. ch. (4) **4.** 169.)

Potassium titanate, K_2TiO_3.

Anhydrous. Decomp. with H_2O.

$+4H_2O$. Deliquescent. Very sol. in H_2O. Precipitated from aqueous solution by alcohol. (Demoly, Compt. chim. **1849.** 325.)

Potassium titanate, acid, K_2O, $3TiO_2+2H_2O$

Insol. in H_2O. (Demoly.)

K_2O, $6TiO_2+2H_2O$. (Demoly.)

K_2O, $3TiO_2+3H_2O$. Insol. in H_2O. Completely sol. in HCl+Aq if only cold H_2O is used for washing. When heated to 100°, no longer completely sol. in HCl+Aq. (Rose, Pogg. **74.** 563.)

K_2O, $12TiO_2$. (Rose, Gilb. Ann. **73.** 78.)

Sodium titanate, Na_2TiO_3.

Anhydrous. Decomp. by H_2O into NaOH, and an acid titanate, insol. in H_2O.

$+4H_2O$. Deliquescent. Very sol. in H_2O. Precipitated from aqueous solution by alcohol. (Demoly.)

Sodium titanate, acid, $2Na_2O$, $9TiO_2+5H_2O$.

If not heated to 100°, is sol. in cold HCl+Aq. (Rose, Gilb. Ann. **73.** 78.)

$2Na_2O$, $3TiO_2$. Insol. in H_2O; slowly sol. in cold, easily in hot HCl+Aq. (Cormimbœuf, C. R. 115. 823.)

Na_2O, $2TiO_2$. As above. (C.)

Na_2O, $3TiO_2$. Insol. in H_2O, and nearly so in boiling HCl+Aq. (C.)

Strontium titanate, $2SrO$, $3TiO_2$.

(Bourgeois, C. R. **103.** 141.)

Zinc titanate, ZnO, TiO_2(?).

(Lévy, A. ch. (6) 24. 456.)

$2ZnO$, TiO_2(?). (Lévy.)

$3ZnO$, $2TiO_2$. Slowly attacked by warm H_2SO_4 or HNO_3+Aq, and by H_2SO_4+HF. Wholly sol. in cold HCl+Aq. (Lévy.)

$4ZnO$, $5TiO_2$. Not attacked by cold conc. acids, but sol. by boiling except in HCl+Aq. (Lévy.)

ZnO, $3TiO_2$. Insol. in H_2O, alcohol, or ether. Dil. HNO_3, H_2SO_4, or HCl+Aq do not attack even on boiling; boiling H_2SO_4 dissolves with difficulty; not attacked by conc. boiling alkalies+Aq. (Lévy, A. ch. (6) **25.** 471.)

***Per*titanic acid.**

See **Pertitanic acid.**

Titanium, Ti.

Decomp. H_2O even under 100° (Wöhler); not attacked by H_2O under 500°. (Kern, C. N. **33.** 57).

Does not decomp. H_2O at 100°. (Schneider, Z. anorg. 1894, **8.** 85.)

Sol. in HCl+Aq if warmed. Rapidly sol. in HF+Aq. Sol. in cold dil. H_2SO_4+Aq, HNO_3+Aq, or $HC_2H_3O_2$+Aq. Dissolves almost instantaneously in HF+Aq. (Merz.)

Sol. in molten lead and iron; sol. in HCl, HNO_3 and aqua regia. (Moissan, C. R. 1895, **120.** 293.)

Amorphous. Loses its spontaneous inflammability when left for a time in contact with H_2O. (Schneider, Z. anorg. 1895, **8.** 85.)

Titanium amide, $Ti(NH_2)_4$.

Violently attacked by H_2O. (Stähler, B. 1905, **38.** 2629.)

Titanium *tri*bromide, $TiBr_3+6H_2O$.

Very hydroscopic. (Stähler, B. 1904, **37.** 4405.)

Titanium *tetra*bromide, $TiBr_4$.

Deliquescent. Decomp. by H_2O. (Duppa, C. R. **42.** 352.)

Sol. in absolute alcohol and in dry ether. (Rosenheim and Schütte, Z. anorg. 1900, **24.** 238.)

Titanium bromonitride, TiNBr.

Decomp. by a small amount of H_2O. On addition of more H_2O, a part dissolves forming a solution which decomp. on warming with separation of titanic acid. It behaves similarly toward dil. HNO_3, dil. HCl and dil. H_2SO_4. Completely sol. in warm dil. H_2SO_4. (Ruff, B. 1908, **41.** 2262.)

Titanium carbide, TiC.

Sol. in HNO_3+Aq. (Shimer, C. N. **55.** 71.)

Insol. in HCl. Slowly sol. in aqua regia. (Moissan, C. R. 1895, **120.** 295.)

Titanium carbide nitride, $Ti_{10}C_2N_8 = Ti(CN)_2$, $3Ti_3N_2$.

Insol. in, and not attacked by boiling HNO_3 or H_2SO_4 (Wollaston), but sol. in HNO_3+HF (Berzelius).

Titanium *di*chloride, $TiCl_2$.

Very deliquescent. Decomposes H_2O with violence. Insol. in ether, CS_2, or $CHCl_3$. Decomp. by 99.5% alcohol.

Titanium *tri*chloride, $TiCl_3$.

Deliquescent. Sol. in H_2O with evolution of heat.

$+4H_2O$. (Glatzel, B. **9.** 1829.)

$+6H_2O$. Very sol. in H_2O. (Polidori, Z. anorg. 1898, **19.** 307.)

Titanium *tetra*chloride, $TiCl_4$.

Anhydrous. Sol. in H_2O with evolution of much heat.

$+5H_2O$. Deliquescent.

Titanium sulphuryl chloride, $TiCl_4SO_3 = TiCl_3OSO_2Cl$.

Deliquesces gradually in moist air. (Clausnitzer, B. **11.** 2011.)

Titanium chloride ammonia, $TiCl_4$, $4NH_3$.

Deliquescent. Solution in H_2O is not quite clear. (Rose.)

According to Persoz (A. ch. **46.** 315), is $TiCl_4$, $6NH_3$.

$TiCl_4$, $6NH_3$ and $TiCl_4$, $4NH_3$.

Both compds. are unstable in moist air; insol. in ether. (Rosenheim, Z. anorg. 1901, **26.** 245.)

$TiCl_4$, $8NH_3$. Violently decomp. by H_2O. (Stähler, B. 1905, **38.** 2627.)

Titanium *tetra*chloride cyanobromide, $TiCl_3$, $NCClBr$.

(Schneider, Z. anorg. 1894, **8.** 92.)

Titanium chloride cyanhydric acid, $TiCl_4$, $2HCN$.

Deliquescent. Sol. in H_2O with evolution of heat. (Wöhler, A. **73.** 226.)

Titanium *tri*chloride nitrogen sulphide, $2TiCl_3$, N_4S_4.

Decomp. rapidly in air. (Davis, Chem. Soc. 1906, **89.** (2) 1576.)

Titanium *tetra*chloride nitrogen sulphide, $TiCl_4$, N_4S_4.

Hydroscopic.

Decomp. by H_2O, HNO_3, HCl, KOH and alcohol. (Wölbling, Z. anorg. 1908, **57.** 282.)

Titanium chloride phosphine.

Decomp. by H_2O, HCl+Aq, KOH+Aq, K_2CO_3+Aq, or $(NH_4)_2CO_3$+Aq. (Rose.)

Titanium *tetra*chloride phosphoryl chloride, $TiCl_4$, $2POCl_3$.

(Ruff, B. 1903, **36.** 1783.)

Titanium chloronitride, TiNCl.

Decomp. by small amount cold H_2O. On the addition of more H_2O it is only partially decomp. For complete solution, the addition of dil. HCl or a mixture of warm dil. H_2SO_4 and HF is necessary. Easily sol. in conc. HNO_3 and in conc. H_2SO_4. (Ruff, B. 1908, **41.** 2259.)

Titanium *di*fluoride.

(Hautefeuille, C. R. **57.** 151.)

Probably *sesqui*fluoride.

Titanium *sesqui*fluoride, Ti_2F_6.

Appears to be two modifications, one sol. in H_2O, and the other insol. in H_2O. (Hautefeuille, C. R. **59.** 189.)

Insol. in H_2O. (Weber, Pogg. 120. 292.)

Titanium *tetra*fluoride, TiF_4.

Decomp. by H_2O. (Unverdorben.)

Sol. in H_2O, but solution decomp. upon evaporation. (Marignac, Ann. Min. (5) **15.** 258.)

Sol. in H_2O. (Emich, M. 1904, **25.** 910.)

Very hydroscopic.

Sol. in H_2O. Sl. sol. in conc. HF+Aq.

Sol. in cold $POCl_3$ without decomp. Decomp. in warm $POCl_3$.

Sol. in alcohol and dry pyridine.

Insol. in ether, CS_2, CCl_4, $SiCl_4$, $SiBr_4$, SO_2Cl_2, $SOCl_2$, SCl_2, $AsCl_3$, SO_3, CrO_3, PCl_3. (Ruff, B. 1903, **36.** 1780.)

$+2H_2O$. Sol. in H_2O. (Ruff, B. 1903, **36.** 1780.)

Titanium hydrogen fluoride, 2HF, $TiF_4 = H_2TiF_6$.

Sol. in H_2O with decomposition and separation of a basic salt. Corresponds to fluosilicic acid, and may be considered as fluotitanic acid H_2TiF_6.

Titanium fluoride *with* MF.

See **Fluotitanate, M.**

Titanium *tetra*fluoride ammonia, TiF_4, $2NH_3$.

Sol. in H_2O; decomp. in aq. solution on boiling. (Ruff, B. 1903, **36.** 1781.)

Titanium *mono*hydroxide, TiO_2H_2.

Ppt. (Wöhler, A. **73.** 49.)

Ti_3O_4H. Not attacked by cold conc. acids; sl. attacked on warming. Insol. in cold or hot KOH+Aq. (Winkler, B. 1890, **23.** 2659.)

Titanium *sequi*hydroxide, Ti_2O_3, xH_2O.

Decomposes very quickly with H_2O, forming titanium *di*hydroxide.

TiO_3H_3. (Polidori, Z. anorg. 1899, **19.** 306.)

Titanium *di*hydroxide.

See **Titanic acid.**

Titanium hydroxychloride, $TiCl_3(OH)$.

Deliquescent. Easily sol. in H_2O and alcohol. Sol. in ether.

$TiCl_2(OH)_2+1\frac{1}{2}H_2O$. Deliquescent. Sol. in H_2O, alcohol, and ether. Aqueous solution decomp. by boiling.

$TiCl(OH)_3+H_2O$. Nearly insol. in H_2O. Insol. in alcohol and ether. (König and v. der Pfordten, B. **21.** 1708.)

See also **Titanium oxychloride.**

Titanium *di*iodide, TiI_2.

Very hydroscopic; insol. in organic solvents; sol. in conc. HF and boiling HCl; decomp. by

H_2O, alkalies, H_2SO_4 and HNO_3. (Defacqz, C. R. 1908, **147.** 66.)

Titanium ***tri*****iodide,** TiI_3+6H_2O.

Very hydroscopic. (Stähler, B. 1904, **37.** 4410.)

Titanium ***tetra*****iodide,** TiI_4.

Fumes on air, and dissolves rapidly in H_2O with evolution of heat. Solution decomposes on standing. (Weber.)

Titanium nitride, Ti_3N_4.

Difficultly sol. in warm HNO_3+Aq. More easily sol. in aqua regia. (Rose.)

Insol. in dil. acids. Decomp. by hot conc. H_2SO_4 and by conc. HNO_3, especially when HF is added, and by boiling KOH+Aq. (Ruff and Eisner, B. 1908, **41.** 2252.)

Decomp. by H_2O and dil. acids.

Insol. in all ordinary indifferent organic solvents. (Ruff, B. 1912, **45.** 1369.)

TiN_2. Insol. in H_2O. (Wöhler.)

Is TiN, according to Guerin (C. R. **82.** 972.)

Titanium ***mon*****oxide,** TiO.

(Moissan, C. R. 1895, **120.** 290.)

Titanium ***sesqui*****oxide,** Ti_2O_3.

Insol. in HCl or HNO_3+Aq. Difficultly sol. in H_2SO_4. (Ebelmen, A. ch. (3) **20.** 392.)

When moist, insol. in H_2O or NH_4OH+Aq, but quickly decomp. to TiO_2. Sol. in oxygen acids, but quickly decomp. (Berzelius.)

Titanium ***di*****oxide,** TiO_2.

Amorphous. Insol. in H_2O, HCl, or dil. H_2SO_4+Aq, even when heated for a long time.

Sol. in conc. H_2SO_4 by long digestion.

TiO_2, strongly ignited at 1000°, is practically insol. in conc. H_2SO_4 and HF.

When less strongly ignited (by heating ortho or metatitanic acid to 700°) it is easily sol. therein. (Bornemann and Schirrmeister, C. C. **1910,** II. 1870.)

Ignited TiO_2 is very difficultly sol. in HF. (Pennington, J. Am. Chem. Soc. 1896, **18.** 56.)

The solubility of ignited TiO_2 in H_2SO_4 is helped by H_2O_2. (Weiss and Landecker, Z. anorg. 1909, **64.** 71.)

The solubility in H_2SO_4 is increased by addition of H_2O_2. H_2O_2 brings TiO_2 quickly and completely into solution in the presence of NH_4OH, NH_4Cl, NaOH, Na_2CO_3 and Na_2HPO_4. (Weiss and Landecker, Z. anorg. 1909, **64.** 71.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Crystalline. Min. *Rutile, Brookite,* and *Anatase.* Solubility as above.

See also **Titanic acid.**

Titanium oxide, Ti_3O_5.

(Deville, C. R. **53.** 163.)

True formula is Ti_7O_{12}. (v. der Pfordten, A. **237.** 201.)

Titanium ***per*****oxide,** TiO_3.

Sol. in acids. Solution in H_2SO_4 is very stable, but the HCl solution decomposes very easily. (Weber, B. **15.** 2599; Piccini, B. **15.** 2221; Classen, B. **21.** 370.)

Titanium oxychloride, TiO_2, $TiOCl_2+8H_2O$.

Sol. in much H_2O. (Merz, Bull. Soc. **1867.** 101.)

$Ti_2O_2Cl_2$. Insol. in H_2O. Sol. in NH_4OH+Aq with separation of TiO_2.

See also **Titanium hydroxychloride.**

Titanium oxyfluoride.

Insol. in H_2O. (Berzelius.)

Titanium oxyfluoride ***with*** **MF.**

See **Fluoxypertitanate, M.**

Titanium phosphide, TiP.

Sl. sol. in boiling aqua regia.

Insol. in dil. or conc. acids and alkalies.

Sl. attacked by fuming HNO_3 in sealed tube at 250°–300°. (Gewecke, A. 1908, **361.** 84.)

Titanium phosphochloride.

See **Phosphorus titanium chloride.**

Titanium silicide, $TiSi_2$.

Sol. in HF; insol. in other min. acids.

Slowly sol. in 10% KOH+Aq. (Hönigschmid, C. R. 1906, **143.** 226.)

Titanium ***mono*****sulphide,** TiS.

Insol. in alkalies. Difficultly sol. in nitric acid and aqua regia.

Insol. in HF. (v. der Pfordten, A. **234.** 257.)

Titanium ***di*****sulphide,** TiS_2.

Decomp. slowly on moist air. Insol. in HCl or dil. H_2SO_4+Aq. (Ebelmen.)

Sol. in aqua regia or HNO_3+Aq. Decomp. by KOH+Aq or NaOH+Aq. Insol. in KSH+Aq. (Rose.)

Sol. in HF at 100°. (v. der Pfordten, A. **234.** 257.)

Titanium ***sesqui*****sulphide,** Ti_2S_3.

Insol. in caustic alkalies+Aq. Sol. in HF at a high temp. Insol. in aqua regia. (v. der Pfordten, A. **234.** 257.)

Titanomolybdic acid, TiO_2, $12MoO_3+22H_2O$.

Very sol. in H_2O.

Sol. in ether. (Pèchard, C. R. 1893, **117.** 790.)

Ammonium titanomolybdate, $2(NH_4)_2O$, TiO_2, $12MoO_3+10H_2O$.

Sol. in H_2O and acids; completely insol. in solutions of ammonium salts. (Pèchard.)

Potassium titanomolybdate, $2K_2O$, TiO_2, $12MoO_3+16H_2O$.

Efflorescent.
Sol. in H_2O. (Pèchard.)

Titano*deci*tungstic acid, $H_8TiW_{10}O_{36}+xH_2O$.

(Lecarme, Bull. Soc. (2) **36.** 17.)

Titanotungstic acid or Titano*duodeci*tungstic acid, $H_8TiW_{12}O_{42}+xH_2O$

(Lecarme, Bull. Soc. (2) **36.** 17.)

Titanous acid.

Sodium titanite, $Na_3TiO_3=3Na_2O, Ti_2O_3$.

Sol. in dil. acids. (Koenig and v. der Pfordten, B. **22.** 2075.)

Titanyl compounds.

See **Titanium oxy- compounds.**

Triamine cobaltic compounds.

See **Dichrocobaltic compounds.**

Trithionic acid, $H_2S_3O_6$.

Known only in aqueous solution.

Solution in H_2O gradually decomposes in the cold, rapidly at 80°. Not decomp. if very dilute or in presence of acids, except HNO_3, $HClO_3$, and HIO_3. (Fordos and Gélis, A. ch. (3) **28.** 451.)

Trithionates.

The trithionates are all sol. in H_2O, and very easily decomposed.

Ammonium trithionate, $(NH_4)_2S_3O_6$.

Very deliquescent and unstable.
Very sol. in H_2O.
Insol. in abs. alcohol. (Divers and Ogawa, Chem. Soc. 1900, **77.** 337.)

Barium trithionate, $BaS_3O_6+2H_2O$.

Very sol. in H_2O. Precipitated from aqueous solution by large excess of alcohol. Aqueous solution is very unstable. (Kessler, Pogg. **74.** 250.)

Lead trithionate, PbS_3O_6.

Very sl. sol. in H_2O. Sol. in $Na_2S_2O_3$+Aq. (Fogh, C. R. **110.** 524.)

Potassium trithionate, $K_2S_3O_6$.

Sol. in H_2O. Insol. in alcohol. (Kessler, Pogg. **74.** 270.)
Sol. in H_2O with decomp.
Insol. in alcohol. (Langlois, A. 1841, **40.** 102.)

Sodium trithionate, $Na_2S_3O_6$.

Very sol. in H_2O.
$+3H_2O$. (Villiers, C. R. **106.** 1356.)

Thallous trithionate, $Tl_2S_3O_6$.

Sol. in H_2O. (Bevan, C. N. **38.** 294.)

Zinc trithionate.

Sol. in H_2O, but decomposes upon warming the solution. (Fordos and Gélis, C. R. **16.** 1070.)

Tungsten, W.

Metallic. Not attacked by heating with fuming HNO_3, aqua regia, or other acids, or by boiling KOH+Aq. Sol. in KOH+Aq and NaClO+Aq. (v. Uslar, A. **94.** 255.)

Not easily acted upon by moist air, if no CO_2 present. Sol. in a mixture of HF and HNO_3. Very slowly sol. in H_2SO_4, HCl and HF. (Moissan, C. R. 1896, **123.** 15.)

Very slowly attacked by HNO_3, H_2SO_4, HCl and even CrO_3. A mixture of CrO_3 and H_2SO_4 dissolved 1.67 g. in 16 hrs. from a fine wire and 1.36 g. in 14 hours. (Fink, Met. Chem. Eng. 1910, **8.** 341.)

Compact tungsten is not attacked by dil., and only sl. dissolved by conc. H_2SO_4. Not attacked by dil. or conc. HCl. HNO_3 and HNO_3+HCl attack slowly by long heating, forming thin layer of WO_3. Slowly sol. in HNO_3+HF. (Weiss, Z. anorg. 1910, **65.** 339.)

Aluminothermic tungsten is insol. in acids and in aqua regia. Sol. in fused KOH. (Stavenhagen, B. 1899, **32.** 1515.)

Insol. in HCl of any concentration at room temp. and only very sl. sol. at 110°. After being in contact with hot conc. HCl (sp. gr. 1.15) for 175 hrs. the metal lost 0.5% of its weight. Sl. sol. in dil. HCl at 110°.

Insol. in conc. H_2SO_4 at room temp. and in dil. H_2SO_4 at 110°. Somewhat sol. in conc. H_2SO_4 at high temp.

Insol. in conc. HNO_3, and hot or cold HF.

Sl. sol. in aqua regia.

Very sol. in HF+HNO_3. (Ruder, J. Am. Chem. Soc. 1912, **34.** 387.)

Insol. in aqua regia and acids; sol. in fused KOH. (Stavenhagen, B. 1899, **32.** 1514.)

Insol. in KOH+Aq.
Sol. in fused KOH.

Slowly sol. in fused Na_2CO_3, K_2CO_3 or mixture of the two.

Somewhat sol. in NaOCl+Aq. (Ruder, J. Am. Chem. Soc. 1912, **34.** 388.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Crystalline. Insol. in H_2O, HCl, or H_2SO_4. Oxidised by HNO_3 or aqua regia. (D'Elhujar.)

Sol. in boiling KOH+Aq. (Riche, A. ch. (3) **50.** 5.)

Amorphous. Easily oxidised by HNO_3+Aq. (Zettnow.)

Tungsten amide.

See **Tungsten nitride.**

Tungsten arsenide, WAs_2.

Insol. in H_2O and other solvents. Not attacked by boiling HF or HNO_3. Sol. in cold $HF+HNO_3$ and in hot aqua regia. Not attacked by hot KOH+Aq or NaOH+Aq. Decomp. by fused KOH or NaOH. (Defacqz, C. R. 1901, **132.** 139.)

Tungsten boride, WB_2.

Slowly attacked by conc. acids; vigorously attacked by aqua regia. (Tucker and Moody, Chem. Soc. 1902, **81.** 16.)

Tungsten *di*bromide, WBr_2.

Partly sol. in H_2O, the rest decomposing to WO_2 and HBr.

Tungsten *penta*bromide, WBr_5.

Decomp. by moist air or H_2O. Sol in caustic alkalies+Aq.

Very hydroscopic. Fumes in the air.

Decomp. by H_2O.

Sol. in HF, or conc. HCl. Sl. sol. in fuming HBr. Decomp. by dil. HCl, conc. HNO_3 or dil. H_2SO_4. Readily attacked by fused alkalies or alkalies +Aq. Sol. in CCl_4, $CHCl_3$, $CHBr_3$, abs. alcohol, ether, essence of terebenthine and benzene. (Defacqz, C. R. 1899, **128.** 1232.)

Tungsten *hexa*bromide, WBr_6.

Decomp. by H_2O and in the air.

Sol. in NH_4OH+Aq. (Smith, J. Am. Chem. Soc. 1897, **18.** 1100.)

Tungsten bromochloride, WCl_6, WBr_6.

Decomp. by H_2O. Sol. in HF. Decomp. by HNO_3 or H_2SO_4. Violently attacked by fused alkali or alkali+Aq. Sol. in most organic solvents.

WCl_6, $3WBr_6$. Properties like those of WCl_6, WBr_6. (Defacqz, C. R. 1899, **129.** 516.)

Decomp. by H_2O. Sol. in 40% HF+Aq. 22° B. HCl +Aq gives a sl. ppt. of WO_3. Decomp. by HNO_3 and by H_2SO_4. Sol. in abs. alcohol, ether, CS_2, C_6H_6 and glycerine. Sol. in CCl_4 only on warming. Nearly insol. in oil of turpentine. (Defacqz.)

Tungsten bronze.

See—

Tungstate tungsten oxide, barium.

Tungstate tungsten oxide, barium potassium.

Tungstate tungsten oxide, barium sodium.

Tungstate tungsten oxide, calcium potassium.

Tungstate tungsten oxide, calcium sodium.

Tungstate tungsten oxide, lithium.

Tungstate tungsten oxide, lithium potassium.

Tungstate tungsten oxide, potassium.

Tungstate tungsten oxide, potassium sodium.

Tungstate tungsten oxide, potassium strontium.

Tungstate tungsten oxide, sodium.

Tungstate tungsten oxide, sodium strontium.

Tungsten carbide, W_2C.

Sol. in boiling HNO_3; very slowly acted upon by other acids. (Moissan, C. R. 1896, **123.** 16.)

WC. Insol. in dil. acids; only sl. sol. in H_2SO_4 and conc. HNO_3; sol. in fused $KClO_3$ and KNO_3. (Williams, C. R. 198, **126.** 1724.)

Tungsten *di*chloride, WCl_2.

Decomp. on the air or with H_2O. (Roscoe.)

Tungsten *tetra*chloride, WCl_4.

Deliquescent. Partly sol. in H_2O, with subsequent decomposition. (Roscoe.)

Tungsten *penta*chloride, WCl_5.

Very deliquescent. Decomp. with H_2O with hissing and evolution of heat and separation of W_2O_5.

Very sl. sol. in CS_2. (Roscoe.)

Tungsten *hexa*chloride, WCl_6.

Not decomp. by moist air or H_2O. Decomp. by alcohol. Very sol. in CS_2. (Roscoe.)

Easily sol. in $POCl_3$. (Teclu, A. **187.** 255.)

Tungsten chloride nitrogen sulphide, WCl_4, N_4S_4.

(Davis, Chem. Soc. 1906, **89.** (2) 1575.)

Tungsten chloroarsenide, W_2AsCl_9.

Hydroscopic; decomp. by H_2O and acids; sol. in aq. solution of alkalies; insol. in anhydrous organic solvents. (Defacqz, C. R. 1901, **132.** 139.)

Tungsten chlorosulphide, $W_2S_7Cl_8$.

Decomp. by H_2O.

Sol. in S_2Cl_2. (Smith and Oberholtzer, Z. anorg. 1894, **5.** 68.)

WCl_6, $3WS_3$. Decomp. by H_2O. Insol. in CS_2, alcohol and C_6H_6. (Defacqz, A. ch. 1901, (7) **22.** 266.)

Tungsten *hexa*fluoride, WF_6.

Fumes in the air.

Decomp. by H_2O. Easily sol. in aq. alkalies. (Ruff, B. 1905, **38.** 747.)

Tungsten *di*iodide, WI_2.

Not decomp. by H_2O. (Roscoe, A. **162.** 366.)

Insol. in H_2O, CS_2 and alcohol. Decomp. by boiling H_2O, HNO_3, H_2SO_4 and aqua regia; sol. in fused KOH, and alkali carbonates. (Defacqz, C. R. 1898, **126.** 936.)

Tungsten *tetra*iodide, WI_4.

Insol. in H_2O, ether, chloroform and turpentine; sol. in abs. alcohol; decomp. when boiled with H_2O; sol. with decomp. in dil. HCl and H_2SO_4, in HNO_3 and aqua regia, and in alkali hydroxides and carbonates fused or in aq. solution. (Defacqz, C. R. 1898, **127.** 511.)

***Tri*tungsten nitride, W_3N_2.**

(Uhrlaub.)

W_2N_3. Insol. in HNO_3, dil. H_2SO_4 and NaOH+Aq. (Rideal, Chem. Soc. 1889, **55.** 44.)

Tungsten nitride amide, $W_3N_6H_4=2WN_2, W(NH_2)_2$.

Not attacked by acids or caustic alkalies+Aq. (Wöhler, A. **73.** 191.)

Tungsten nitride amide oxide, $W_7N_8H_4O_4=3WN_2, W_2(NH_2)_2, 2WO_3$.

Not attacked by acids or alkalies. (Wöhler.)

Tungsten *mon*oxide, WO.

Insol. in H_2O. Not attacked by HCl, HF, H_2SO_4, or KOH+Aq. HNO_3+Aq or aqua regia convert it into WO_3. (Headden, Sill. Am. J. **145.** 280.)

Tungsten *di*oxide, WO_2.

(*a*) When prepared in the dry way, is attacked only by aqua regia, which oxidises to WO_3.

(*b*) When moist, is sol. in HCl or H_2SO_4+Aq, also in KOH+Aq. Insol. in NH_4OH+Aq. (Riche, A. ch. (3) **50.** 5.)

Cryst. Insol. in HCl, H_2SO_4 and conc. aq. alkalies; sol. in HNO_3. (Hallopeau, C. R. 1898, **127.** 135.)

Tungsten oxide, blue.

W_2O_5 (Riche, A. ch. (3) **50.** 33); W_3O_8 (v. Uslar); W_4O_{11} (Gmelin).

All are probably the same substance. Not attacked by boiling HNO_3 or aqua regia. Slowly sol. in boiling KOH+Aq.

Tungsten *tri*oxide, WO_3.

Insol. in H_2O or acids. Sl. sol. in dil. KOH+Aq, NaOH+Aq, Na_2CO_3+Aq, or H_2CO_3+Aq, but easily sol. in conc. boiling solutions of same. NH_4OH+Aq when boiling has a solvent action.

Insol. in conc. and dil. H_2SO_4. (Desi, J. Am. Chem. Soc. 1897, **19.** 214.)

Min. *Tungstite.* Insol. in acids. Sol. in NH_4OH+Aq.

Tungsten oxide, W_2O_3.

Sol. in alkalies. (Desi, J. Am. Chem. Soc. 1897, **19.** 214.)

W_3O_8. Insol. in acids and alkalies. (Desi, J. Am. Chem. Soc. 1897, **19.** 228.)

+H_2O. Like $W_5O_{14}+H_2O$. (Allen and Gottschalk, Am. Ch. J. 1902, **27.** 336.)

W_4O_3. (Desi, J. Am. Chem. Soc. 1897, **19.** 219.)

W_5O_9. (Desi.)

$W_5O_{14}+H_2O$. Insol. in H_2O containing a little HCl.

Slowly attacked by cold, conc. MOH+Aq. (Allen and Gottschalk, Am. Ch. J. 1902, **27.** 333.)

Tungsten *tri*oxide ammonia, $WO_3, 3NH_3$.

(Rosenheim and Jacobsohn, Z. anorg. 1906, **50.** 306.)

Tungsten oxybromide, etc.

See **Tungstyl bromide, etc.**

Tungsten *mono*phosphide, WP.

Not attacked by HF or HCl.

Sol. in warm HNO_3+HF. Slowly attached by hot HNO_3.

Not attacked by KOH+Aq or NaOH+Aq. (Defacqz, C. R. 1901, **132.** 34.)

Tungsten *di*phosphide, WP_2.

Insol. in H_2O and in most organic solvents; insol. in HCl and HF; sol. in a mixture of HF and HNO_3 in the cold, and in aqua regia on warming. (Defacqz, C. R. 1900, **130.** 916.)

Tungsten phosphide, W_4P_2.

Not attacked by any acid, not even by aqua regia. (Wöhler and Wright, A. **79.** 244.)

W_3P_4. (Wöhler and Wright.)

Tungsten *di*selenide, WSe_2.

(Uelsmann.)

Tungsten *tri*selenide, WSe_3.

Easily sol. in alkali sulphides or selenides +Aq. (Uelsmann, Jahrb. f. Ch. **1860.** 92.)

Tungsten silicide.

Sol. in HF.

Only very sl. sol. in other acids. (Warren, C. N. 1898, **78.** 319.)

WSi_2. Not attacked by ordinary acids and scarcely by warm aqua regia, but violently attacked by HNO_3+HF. Sl. attacked by 10% alkalies+Aq. (Hönigschmid, M. 1907, **28.** 1017.)

Not attacked by dil. or conc. HCl, HF, HNO_3 or H_2SO_4, nor by not aqua regia.

Attacked by HNO_3+HF or by fused alkalies. (Defacqz, C. R. 1907, **144.** 850.)

WSi_3. Violently attacked by HNO_3+HF. Not attacked by HNO_3, H_2SO_4, HCl or HF. (Frilley, Rev. Mét. 1911, **8.** 509.)

W_2Si_3. Insol. in acids including HF; sol. in a mixture of HF and HNO_3; sol. in fused alkali hydroxides and carbonates. (Vigouroux, C. R. 1898, **127.** 394.)

Tungsten *di*sulphide, WS_2.

Oxidised by HNO_3+Aq. (Berzelius.)

Insol. in min. acids.

Sol. in a mixture of HF and HNO_3 and in fused alkalies and alkali carbonates. (Defacqz, C. R. 1899, **128.** 611.)

Tungsten *tri*sulphide, WS_3.

Somewhat sol. in cold, abundantly in hot H_2O, but separated out by the addition of salts, especially NH_4Cl, or acids. Sol. in alkali sulphides, and hydrosulphides+Aq. Sol in caustic alkalies, and alkali carbonates +Aq. Slowly sol. in NH_4OH+Aq in the cold.

Tungstic acid, H_2WO_4.

Insol. in H_2O. Sol. in HF Insol. in tungstates+Aq.

44.7% H_2WO_4 is sol. in 50% HF+Aq at 25°.

55.3% H_2WO_4 is sol. in 50% HF +Aq at 50°.

100 g. sat. H_2WO_4+HCl+Aq contain 0.68 g. H_2WO_4 at 80°.

9.8 % H_2WO_4 is sol. in sat. alcoholic HCl at 75°.

Insol. in alcoholic solutions of HBr and HI. (Rosenheim, Chem. Soc. 1911, **100.** (2) 402.)

Freshly pptd. tungstic acid dissolves in H_2O_2. (Kellner, Dissert. **1909.**)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

H_4WO_5. Precipitate. Sl. sol. in H_2O and aqueous solutions of the tungstates. Sol. in 250-300 pts. H_2O. When freshly pptd., sol. in alkali hydrates or carbonates+Aq. (Anthon, J. pr. **9.** 6.)

***Meta*tungstic acid, $H_2W_4O_{13}+9H_2O$.**

Sol. in H_2O. Solution may be boiled and evaporated to a syrupy consistency, when it suddenly gelatinises and ordinary tungstic acid is precipitated.

Sol. in H_2O. When heated to 50°, it becomes insol. in H_2O. (Soboleff, Z. anorg. 1896, **12.** 28.)

Solubility in H_2O at t°.

t°	100 ccm. H_2O dissolve g. of the cryst. acid	Sp. gr. of the solution
0	41.46	1.6025
22	88.57	2.5239
43.5	111.87	3.6503

(Soboleff.)

Sp. gr. of solution of metatungstic acid at 17.5° containing:

2.79	12.68	27.61	43.75% WO_3.
1.0257	1.1275	1.3274	1.6343

(Scheibler, J. pr. **83.** 273.)

Sp. gr. of aqueous solution calculated by M=Mendelejeff, and G=(Gerlach (Z. anal. **27.** 300), containing:

	5	10	15	20	25% WO_3,
M	1.047	1.098	1.153	1.214	1.285
G	1.0469	1.0980	1.1544	1.2172	1.2873

	30	35	40	45	50% WO_3.
M	1.366	1.458	1.555	1.581 (?)	
G	1.3660	1.4540	1.5527	1.6630	1.7860

Solubility in ether at t°.

t°	100 ccm. ether dissolve g. of the cryst. acid
0	83.456
7.8	88.389
18.2	99.66
24.3	110.76

(Soboleff, Z. anorg. 1896, **12.** 32.)

Colloidal. Sol. in H_2O. Not precipitated by acids or alcohol. Can be evaporated to dryness and heated to 200°, and still remains sol. in H_2O. Sol. in ¼pt. of H_2O.

Sp. gr. of aqueous solution containing:

5	20	50	66.5	79.8% WO_3.
1.0475	1.2168	1.8001	2.596	3.243

(Graham, Chem. Soc. **17.** 318.)

Perhaps *para*tungstic acid, $H_{10}W_{12}O_{41}$. (Klein, Bull. Soc. (2) **36.** 547.)

Tungstates.

Few normal tungstates are sol. in H_2O, even some of the K and NH_4 salts are very sl. sol. Most of the metatungstates, however, are easily sol. in H_2O.

Tungstates insol. in H_2O are usually insol. in dil. acids.

Aluminum tungstate, $Al_2(WO_4)_3+8H_2O$.

Precipitate. Insol. in H_2O and Na_2WO_4+Aq. Sol. in $(NH_4)_2Al_2(SO_4)_4$+Aq, NaOH+Aq, NH_4OH+Aq.

Easily sol. in H_3PO_4, $H_2C_2O_4$, and $H_2C_4H_4O_6$+Aq. (Lotz, A. **83.** 65.)

Sol. in 1500 pts. H_2O at 15°. (Lefort, C. R. 87. 748.)

Al_2O_3, $4WO_3+9H_2O$. Sol. in 400 pts. H_2O at 15°. (Lefort, C. R. **87.** 748.)

Al_2O_3, $5WO_3+6H_2O$. Sol. in H_2O, from which it is pptd. by alcohol. (Lefort.)

Formula according to Lefort is Al_2O_3, $3WO_3$ $+3H_2O$, $2WO_3$.

See also **Aluminicotungstic acid.**

Aluminum *para*tungstate, $5Al_2O_3$, $36WO_3$+ $46H_2O=Al_2O_3$, $7WO_3+9H_2O$ (?).

Easily sol. in an alum solution. (Lotz, A. **83.** 65.)

Aluminum ammonium tungstate, $3(NH_4)_2O$, Al_2O_3, $9WO_3+4H_2O$.

Sol. in conc. HNO_3 and in conc. HCl. (Balke and Smith, J. Am. Chem. Soc. **1903,** **25.** 1230.)

Aluminum ammonium antimony tungstate.
See **Aluminicoantimoniotungstate, ammonium.**

Aluminum antimony tungstate.
See **Aluminicoantimoniotungstic acid.**

Aluminum zinc tungstate, Al_2O_3, ZnO, $9WO_3$ $+20H_2O$.
Very sol. in H_2O. (Daniels, J. Am. Chem. Soc. 1908, **30.** 1850.)
$2Al_2O_3$, $3ZnO$, $18WO_3+16H_2O$. Sol. in much H_2O.
Sol. in very dil. mineral acids or in acetic acid. (Daniels.)

Ammonium tungstate, $(NH_4)_2WO_4$.
Known only in solution.
$(NH_4)_4W_3O_{11}+3H_2O=2(NH_4)_2O$, $3WO_3+3H_2O$. Sol. in H_2O with decomp. Decomp. on air with evolution of NH_3, and formation of *para*tungstate. Sol. in NH_4OH+Aq. (Marignac, A. ch. (3) **69.** 23.)
$(NH_4)_4W_5O_{17}+5H_2O=2(NH_4)_2O$, $5WO_3+5H_2O$. Sol. at ordinary temp. in 26-29 pts. H_2O with partial decomposition. (Marignac.)
$+2\frac{1}{2}H_2O$, $+3H_2O$, $+4H_2O$, $+4\frac{1}{2}H_2O$, and $+5H_2O$. (Pinagel, Dissert, **1904.**)
$(NH_4)_6W_8O_{27}+8H_2O=3(NH_4)_2O$, $8WO_3+8H_2O$. Sol. in H_2O. (Marignac.)
Colloidal. $(NH_4)_2O$, $6WO_3+4$ or $6H_2O$. Miscible with water in nearly all proportions. (Taylor, J. Am. Chem. Soc. 1902, **24.** 632.)

Ammonium *meta*tungstate, $(NH_4)_2W_4O_{13}$.
$+6H_2O$. (Marignac, A. ch. (4) **3.** 74.)
$+8H_2O$. Efflorescent. Very sol. in H_2O.
1 pt. dissolves at 15° in 0.84 pt. H_2O. (Lotz.)
1 pt. dissolves at ordinary temp. in 0.35 pt. H_2O. (Riche.)
Solubility increases rapidly with the temperature.
Saturated solution at 40° is solid on cooling.
Sl. sol. in ordinary, insol. in absolute alcohol. (Lotz.) Insol. in ether. (Riche.)
[$(NH_4)_2W_3O_{10}+5H_2O$ of Margueritte.]
$(NH_4)_6W_{16}O_{51}+17H_2O=3(NH_4)_2O$, $16WO_3+17H_2O$. Very efflorescent. Decomp. by dissolving in pure H_2O. (Marignac, A. ch. (4) **3.** 75.)

Ammonium *para*tungstate, $(NH_4)_{10}W_{12}O_{41}=5(NH_4)_2O$, $12WO_3$.
(Marignac, A. ch. (3) **69.** 25.)
According to Lotz (A. **91.** 49) and Scheibler (J. pr. **80.** 208), formula is $(NH_4)_6W_7O_{24}=3(NH_4)_2O$, $7WO_3$.
$+5H_2O$. (Scheibler, J. pr. **48.** 232.)
$+11H_2O$. Sol. in 25-28 pts. cold H_2O. (Anthon.)
Sol. in 26.1 pts. H_2O at 10.7°, and 5.8 pts. at 100°. (Lotz.)
Sol. in 33.3 pts. cold H_2O, and 9.6 pts at 100°. (Riche.)
Sol. in 22-38 pts. H_2O at 15-18°. The solution gradually decomposes, with the formation of a more soluble salt. (Marignac.)
Not much more sol. in NH_4OH+Aq than in H_2O. Insol. in alcohol. (Anthon.)
Sol. in H_2O_2. (Kellner, Dissert, **1909.**)

Ammonium bismuth tungstate.
See **Bismuthicotungstate, ammonium.**

Ammonium cadmium *para*tungstate, $3(NH_4)_2O$, $12CdO$, $35WO_3+35H_2O$.
Ppt. Sol. in H_2O acidulated with HNO_3. (Lotz, A. **91.** 49.)

Ammonium cerium tungstate.
See **Cericotungstate, ammonium.**

Ammonium cobaltous tungstate, $8(NH_4)_2O$, $2CoO$, $15WO_3+3H_2O$.
(Carnot, C. R. **109.** 147.)

Ammonium hydroxylamine tungstate, $NH_4OWO_4NH_4$.
Sol. in H_2O. (Hofmann, Z. anorg. 1898, **16.** 465.)

Ammonium iron (ferric) tungstate, $5(NH_4)_2O$, Fe_2O_3, $5WO_3+5H_2O$.
Sol. in H_2O. (Borck.)

Ammonium lanthanum tungstate.
See **Lanthanicotungstate, ammonium.**

Ammonium magnesium *para*tungstate, $2(NH_4)_2O$, $3MgO$, $12WO_3+24H_2O$.
Very slightly sol. in H_2O. (Marignac, A. ch. (3) **69.** 58.)
$(NH_4)_2O$, $2MgO$, $7WO_3+10H_2O$. Very sl. sol. in H_2O; sol. in H_2O acidulated with HNO_3. (Lotz.)

Ammonium mercuric tungstate, $(NH_4)_2WO_4$, $HgWO_4+H_2O$.
Insol. in H_2O. Decomp. by acids or alkalies. (Anthon.)

Ammonium neodymium tungstate.
See **Neodymicotungstate, ammonium.**

Ammonium nickel tungstate.
See **Nickelicotungstate, ammonium.**

Ammonium potassium *para*tungstate, $5K(NH_4)O$, $12WO_3+11H_2O$.
Sol. in boiling H_2O; sl. sol. in cold H_2O. (Hallopeau, C. R. 1896, **123.** 180.)

Ammonium potassium sodium *para*tungstate, $5(K, Na, NH_4)_2O, 12WO_3+13H_2O$, where $K:Na:NH_4=3:3:4$.
$10(K, Na, NH_4)_2O$, $24WO_3+26H_2O$, where $K:Na:NH_4=3:3:14$. (Laurent.)

Ammonium sodium *para*tungstate, $4(NH_4)_2O$, Na_2O, $12WO_3+5H_2O$.

Can be crystallised from H_2O without decomp. (Lotz, A. **91.** 57.)

$+14H_2O$. Sol. in warm H_2O. (Hallopeau, C. R. 1896, **123.** 181.)

$(NH_4)_2O$, $4Na_2O$, $12WO_3+25H_2O$. Sl. sol. in H_2O. (Hallopeau, C. R. 1895, **120.** 1344.)

$5Na_2O$, $15(NH_4)_2O$, $48WO_3+48H_2O$. (Marignac, A. ch. (3) **69.** 53.)

$2Na_2O$, $3(NH_4)_2O$, $12WO_3+15H_2O$. (Marignac.)

$3(NH_4)_2O$, $2Na_2O$, $12WO_3+15H_2O$.

$3(NH_4)_2O$, $3Na_2O$, $16WO_3+22H_2O$. Sol. in H_2O without decomp. (Hallopeau, C. R. 1896, **123.** 181.)

$3Na_2O$, $4(NH_4)_2O$, $16WO_3+18H_2O$. (Gibbs, Am. Ch. J. **7.** 236.)

Is $2Na_2O$, $3(NH_4)_2O$, $12WO_3+13H_2O$, according to Knorre (B. **19.** 823).

Very sol. in hot H_2O. (Knorre, B. 1886, **19.** 823.)

$(NH_4)_2O$, $3Na_2O$, $16WO_3+38H_2O$. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 85.)

$6(NH_4)_2O$, $2Na_2O$, $20WO_3+24H_2O$. Can be cryst from boiling H_2O (Baragiola, Dissert, **1902.**)

$4Na_2O$, $16(NH_4)_2O$, $50WO_3+50H_2O$. Sl. sol. in cold H_2O. (Gibbs, Proc. Am. Acad **15.** 12.)

Ammonium zinc *para*tungstate, $(NH_4)_2O$, $2ZnO$, $7WO_3+13H_2O$.

Sl. sol. in boiling H_2O, but more easily on addition of oxalic, tartaric, phosphoric, or dil. nitric acids, or of ammonium tungstate. (Lotz, A. **91.** 49.)

Ammonium zirconium tungstate.

See **Zirconotungstate, ammonium.**

Ammonium *meta*tungstate nitrate.

See **Nitrate *meta*tungstate, ammonium.**

Ammonium tungstate vanadate.

See **Vanadiotungstate, ammonium.**

Antimony tungstate, Sb_2O_3, $5WO_3+4H_2O$.

Sol. in H_2O without decomp. (Lefort.)

Sb_2O_3, $6WO_3+8H_2O$. Ppt.

See also **Antimoniotungstic acid.**

Barium tungstate, $BaWO_4$.

Anhydrous. Insol. in H_2O. Decomp. by boiling HNO_3+Aq. (Geuther and Forsberg, A. **120.** 270.)

$+\frac{1}{2}H_2O$. Insol. in H_2O or boiling H_3PO_4+Aq. Sol. in boiling, less sol. in cold $H_2C_2O_4$+Aq. (Anthon.)

$+2\frac{1}{2}H_2O$. Insol. precipitate. (Scheibler.)

Pptd. $BaWO_4$ is attacked by dil. acids. More sol. in NH_4NO_3+Aq than in H_2O. (Smith and Bradbury, B. **24.** 2930.)

Barium *di*tungstate, $BaW_2O_7+H_2O$ (?).

Nearly insol. in H_2O. 100 ccm. H_2O dissolve about 0.05 g. at 15°. (Lefort, A. ch. (5) **15.** 325.)

Barium *tri*tungstate $BaW_3O_{10}+4H_2O$ (?).

Sol. in about 300 pts. H_2O at 15°. Decomp. by boiling H_2O into an insol. salt. (Lefort, C. R. **88.** 798.)

$+6H_2O$. (Scheibler.)

Barium *meta*tungstate, $BaW_4O_{13}+9H_2O$.

Efflorescent. Quite sol. in hot H_2O. Partly decomp. by cold H_2O into BaW_3O_{10} and WO_3, which recombine on heating. (Scheibler, J. pr. **80.** 204.)

Barium tungstate, $BaW_8O_{25}+8H_2O$.

Insol in H_2O or HCl+Aq. (Zettnow.)

BaW_6O_{15}. *Barium bronze.* (Hallopeau, A. ch. 1900, (7) **19.** 121.)

Barium *para*tungstate, $Ba_5W_{12}O_{41}+14H_2O$, or $Ba_3W_7O_{24}+8H_2O$

Insol. in cold H_2O; when freshly pptd. is sl. sol. in HNO_3+Aq. (Lotz, A. **91.** 60.) Sol. in NH_4Cl+Aq. (Wackenroder.)

$+27H_2O = Ba_3W_7O_{24}+16H_2O$. Insol. in cold, sl. sol. in hot H_2O. (Knorre, B. **18.** 327.)

Barium potassium tungstate tungsten oxide, BaW_4O_{12}, $5K_2W_4O_{12}$.

(Engels, Z. anorg. 1903, **37.** 136.)

Barium silver *meta*tungstate.

(Scheibler.)

Barium sodium *para*tungstate, 2BaO, $3Na_2O$, 12 WO_3+24H_2O. (Marignac), or BaO, $2Na_2O$, $7WO_3+14H_2O$ (Scheibler).

Insol. in H_2O.

Barium sodium tungstate tungsten oxide, $2BaW_4O_{12}$, $3Na_2W_5O_{15}$.

BaW_4O_{12}, $5Na_2W_3O_9$. (Engels, Z. anorg. 1903, **37.** 131.)

Bismuth tungstate, Bi_2O_3, $6WO_3+8H_2O$.

Very sol. in H_2O with decomp. Pptd. by alcohol from aqueous solution. (Lefort, C. R. **87.** 748.)

Cadmium tungstate, $CdWO_4$.

Anhydrous.

$+H_2O$. Sol. in about 2000 pts. H_2O. (Lefort.)

$+2H_2O$. Insol. in H_2O. Sol. in hot phosphoric or oxalic acids, or in NH_4OH+Aq. (Anthon, J. pr. **9.** 341.)

Sol. in KCN+Aq. (Smith and Bradbury, B. **24.** 2390.)

Cadmium *di*tungstate, $CdW_2O_7+3H_2O$ (?).
Sol. in about 500 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 346.)

Cadmium *tri*tungstate, $CdW_3O_{10}+4H_2O$ (?).
(Lefort.)

Cadmium *meta*tungstate, $CdO, 4WO_3+10H_2O$.
Not efflorescent. (Scheibler, J. pr. **83.** 273.)
Somewhat less sol. in H_2O than the Mn salt. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 84.)

Cadmium *para*tungstate, $Cd_3W_7O_{24}+16H_2O$.
Ppt. (Gonzalez.)
Insol. in H_2O. Sol. in NH_4OH+Aq, and hot H_3PO_4, $H_2C_2O_4$, or $HC_2H_3O_2$+Aq.

Cadmium sodium *para*tungstate, $2CdO, Na_2O, 7WO_3+18H_2O$.
Difficultly sol. in cold H_2O. (Knorre, B. **19.** 824.)

Calcium tungstate, $CaWO_4$.
Insol. in H_2O or dil. acids. Sol. in about 500 pts. H_2O. (Lefort.)
Decomp. by KOH+Aq. (Anthon.)
When freshly pptd., sol. in NH_4Cl+Aq. (Wackenroder.)
Sol. in Mg, and NH_4 salts, also Na_2WO_4+Aq. (Sonstadt, C. N. **11.** 97.)
Min. *Scheelite*. Decomp. by HCl or HNO_3+Aq, with separation of WO_3.

Calcium *di*tungstate, $CaW_2O_7+3H_2O$ (?).
Sol. in 30 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 328.)

Calcium *tri*tungstate, $CaW_3O_{10}+6H_2O$ (?).
Sol. in cold H_2O. (Lefort.)

Calcium *meta*tungstate, $CaW_4O_{13}+10H_2O$.
Easily sol. in H_2O. (Scheibler.)

Calcium *para*tungstate, $Ca_3W_7O_{24}+18H_2O$ (or $Ca_5W_{12}O_{41}+30H_2O$).
Much more sol. than Sr or Ba salt. (Knorre B. **18.** 328.)
Easily sol. in H_2O_2. (Knorre, B. 1885, **18.** 326.)

Calcium potassium tungstate tungsten oxide, $CaW_4O_{12}, 5K_2W_4O_{12}$.
(Engels, Z. anorg. 1903, **37.**149.)

Calcium sodium *para*tungstate, $2CaO, 3Na_2O, 12WO_3+3H_2O$.
(Gonzalez, J. pr. (2) **36.** 44.)

Calcium sodium tungstate tungsten oxide, $CaW_4O_{12}, 5Na_2W_5O_{15}$.
Engels, Z. anorg. 1903, **37.** 145.)

Cerium tungstate, $Ce_2(WO_4)_3+H_2O$.
Precipitate. (Cossa and Zecchino, Gazz. ch. it. **10.** 225.)

Cerium *meta*tungstate, $Ce_2O_3, 12WO_3+30H_2O$.
Permanent. Sol. in H_2O. (Scheibler.)

Cerium sodium tungstate, $Ce_2Na_8(WO_4)_7$.
Insol. in H_2O. Slowly sol. in dil. acids, easily in HCl+Aq. (Högbom, Bull. Soc. (2) **42.** 2.)
$Ce_2(WO_4)_3, 3Na_2WO_4$. (Didier, C. R. **102.** 823.)

Cerium tungstate chloride, $3Ce_2(WO_4)_3, 2CeCl_3$.
(Didier, C. R. **102.** 823.)

Chromic tungstate, basic, $Cr_2O_3, 2WO_3+5H_2O$.
Sol. in 400 pts. H_2O at 15°. (Lefort, C. R. **87.** 748.)

Chromic tungstate, $Cr_2(WO_4)_3$+7, and $13H_2O$.
Sol. in $CrCl_3$+Aq, and in phosphoric, oxalic, or tartaric acids +Aq. (Lotz.)
$+3H_2O$. (Lefort, C. R. **87.** 748.)
$Cr_2O_3, 4WO_3+6H_2O$. Sol. in about 50 pts. H_2O at 15°. (Lefort.)
$Cr_2O_3, 5WO_3$. Not attacked by aqua regia. (Smith and Oberholtzer, Z. anorg. **5.** 63.)

Chromic *para*tungstate, $Cr_2W_7O_{24}+9H_2O$.
Insol. in H_2O or NH_4 paratungstate+Aq; sol. in $CrCl_3$+Aq. (Lotz.)

Cobaltous tungstate, $CoWO_4$.
Anhydrous. Insol. in H_2O and acids.
$+2H_2O$. Insol. in H_2O and cold HNO_3+Aq. Sl. sol. in $H_2C_2O_4$+Aq. Completely sol. in warm H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. (Anthon, J. pr. **9.** 344.)
Sol. in about 500 pts. H_2O. (Lefort.)

Cobaltous *di*tungstate, CoW_2O_7 (?).
$+3H_2O$. Insol. in H_2O. Sl. sol. in $H_2C_2O_4$+Aq. Completely sol. in H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. (Anthon.)
$+5H_2O$. Sol. in about 100 pts. H_2O. (Lefort.)
$+8H_2O$(?). (Lefort.)

Cobaltous *tri*tungstate, $CoW_3O_{10}+4H_2O$ (?).
Sol. in H_2O. (Lefort, C. R. **88.** 798.)

Cobaltous *meta*tungstate, $CoW_4O_{13}+9H_2O$.
Sol. in H_2O. (Scheibler, J. pr. **83.** 317.)

Cobaltous *para*tungstate, $Co_3W_7O_{24}+25H_2O$.
(Gonzalez, J. pr. (2) **36.** 44.)

Cobaltous sodium *para*tungstate, $2CoO, 3Na_2O, 12WO_3+30H_2O$.
(Gonzalez.)

Cupric tungstate, $CuWO_4$.
$+2H_2O$. Insol. in H_2O. Sol. in H_3PO_4, $HC_2H_3O_2$, or NH_4OH+Aq. Insol. in $H_2C_2O_4$+Aq. (Anthon.)
100 ccm H_2O at 15° dissolve 0.1 g. (Lefort.)

Cupric *di*tungstate, CuW_2O_7 (?).
$+4H_2O$. Insol. in H_2O and HNO_3. Sol. in NH_4OH+Aq. (Anthon, J. pr. **9.** 346.)
$+5H_2O$. Sol. in about 300 pts. H_2O (Lefort.)

Cupric *meta*tungstate, $CuW_4O_{13}+11H_2O$.
Sol. in H_2O. (Scheibler.)

Cupric *para*tungstate, $Cu_3W_7O_{24}+19H_2O$.
Insol. in H_2O. (Knorre, B. **19.** 826.)

Cuprocupric tungstate, $Cu_2WO_4, 2CuWO_4$.
Insol. in H_2O. (Zettnow, Pogg. **130.** 255.)

Cupric sodium *para*tungstate, $Cu_3Na_3(W_7O_{24})_2+32H_2O$.
Ppt. (Knorre, B. **19.** 826.)
$CuO, 4Na_2O, 12WO_3+32H_2O$. Ppt. (Gonzalez, J. pr. (2) **36.** 52.)

Cupric tungstate ammonia, $CuWO_4, 2NH_3+H_2O$.
(Schiff, A. **123.** 39.)
$CuWO_4, 4NH_3$. Gives off NH_3 at ord. temp. Sol. in H_2O. Sol. in dil. NH_4OH+Aq. (Briggs, Chem. Soc. 1904, **85.** 676.)
$CuO, 4WO_3, 6NH_3+8H_2O$. Insol. in H_2O. Nearly insol. in dil. NH_4OH+Aq. (Briggs, Chem. Soc. 1904, **85.** 676.)

Didymium tungstate, $Di_2(WO_4)_3$.
Precipitate. (Frerichs and Smith, A. **191.** 355.)

Didymium *meta*tungstate.
Sol. in H_2O. (Scheibler.)

Didymium sodium tungstate, $DiNa_3(WO_4)_3$.
Insol. in H_2O. Slowly sol. in dil. acids. Sol. in conc. HCl+Aq.
$DiNa(WO_4)_2$. As above. (Högbom, Bull. Soc. (2) **42.** 2.)

Erbium sodium tungstate, $Na_6Er_4(WO_4)_9$.
Insol. in H_2O. (Högbom.)

Glucinum *meta*tungstate.
Very sol. in H_2O.

Indium tungstate, $In_2(WO_4)_3+8H_2O$.
Insol. in H_2O. Decomp. by acids. (Renz, Dissert. **1902.**)

Iron (ferrous) tungstate, $FeWO_4$.
Min. *Ferberite, Reinite.*
$+3H_2O$. Insol. in H_2O. Sol. in cold H_2SO_4, HCl, or HNO_3+Aq. Decomp. by boiling acids with separation of WO_3. Sol. in boiling H_3PO_4+Aq or warm $H_2C_2O_4$+Aq. (Anthon, J. pr. **9.** 343.)
$+xH_2O$. Very unstable. (Lefort, A. ch. (5) **15.** 314.)

Iron (ferrous) *di*tungstate, FeW_2O_7 (?).
Insol. in H_2O. Sol. in hot H_3PO_4+Aq or $H_2C_2O_4$+Aq. Decomp. by dil. HCl+Aq or by KOH+Aq. (Ebelmen, C. R. **17.** 1198.)
$+xH_2O$. Very unstable. (Lefort.)

Iron (ferrous) *tri*tungstate, $FeW_3O_{10}+4H_2O$ (?).
Ppt. Decomp. by cold, more rapidly by hot H_2O. (Lefort.)

Iron (ferrous) *meta*tungstate.
Sol. in H_2O. (Scheibler, J. pr. **83.** 315.)

Iron (ferric) tungstate, basic, $Fe_2O_3, 2WO_3+4H_2O$.
Sol. in about 50 pts. H_2O. (Lefort.)
$2Fe_2O_3, 3WO_3+6H_2O$. Sol. in about 300 pts. H_2O at 15°. (Lefort.)

Iron (ferric) *tri*tungstate (?), $Fe_2O_3, 4WO_3+4H_2O=Fe_2O_3, 3WO_3+WO_3, 4H_2O$ (?).
Sol. in H_2O without decomp. (Lefort.)

Iron (ferric) *meta*tungstate.
Sol. in H_2O. (Scheibler, J. pr. **83.** 273.)

Iron (ferrous) manganous tungstate, $7FeWO_4, MnWO_4$.
(Geuther and Forsberg, A. **120.** 277.)
$4FeWO_4, MnWO_4$. (G. and F.)
$3FeWO_4, MnWO_4$. Partially sol. in conc. HCl+Aq. (G. and F.)
$3FeWO_4, 2MnWO_4$. (G. and F.)
$FeWO_4, MnWO_4$. (Zettnow, Pogg. **130.** 250.)
$FeWO_4, 2MnWO_4$. (G. and F.)
$FeWO_4, 7MnWO_4$. (G. and F.)
$xFeWO_4, yMnWO_4$. Min. *Wolframite.* Sol. in HCl+Aq, and boiling H_3PO_4+Aq.

Lanthanum tungstate, $La_2(WO_4)_3$.
Precipitate.

Lanthanum *meta*tungstate.
Sol. in H_2O. (Scheibler.)

Lanthanum silver tungstate.
See **Lanthanicotungstate, silver.**

Lanthanum sodium tungstate, $Na_8La_2(WO_4)_7$.
Insol. in H_2O. Slowly sol. in dil. acids. Sol. in HCl+Aq.
$La_4Na_6(WO_4)_9$. As above. (Högbom, Bull. Soc. (2) **42.** 2.)

Lead tungstate, $PbWO_4$.

Insol. in H_2O or cold HNO_3+Aq. Sol. in KOH+Aq. Decomp. by hot HNO_3+Aq. (Anthon, J. pr. **9.** 342.)

Sol. in about 4000 pts. H_2O. (Lefort.)

Min. *Scheelenite, Stolzite*. Sol. in KOH+Aq; decomp. by HNO_3.

Absolutely insol. in NH_4NO_3+Aq. (Smith and Bradbury, B. **24.** 2930.)

Lead *di*tungstate, $PbW_2O_7+2H_2O$ (?).

Sol. in about 80 pts. H_2O at 15°. (Lefort.)

Lead *tri*tungstate, $PbW_3O_{10}+2H_2O$ (?).

Ppt. (Lefort.)

Lead *meta*tungstate, $PbW_4O_{13}+5H_2O$.

Sl. sol. in cold, more in hot H_2O. Sol. in hot HNO_3+Aq. (Scheibler, J. pr. **83.** 318.)

Lead *para*tungstate, $Pb_3W_7O_{24}$.

Insol. in H_2O, dil. HNO_3+Aq, $(NH_4)_2WO_4$+Aq, or $Pb(NO_3)_2$+Aq. Sol. in NaOH+Aq or boiling H_3PO_4+Aq. (Lotz, A. **91.** 49.)

Lead sodium *para*tungstate, PbO, $4Na_2O$, $12WO_3+28H_2O$.

(Gonzalez.)

Lithium tungstate, Li_2WO_4.

Rather easily sol. in H_2O. (Gmelin.)

Lithium *meta*tungstate, $Li_2W_4O_{13}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27.** 94.)

$+xH_2O$. Syrup. (Scheibler.)

Lithium *para*tungstate, $Li_{10}W_{12}O_{41}+33H_2O$ (or $Li_6W_7O_{24}+19H_2O$).

According to Scheibler, more sol. than the *para*tungstates of the other alkali metals.

Lithium tungstate tungsten oxide, $Li_2W_5O_{15}$.

Lithium bronze. Insol. in H_2O.

Lithium potassium tungstate tungsten oxide, $Li_2W_5O_{15}$, $3K_2W_4O_{12}$.

Lithium potassium bronze. Insol. in H_2O. (Feit, B. **21.** 135.)

Lithium sodium tungstate, $Li_2WO_4+3H_2O$, $3(Na_2WO_4+3H_2O)$.

(Traube, N. Jahrb. Miner, **1894,** I. 190.)

Magnesium tungstate, $MgWO_4$.

Anhydrous. Insol. in H_2O. Gradually decomp. by boiling conc. HNO_3+Aq. (Geuther and Forsberg, A. **120.** 272.)

$+3H_2O$. Very sol. in H_2O; nearly insol. in alcohol. (Lefort, A. ch. (5) **15.** 329.)

$+7H_2O$. Slowly sol. in cold, very easily in hot H_2O. (Ullik, W. A. B. **56. 2.** 152.)

Magnesium *di*tungstate, $MgW_2O_7+8H_2O$ (?).

Sol. in about 100 pts. H_2O. (Lefort.)

Magnesium *tri*tungstate, $MgW_3O_{10}+4H_2O$(?).

Easily sol. in H_2O with gradual decomp. (Lefort.)

Magnesium *meta*tungstate, $MgW_4O_{13}+8H_2O$.

Sol. in H_2O. (Scheibler.)

Magnesium *para*tungstate, $Mg_3W_7O_{24}+24H_2O$.

Very difficultly sol. in cold, somewhat sol. in hot H_2O. (Knorre, B. **19.** 825.)

Magnesium potassium tungstate, $MgWO_4$, K_2WO_4.

$+2H_2O$. Very sl. sol. in H_2O. (Ullik.)

$+6H_2O$. Precipitate.

Magnesium potassium *para*tungstate, $5(^2/_3K_2O, {}^1/_3MgO)$, $12WO_3+24H_2O$.

Insol. in cold, sol. in hot H_2O. (Hallopeau, C. R. 1898, **127.** 621.)

Magnesium sodium *para*tungstate, 3MgO, $3Na_2O$, $14WO_3+33H_2O$.

Nearly insol. in H_2O. (Knorre, B. **19.** 825.)

Manganous tungstate, $MnWO_4$.

Min. *Hubnerite*. Partially sol. in HCl+Aq.

$+2H_2O$. Insol. in H_2O; sol. in warm H_3PO_4 and $H_2C_2O_4$+Aq; sl. sol. in $HC_2H_3O_2$+Aq. Insol. in cold HCl+Aq. (Anthon.)

$+H_2O$. Sol. in about 2500 pts. H_2O at 15°. (Lefort.)

Manganous *di*tungstate, $MnW_2O_7+3H_2O$ (?).

Sol. in about 450 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 333.)

Manganous *tri*tungstate, $MnW_3O_{10}+5H_2O$(?).

Decomp. by H_2O into MnW_2O_7 and MnW_4O_{13}. (Lefort, A. ch. (5) **17.** 480.)

Manganous *meta*tungstate, $MnW_4O_{13}+10H_2O$.

Very sol. in H_2O. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 82.)

Manganous *para*tungstate, 5MnO, $12WO_3+34H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

$Mn_3W_7O_{24}+11H_2O$. When recently pptd., sol. in a small amt. of H_2O acidulated with HNO_3. (Lotz.)

Manganous potassium tungstate, 2MnO, $3K_2O$, $12WO_3+16H_2O$.

Completely insol. in H_2O. (Hallopeau, Bull. Soc. 1898, (3) **19.** 955.)

Manganous sodium *para*tungstate, $3Na_2O$, $3MnO$, $14WO_3+36H_2O$.

Sol. in H_2O. (Knorre, B. **19.** 826.)

Manganic sodium tungstate.

See **Permanganotungstate, sodium.**

Mercurous tungstate, Hg_2WO_4

Insol. in H_2O. (Anthon.)

Impossible to obtain pure, as it is decomp. into—

$2Hg_2O$, $3WO_3+8H_2O$. Sol. in 100 pts. H_2O at 15°. (Lefort.)

Mercurous *meta*tungstate, $Hg_2W_4O_{13}+25H_2O$.

Ppt. (Scheibler, J pr. **83.** 319.)

Mercuric tungstate, $HgWO_4$.

Sl. sol. in H_2O and very unstable. (Lefort, A. ch. (5) **15.** 356.)

$3HgO$, $2WO_3$. Insol. in H_2O. (Anthon.)

$2HgO$, $3WO_3$. Insol. in H_2O. (Anthon.)

$3HgO$, $5WO_3+5H_2O$. Sol. in about 250 pts. H_2O at 15°. (Lefort.)

$2HgO$, $5WO_3+7H_2O$. Decomp. by hot or cold H_2O. (Lefort, C. R. **88.** 798.)

Mercuric *tri*tungstate, $HgW_3O_{10}+7H_2O$ (?).

Sol. in about 120 pts. H_2O at 15°. (Lefort, A. ch. (5) **15.** 360.)

Molybdenum tungstate.

Easily sol. in H_2O. Insol. in NH_4Cl+Aq or in alcohol of 0.87 sp. gr. (Berzelius.)

Neodymium tungstate, $Nd_2(WO_4)_3$.

Very sl. sol. in H_2O. 1 pt. is sol. in 52630 pts. H_2O at 22°; 59580 pts. at 65°; 66040 pts. at 98°. (Hitchcock, J. Am. Chem. Soc. 1895, **17.** 532.)

Nickel tungstate, $NiWO_4$.

$+3H_2O$. Sol. in about 1000 pts. H_2O at 15°. (Lefort.)

$+6H_2O$. Insol. in H_2O or $H_2C_2O_4+Aq$. Sol. in boiling H_3PO_4+Aq, $HC_2H_3O_2+Aq$, or in warm NH_4OH+Aq. (Anthon.)

Nickel *di*tungstate, $NiW_2O_7+5H_2O$ (?).

Sol. in about 250 pts. H_2O. (Lefort.)

Nickel *tri*tungstate, $NiW_3O_{10}+4H_2O$ (?).

Sol. in H_2O. Pptd. by alcohol. Decomp. by cold or warm H_2O after above pptn. (Lefort.)

Nickel *meta*tungstate, $NiW_4O_{13}+8H_2O$.

Sol. in H_2O. (Scheibler, J. pr. **83.** 273.)

Nickel *para*tungstate, $Ni_3W_7O_{24}+14H_2O$.

Insol. in H_2O. Sl. sol. in $H_2C_2O_4+Aq$. Completely sol. in warm H_3PO_4 or $HC_2H_3O_2+Aq$. (Anthon.)

Potassium tungstate, K_2WO_4.

Anhydrous. Rather deliquescent. Easily sol. in H_2O.

$+H_2O$ Easily sol in H_2O. Insol. in alcohol.

$+2H_2O$. Very sol. in H_2O with absorption of heat.

1 pt. dissolves in 1.94 pts. cold, and 0.66 pt boiling H_2O. Alcohol does not mix with conc. aq. solution, but slowly separates out the salt from it. Acids, even H_2SO_3, $HC_2H_3O_2$ or $H_2C_2O_4$, separate out WO_3 from solution. (Riche, A. ch. (5) **50.** 45.)

Potassium *di*tungstate, $K_2W_2O_7+2H_2O$.

Sol. in about 8 pts. H_2O at 15°, but on heating is converted into—

$+3H_2O$. 100 pts. H_2O dissolve only 2-3 pts. at 15°. (Lefort, A. ch. (5) **9.** 102.)

Potassium *tri*tungstate, $K_2W_3O_{10}+2H_2O$.

Sol. in 5-6 pts. H_2O at 15°. Can be re-cryst. from hot H_2O (Lefort, A. ch. (5) **9.** 105.)

Potassium *meta*tungstate, $K_2W_4O_{13}+5H_2O$.

Not efflorescent. Easily sol. in H_2O. (Marignac.)

($K_4W_5O_{17}+8H_2O$ of Margueritte.)

$+8H_2O$. Extremely efflorescent. (Scheibler.)

Potassium *octo*tungstate, $K_2W_8O_{25}$.

Insol. in H_2O. (Knorre, J. pr. (2) **27.** 49.)

Potassium tungstate, $K_8W_{10}O_{34}+9H_2O = 4K_2O, 10WO_3+9H_2O$.

Properties resemble the *para*tungstate. (Gibbs, Proc. Am. Acad. **15.** 11.)

$+8H_2O = K_4W_5O_{17}+4H_2O$. Sol. in 15 pts. H_2O at 15°, but decomposed by heating into $K_2W_2O_7$ and $K_2W_3O_{10}$. (Lefort, A. ch. (5) **9.** 104.)

$K_{10}W_{14}O_{47}$. Very difficulty sol. in cold, appreciably sol. in hot H_2O, probably with decomposition. (Knorre.)

Potassium *para*tungstate, $K_{10}W_{12}O_{41}+11H_2O$ **(or** $K_6W_7O_{24}+6H_2O$**, according to Lotz and Scheibler.)**

Much more sol. in hot than cold H_2O. (Anthon.)

Sol. in 100 pts. H_2O at 16°, in 8.5 pts. at 100°. (Anthon.)

Sol. in 46.5 pts. cold, and 15.15 pts. boiling H_2O. (Riche.)

By shaking the crystals several days at 20°, 1 pt. dissolves in 71 pts. H_2O. If the salt is treated with boiling water, more goes into solution the longer it is boiled, until after several days' boiling 1 pt. of the salt dissolved in 5.52 pts. H_2O at 18°. Kept in a closed flask, this solution contained after 26 days 1 pt. of salt to 11.9 pts. H_2O; after 153 days, 1 pt. of salt to 15.6 pts. H_2O; after 334 days, 1 pt. of salt to 15.6 pts. H_2O. Insol. in alcohol. (Marignac.)

$+8H_2O$.

Potassium sodium tungstate, K_2WO_4, $2Na_2WO_4+14H_2O$.

Easily sol. in hot and cold H_2O. (Ullik, W. A. B. **56, 2.** 150.)

Deliquescent. Sol. in 1 pt. cold, and ½ pt. hot H_2O. (Anthon.)

Potassium sodium *para*tungstate, Na_2O, $4K_2O$, $12WO_3+15H_2O$.

Sol. in H_2O. (Marignac.)

$^8/_{11}Na_2O$, $^3/_{11}K_2O$, $12WO_3+25H_2O$. Sol. in H_2O. (Marignac.)

Potassium strontium tungstate tungsten oxide, $5K_2W_4O_{12}$, SrW_4O_{12}.

(Engels, Z. anorg. 1903, **37.** 143.)

Potassium uranous tungstate.

See **Uranosotungstate, potassium.**

Potassium zirconium tungstate.

See **Zirconotungstate, potassium.**

Potassium tungstate tungsten oxide, K_2WO_4, W_2O_5.

Potassium tungsten bronze. (Scheibler, J. pr. 83. 321.)

Formula is $K_2W_4O_{12}$. Not attacked by acids, and only very sl. by alkalies. (Knorre, J. pr. (2) **27.** 49.)

K_2WO_4, $4WO_2$. Not attacked by acids, even HF, or by alkalies+Aq. Insol. in alcohol. (Zettnow, Pogg, **130.** 262.)

Does not exist. (Knorre.)

Potassium sodium tungstate tungsten oxide, $5K_2W_4O_{12}+2Na_4W_5O_{15}$.

Potassium sodium tungsten bronze. Properties as potassium bronze.

$3K_2W_4O_{12}$, $2Na_2W_3O_9$. As above. (Knorre, J. pr. (2) **27.** 49.)

Praseodymium tungstate, $Pr_2(WO_4)_3$.

Very sl. sol. in H_2O.

Insol. in H_2O at 20°; at 75°, 1 pt. is sol. in 23,300 pts. H_2O. (Hitchcock, J. Am. Chem. Soc. 1895, **17.** 529.)

Rubidium *meta*tungstate, Rb_2O, $4WO_3+8H_2O$.

Sol. in about 10 pts. cold H_2O.

Moderately sol. in warm H_2O. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 69.)

Rubidium *penta*tungstate, $Rb_2W_5O_{16}$.

Almost insol. in hot H_2O. When finely powdered, it is sol. in alkali carbonates+Aq. (Schaeffer, Z. anorg. 1904, **38.** 163.)

Rubidium *octo*tungstate, $Rb_2W_8O_{25}$.

Insol. in H_2O, acids, and alkalies. (Schaeffer, Z anorg. 1904, **38.** 103.)

Rubidium *para*tungstate, $5Rb_2O$, $12WO_3+18H_2O$.

Very sl. sol. in H_2O. (Schaeffer, Z. anorg. 1904, **38.** 173.)

Samarium *meta*tungstate, Sm_2O_3, $12WO_3+35H_2O$.

Easily sol. in H_2O. (Cleve.)

Samarium sodium tungstate, $Na_6Sm_4(WO_4)_9$.

Insol. in H_2O. Slowly sol. in dil. acids, easily in conc. HCl+Aq. (Högbom, Bull. Soc. (2) **42.** 2.)

Silver (argentous) tungstate, Ag_4O, $2WO_3$.

HNO_3+Aq separates WO_3. KOH+Aq dissolves out WO_3 and separates Ag_4O. (Wöhler and Rautenberg, A. **114.** 120.)

Does not exist. (Muthmann, B. **20.** 983.)

Silver tungstate, Ag_2WO_4.

Sol. in about 2000 pts. H_2O at 15°. Easily decomp. by NaCl+Aq or HNO_3+Aq. (Lefort.)

$Ag_2W_2O_7$. Insol. in H_2O. Nearly insol. in $HC_2H_3O_2$ or H_3PO_4+Aq. More sol. in KOH, NH_4OH+Aq, or $H_2C_2O_4$+Aq. (Anthon, J. pr. **9.** 347.)

$+H_2O$. Sol. in about 5000 pts. H_2O at 15°. (Lefort.)

Silver *meta*tungstate, $Ag_2W_4O_{13}+3H_2O$.

Sl. sol. in H_2O. (Scheibler, J. pr. **83.** 318.)

Nearly insol. in H_2O. (Rosenheim, Z. anorg. 1911, **69.** 250.)

Silver *para*tungstate, $Ag_{10}W_{12}O_{41}+8H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

Silver tungstate ammonia, Ag_2WO_4, $4NH_3$.

Sol. in H_2O with rapid decomp. (Widmann, Bull. Soc. (2) **20.** 64.)

Sodium tungstate, $Na_2WO_4+2H_2O$.

Sol. in 4 pts. cold, and 2 pts. boiling H_2O. (Vauquelin and Hecht.)

Sol. in 1.1 pts. cold, and 0.5 pt. boiling H_2O. (Anthon.)

Sol. in 2.44 pts. H_2O at 0°; 1.81 pts. at 15°; 0.81 pt. at 100°. (Riche.)

Solubility in H_2O at t°.

t°	% Na_2WO_4	Mols. H_2O to 1 mol. Na_2WO_4	Mols. of anhydrous salt to 100 mols. H_2O
−3.5	41.67	22.87	4.37
+0.5	41.73	22.80	4.39
21.0	42.27	22.30	4.48
43.5	43.98	20.80	4.81
80.5	47.65	17.95	5.57
100.0	49.31	16.79	5.95

(Funk, B. 1900, **33.** 3701.)

See also $+10H_2O$.

Sp. gr. of Na_2WO_4+Aq at 24.5° containing:

5	10	15 % $Na_2WO_4+2H_2O$,
1.036	1.075	1.119
20	25	30 % $Na_2WO_4+2H_2O$,
1.166	1.215	1.274
35	40	44 % $Na_2WO_4+2H_2O$.
1.349	1.430	1.492

(Franz, J. pr. (2) **4.** 238.)

Sp. gr. of Na_2WO_4+Aq at 25°.

Sp. gr. at 20°	Per cent Na_2WO_4	Per cent $Na_2WO_4,2H_2O$
1.02016	2.21	2.48
1.03945	4.26	4.78
1.04292	4.59	5.15
1.05831	6.25	7.01
1.07449	7.82	8.79
1.08209	8.61	9.66
1.09687	10.08	11.31
1.12114	12.30	13.81
1.13036	13.16	14.77
1.14392	14.44	16.21
1.16896	16.56	18.62
1.19154	18.52	20.79
1.19938	19.10	21.44
1.20787	19.74	22.16
1.21720	20.59	23.11
1.25041	23.16	25.99
1.25083	23.30	26.15
1.26234	24.05	27.00
1.28143	25.46	28.58
1.33993	29.50	33.11
1.38826	32.68	36.68
1.41072	33.91	38.06
1.47193	37.30	41.87
1.48481	38.20	42.87
1.48595	38.43	43.14

(Pawlewski, B. 1900, **33.** 1224.)

Na_2WO_4+Aq is pptd. by HCl, HNO_3, or H_2SO_4+Aq, but not by H_2SO_3, HI, HCN, oxalic, or tartaric acids+Aq, but pptn. by the former acids is not prevented by presence of the latter, but when heated with $HC_2H_3O_2$+Aq, or in presence of H_3PO_4+Aq, mineral acids cause no ppt. (Zettnow, Pogg, **130.** 16.)

Much more sol. in H_2O_2 than in H_2O. (Kellner, Dissert, **1909.**)

Sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 829.)

Insol. in alcohol. (Riche, A. ch. (3) **50.** 52.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+10H_2O$.

Solubility in H_2O at t°.

t°	% Na_2WO_4	Mols. H_2O to 1 mol. Na_2WO_4	Mols. anhydrous salt to 100 mols. H_2O
−5.	30.60	37.04	2.70
−4.0	31.87	34.92	2.86
−3.5	32.98	33.19	3.01
−2.0	34.59	30.90	3.23
0.0	36.54	28.37	3.52
+3.0	39.20	25.33	3.95
+5.0	41.02	23.48	4.26

(Funk, B. 1900, **33.** 3701.)

Sodium *di*tungstate, $Na_2W_2O_7$.

Sol. in H_2O by heating several hours to 130–150°. (Knorre, J. pr. (2) **27.** 80.)

$+6H_2O$. Sol. in 13 pts. H_2O at 15°. (Lefort, C. R. **88.** 798.)

Sodium *tri*tungstate, $Na_2W_3O_{10}+4H_2O$.

Sol. in 1 pt. H_2O. Decomp. on standing into sol. *tetra*tungstate and insol. *di*tungstate. (Lefort, C. R. **88.** 798.)

Neither this nor the other *tri*tungstates of Lefort exist, according to Knorre (J. pr. (2) **27.** 49.)

Sodium *meta*tungstate, $Na_2W_4O_{13}$.

Anhydrous. Insol. in H_2O.

$+10H_2O$. Sol. at 13° in 0.935 pt. H_2O to form a solution of 3.02 sp. gr. (Scheibler.)

Sol. at 19° in 0.195 pt. H_2O. (Forcher.)

Precipitated by alcohol.

Sodium *penta*tungstate, $Na_2W_5O_{16}$.

Sl. sol. in H_2O by heating 3 hours at 150°. (Knorre, J. pr. (2) **27.** 49.)

Sodium *octo*tungstate, $Na_2W_8O_{25}$.

Insol. in H_2O. Very difficultly attacked by acids and alkalies. (Knorre.)

$+12H_2O$. Easily sol. in cold H_2O, and can be recryst. without decomp. (Ullik, W. A. B. **56,** 2. 157.)

$3Na_2O, 8WO_3+17H_2O$. Very efflorescent. Very sol. in hot H_2O. (Wells, J. Am. Chem. Soc. 1907, **29.** 112.)

Sodium tungstate, $Na_6W_7O_{27}$ (?).

$+16H_2O$ (?). (Marignac, A. ch. (3) **69.** 51.)

$+21H_2O$ (?). Much more sol. and much more rapidly than the paratungstate. (Marignac.)

$Na_4W_3O_{11}+7H_2O$(?). Mixture of $Na_2W_4O_{13}$ and Na_2WO_4. (Knorre, J. pr. (2) **27.** 49.)

$Na_4W_5O_{17}+11H_2O$. Efflorescent. Sol. in H_2O. (Marignac.)

100 pts. H_2O dissolve 16 pts. at 15°. (Lefort, A. ch. (5) **9.** 97.)

Formula is $4Na_2O, 10WO_3+23H_2O$, according to Gibbs (Proc. Am. Acad. **15.** 5.)

Sodium *para***tungstate,** $Na_{10}W_{12}O_{41}+21H_2O$.
$+25H_2O$.
$+28H_2O = 3Na_6W_7O_{24}+16H_2O$, according to Lotz and Scheibler.

Sol. in 8 pts. cold H_2O (Anthon); in 12.6 pts. at 22°. (Forcher).

Sol. in about 12 pts. H_2O. (Marignac.)
The aqueous solution saturated at 35-40° contained to 1 pt. of the salt, after:

	1	12	77	227	410 days,
at	18°	18°	18°	16°	20°
	9.25	11.26	10.92	11.90	11.74 pts. H_2O.

The solution saturated by very long boiling, after a part of the salt had crystallised out, contained, after:

1	2	12 days,
0.68	0.91	2.59 pts. H_2O to 1 pt. salt,
72	222	405 days,
6.88	9.75	8.80 pts. H_2O to 1 pt. salt.

(Marignac.)

Decomp. by boiling with H_2O. (Knorre, B. **18.** 2362.)

Sodium strontium *para***tungstate,** Na_2O, $4SrO$, $12WO_3+29H_2O$.

(Gonzalez, J. pr. (2) **36.** 44.)

Sodium strontium tungstate tungsten oxide, $5NaW_5O_{15}$, SrW_4O_{12}.

$12Na_2W_3O_9$, SrW_4O_{12}. (Engels, Z. anorg. 1903, **37.** 138.)

Sodium thorium tungstate, $Na_4Th(WO_4)_4$.

Insol. in H_2O. Slowly sol. in dil. acids, easily in conc. $HCl+Aq$. (Högbom, Bull. Soc. (2) **42.** 2.)

Sodium ytterbium tungstate, Yb_2O_3, $9Na_2O$, $12WO_3$.

Insol. in H_2O. (Cleve, Z. anorg. 1902, **32.** 154.)
$2Yb_2O_3$, $4Na_2O$, $7WO_3$. Ppt. (Cleve.)

Sodium yttrium tungstate, $Na_8Y_2(WO_4)_7$.

Insol. in H_2O, and very slowly attacked by dil. acids. (Högbom, Bull. Soc. (2) **42.** 2.)

Sodium zinc *para***tungstate,** Na_2O, $2ZnO$, $7WO_3+15H_2O$.

Difficultly sol. in cold, more sol. in hot H_2O. (Knorre, B. **19.** 823.)
$+21H_2O$. (Knorre.)

Sodium tungstate tungsten oxide, Na_2WO_4, W_2O_5.

Yellow tungsten bronze. Gradually deliquesces on air. Not decomp. by any acid, even aqua regia, except HF, or by alkalies. (Wöhler, Pogg. **2.** 350.)
Correct formula is $Na_5W_6O_{18}$, according to Phillip (B. **15.** 499).
Sol. in ammoniacal silver solution with separation of Ag. Easily sol. in boiling alkaline potassium ferricyanide+Aq. (Phillip, B. **12.** 2234.)
Na_2WO_4, $2W_2O_5$. *Blue tungsten bronze.* Not attacked by acids or alkalies. (Scheibler.)
Correct formula is $Na_2W_5O_{15}$, according to Phillip (B. **15.** 506).
Sol. in ammoniacal silver solution with separation of Ag.
$Na_4W_5O_{15}$. Properties as above. (Phillip, B. **15.** 499.)
$Na_2W_3O_9$. Properties as above. (Phillip.)

Strontium tungstate, $SrWO_4$.

Precipitate. (Schultze.)
Sol. in about 700 pts. H_2O. (Lefort.)

Strontium *di***tungstate,** $SrW_2O_7+3H_2O$ (?).

100 ccm. H_2O dissolve 0.35 g. at 15°. (Lefort, A. ch. (5) **15.** 326.)

Strontium *tri***tungstate,** $SrW_3O_{10}+5H_2O$ (?).

Sol. in H_2O with decomp. into SrW_2O_7 and SrW_4O_{13}. (Lefort, A. ch. (5) **17.** 477.)

Strontium *meta***tungstate,** $SrW_4O_{13}+8H_2O$.

Solubility as calcium *meta*tungstate. (Scheibler.)
Extraordinarily sol. in H_2O. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 63.)

Strontium *para***tungstate,** $Sr_3W_7O_{24}+16H_2O$, or $Sr_5W_{12}O_{41}+27H_2O$.

Insol. in cold, sl. sol. in hot H_2O. (Knorre. B. **18.** 327.)

Thallous tungstate, Tl_2WO_4.

Very sl. sol. in H_2O. Sol. in hot Na_2CO_3+Aq. (Flemming, J. B. **1868.** 250.)

Thallous *meta***tungstate,** $Tl_2W_4O_{13}+3H_2O$.

Nearly insol. in H_2O. (Rosenheim, Z. anorg. 1911, **69.** 251.)

Thallous *para***tungstate,** $5Tl_2O$, $12WO_3$.

Insol. in H_2O.
Sol. in Na_2CO_3+Aq. and $KOH+Aq$. decomposed by mineral acids. (Schaeffer, Z. anorg. 1904, **38.** 171.)

Thallous hydrogen tungstate, $TlHWO_4$.

Insol. in H_2O. Difficultly sol. in NH_4OH+Aq. Easily sol. in boiling alkali carbonates or hydrates +Aq. (Oettinger, J. B. **1864.** 254.)

Thorium tungstate.

Precipitate. (Berzelius.)
Insol. in H_2O.

Tin (stannous) tungstate, $SnWO_4+6H_2O$.

Insol. in H_2O. Sol. in oxalic acid and in $KOH+Aq$. Slowly sol. in hot H_3PO_4+Aq. (Anthon, J. pr. **9.** 341.)

Tin (stannic) tungstate, $9SnO_2, 13WO_3$.
Insol. in ammonium tungstate+Aq. Sol. in tin salts+Aq, also in phosphoric, oxalic, or tartaric acids+Aq. (Lotz, A. **91.** 49.)

Tungsten tungstate, $WO_2, WO_3 = W_2O_5$.
See **Tungsten oxide,** W_2O_5.

Uranous tungstate, $UO_2, 3WO_3+6H_2O$.
Decomp. by NaOH+Aq or HNO_3+Aq. Sol. in HCl+Aq, but not in H_2SO_4. (Rammelsberg.)

Uranyl tungstate, UO_3, WO_3+2H_2O.
Sol. in about 100 pts. H_2O. (Lefort, C. R. **87.** 748.)
$UO_3, 3WO_3+5H_2O$ (?). Sol. in about 200 pts. H_2O. (Lefort.)

Vanadium tungstate.
Sl. sol. in H_2O.

Ytterbium tungstate basic, $(YbO)_2WO_4$.
Ppt. (Cleve, Z. anorg. 1902, **32.** 153.)

Ytterbium ***meta*****tungstate,** $Yb_2O_3, 12WO_3+35H_2O$.
Very sol. in H_2O. (Cleve.)

Yttrium tungstate, $Y_2(WO_4)_3+6H_2O$.
Very sl. sol. in H_2O, but more sol. in Na_2WO_4+Aq. (Berlin.)

Zinc tungstate, $ZnWO_4$.
Insol. in H_2O. (Geuther and Forsberg, A. **120.** 270.)
$+H_2O$. Sol. in 500 pts. H_2O.

Zinc ***di*****tungstate,** $ZnW_2O_7+3H_2O$ (?).
Sol. in 10 pts. H_2O at 15°, but solution soon decomposes. (Lefort.)

Zinc ***tri*****tungstate,** $ZnW_3O_{10}+5H_2O$.
Insol. in boiling H_2O. Sol. in $ZnSO_4$+Aq, or $Na_4W_5O_{17}$+Aq. (Gibbs.)

Zinc ***meta*****tungstate,** $ZnW_4O_{13}+10H_2O$.
Easily sol. in H_2O. Loses crystal H_2O by ignition, and becomes insol. in H_2O. (Scheibler, J. pr. **83.** 273.)
$+8H_2O$. More sol. in H_2O than magnesium comp. (Wyrouboff, Bull. Soc. Min. 1892, **15.** 72.)

Zinc tungstate, $Zn_4W_{10}O_{34}+18H_2O = 4ZnO, 10WO_3+18H_2O$.
Insol. in H_2O. Sol. in excess of zinc sulphate or of sodium tungstate+Aq. (Gibbs, Proc. Am. Acad. **15.** 14.)
$+29H_2O$. (Gibbs.)

Zinc ***para*****tungstate,** $5ZnO, 12WO_3+37H_2O$.
(Gonzalez, J. pr. (2) **36.** 44.)

Zinc tungstate, $Zn_9W_{22}O_{75}+66H_2O = 9ZnO, 22WO_3+66H_2O$.
Insol. in H_2O. (Gibbs.)

Zinc tungstate ammonia, $ZnWO_4, 4NH_3+3H_2O$.
Decomp. in the air. (Briggs, Chem. Soc. 1904, **85.** 677.)

Per**tungstic acid.**
See **Pertungstic acid.**

Tungstoarsenic acid.
See **Arseniotungstic acid.**

Tungstoboric acid.
See **Borotungstic acid.**

Tungstocyanhydric acid, $H_4W(CN)_8+6H_2O$.
Hydroscopic.
Sol. in H_2O and abs. alcohol. Insol. in ether, benzene etc. (Olsson, Z. anorg. 1914, **88.** 71.)

Ammonium tungstocyanide, $(NH_4)_4W(CN)_8$.
Easily sol. in H_2O. Aqueous solution decomp. slowly.
Insol. in organic solvents. (Olsson, Z. anorg. 1914, **88.** 62.)

Cadmium tungstocyanide, $Cd_2W(CN)_8+8H_2O$.
Nearly insol. in H_2O. Sl. sol. in dil. HCl. Sol. in conc. NH_4OH+Aq. Insol. in organic solvents. (Olsson, Z. anorg. 1914, **88.** 68.)

Cæsium tungstocyanide, $Cs_4W(CN)_8$.
Easily sol. in H_2O forming stable solutions. Insol. in alcohol and other organic solvents (Olsson.)

Calcium tungstocyanide, $Ca_2W(CN)_8+8H_2O$.
Easily sol. in H_2O. Aqueous solution decomp. slowly.
Insol. in organic solvents. (Olsson.)

Lead tungstocyanide, $Pb_2W(CN)_8+4H_2O$.
Sol. in H_2O. Solution decomp. after short time.
Insol. in organic solvents. (Olsson.)

Magnesium tungstocyanide, $Mg_2W(CN)_8+6H_2O$.
Easily sol. in H_2O. Aqueous solution decomp. on heating.
Insol. in organic solvents. (Olsson.)

Manganous tungstocyanide, $Mn_2W(CN)_8+8H_2O$.
Insol. in H_2O and in acids.
Insol. in organic solvents. (Olsson.)

Potassium tungstocyanide, $K_4W(CN)_8+2H_2O$.

Easily sol. in H_2O from which it can be cryst. 10 ccm. H_2O dissolve 13–14 g. salt at 18°.
Insol. in alcohol, ether and other organic solvents. (Olsson.)

Rubidium tungstocyanide, $Rb_4W(CN)_8+3H_2O$.

Easily sol. in H_2O. Can be cryst. from H_2O.
Insol. in alcohol and other organic solvents. (Olsson.)

Silver tungstocyanide, $Ag_4W(CN)_8$.

Insol. in H_2O.
Insol. in acids. Decomp. by dil. HCl.
Sol. in hot conc. NH_4OH+Aq.
Insol. in organic solvents. (Olsson.)

Sodium tungstocyanide, $Na_4W(CN)_8+2\frac{1}{2}H_2O$.

Hydroscopic.
Easily sol. in H_2O.
Insol. in organic solvents. (Olsson.)

Strontium tungstocyanide, $Sr_2W(CN)_8+8H_2O$, $+9H_2O$.

Easily sol. in H_2O. Aqueous solution decomp. on standing.
Insol. in organic solvents. (Olsson.)

Thallium tungstocyanide, $Tl_4W(CN)_8$.

Difficultly sol. in cold H_2O, more sol. in hot H_2O.
Insol. in organic solvents. (Olsson.)

Zinc tungstocyanide, $Zn_2W(CN)_8+4H_2O$.

Insol. in H_2O, and acids.
Sol. in conc. NH_4OH+Aq. (Olsson.)

*Meta*tungstoiodic acid.

Ammonium *meta*tungstoiodate, $2(NH_4)_2O$, $2I_2O_5$, $4WO_3+12H_2O$.

Very sl. sol. in H_2O. (Chrétien, A. ch. 1898, (7) **15.** 431.)

Potassium tungstoiodate, $K_2H_3WIO_8$.

(Blomstrand, J. pr. (2) **40.** 327.)
$2K_2O$, $2I_2O_5$, $4WO_3+8H_2O$.
5.13 g. are sol. in 1 l. H_2O at 15°; 8.25 g. at 100°. (Chrétien, A. ch. 1898, (7) **15.** 431.)

Tungstoperiodic acid.

Ammonium sodium tungstoperiodate, $2(NH_4)_2O$, Na_2O, I_2O_7, $2WO_3+16H_2O$.

Ppt. (Rosenheim, A. 1899, **308.** 64.)

Barium tungstoperiodate, $5BaO$, I_2O_7, $12WO_3+12H_2O$.

Ppt. (Rosenheim.)

Potassium tungstoperiodate, $5K_2O$, I_2O_7, $12WO_3+8H_2O$.

Sol. in H_2O. (Rosenheim.)

Sodium tungstoperiodate, $3Na_2O$, I_2O_7, $2WO_3+4H_2O$.

Ppt.
$5Na_2O$, I_2O_7, $12WO_3+16H_2O$. Sol. in H_2O. (Rosenheim.)

Strontium tungstoperiodate, $5SrO$, I_2O_7, $12WO_3+28H_2O$.

Sol. in H_2O. (Rosenheim.)

Tungstophosphoric acid,

See **Phosphotungstic acid.**

Tungstosilicic acid,

See **Silicotungstic acid.**

Tungstotungstic acid.

Lithium tungstotungstate, Li_2O, WO_3+WO_2, $3WO_3$.

Insol. in boiling H_2O and conc. HCl. (Hallopeau, C. R. 1898, **127.** 514.)

Potassium tungstotungstate, K_2O, WO_3+WO_2, $3WO_3$.

Insol. in hot H_2O, and conc. HCl. (Hallopeau, Bull. Soc. 1899, (3) **21.** 267.)

Tungstous acid.

Sodium tungstite, $Na_2W_2O_5$.

See **Tungstate tungsten oxide, sodium.**

Tungstovanadic acid.

See **Vanadiotungstic acid.**

Tungstyl *di*bromide, WO_2Br_2.

Not decomp. by cold H_2O. (Roscoe.)

Tungstyl *tetra*bromide, $WOBr_4$.

Extremely deliquescent. Decomposes at once in moist air or with H_2O.

Tungstyl *di*chloride, WO_2Cl_2.

Not decomp. by cold, and but slowly by boiling H_2O. Sol. in alkalies and ammonia.

Tungstyl *tetra*chloride, $WOCl_4$.

Easily decomp. by H_2O or moist air.
Very sol. in CS_2 and S_2Cl_2. Sl. sol. in benzene. (Smith, J. Am. Chem. Soc. 1899, **21.** 1008.)

Tungstyl *tetra*fluoride, WOF_4.

Sol. in H_2O with decomp. Very hydroscopic.
Insol. in carbon tetrachloride.

Sl. sol. in carbon bisulphide, dry benzene and ether.
Easily sol. in chloroform and absolute alcohol. (Ruff, Z. anorg. 1907, **52.** 265.)

Tungstyl *tetra*fluoride ammonia, $2WOF_4$, NH_3.

Sol. in H_2O with decomp.
Insol. in liquid NH_3. (Ruff, Z. anorg. 1907, **52.** 266.)

Ultramarine blue, $2Na_2Al_2Si_2O_8$, Na_2S_2 (?)

Not attacked by solutions of alkalies or NH_4OH+Aq. Decomp. by acids or acid salts +Aq. Decomp. by alum+Aq.

Ultramarine green, $Na_2Al_2Si_2O_8$, Na_2S (?).

Decomp. by mineral acids. Not attacked by alkalies. Decomp. by alum +Aq.

Ultramarine white, $2Na_2Al_2Si_2O_8$, Na_2S (?).

Uranic acid, H_2UO_4.

Insol. in H_2O. Sol. in acids. Very sol. in cold dil. HNO_3+Aq. Sl. sol. in boiling NH_4Cl+Aq. Insol. in KOH, NaOH, or NH_4OH+Aq. Easily sol. in $(NH_4)_2CO_3$, $KHCO_3$, and $NaHCO_3$+Aq; less in K_2CO_3+Aq. (Ebelmen.)
Easily sol. in malic and tartaric acids to form complex compds. (Itzig, B. 1901, **34.** 3822.)
H_4UO_5. Insol. in H_2O; sol. in acids. (Ebelmen.)

Uranates.

Insol. in H_2O; sol. in acids.

Ammonium uranate.

Sl. sol. in pure H_2O; insol. in H_2O containing NH_4Cl or NH_4OH.
Sol. in $(NH_4)_2CO_3$+Aq. (Peligot, A. ch. (3) **5.** 11.)
$(NH_4)_2O$, $4UO_3+7H_2O$. (Grubler, Dissert, **1908.**)
$(NH_4)_2O$, $6UO_3+10H_2O$. Insol. in cold and hot H_2O and alkalies+Aq. Very sol. in H_2SO_4, HCl and acetic acid +Aq. (Zehenter, M. 1900, **21.** 235.)

Barium uranate, $BaUO_4$.

Insol. in H_2O. Sol. in dil. acids.
BaU_2O_7. As above. (Ditte, C. R. **95.** 988.)
$BaU_3O_{10}+4\frac{1}{2}H_2O$. Nearly insol. in H_2O, KOH+Aq. and alcohol.
Easily sol. in cold dil. HCl or HNO_3 and in hot acetic acid. (Zehenter, M. 1904, **25.** 200.)
$Ba_2U_5O_{17}+8H_2O$. Nearly insol. in hot or cold H_2O, KOH+Aq. and alcohol.
Easily sol. in cold dil. HCl or HNO_3 and in hot acetic acid. (Zehenter.)
$Ba_2U_7O_{23}+11H_2O$. Same properties as BaU_3O_{10}. (Zehenter.)

Bismuth uranate, Bi_2O_3, UO_3+H_2O.

Min. *Uranosphaerite.*

Calcium uranate, $CaUO_4$.

Insol. in H_2O; sol. in dil. acids. (Ditte, C. R. **95.** 988.)
CaU_2O_7. Insol. in H_2O; sol. in dil. acids. (Ditte.)

Cobalt uranate.

Insol. in H_2O; sol. in $Pb(C_2H_3O_2)_2$+Aq. (Persoz, J. pr. **3.** 215.)
Sol. in HNO_3+Aq; insol. in KNO_3+Aq. (Ebelmen, A. ch. (3) **5.** 222.)

Cupric uranate, CuU_2O_7.

Insol. in H_2O. (Debray, A. ch. (3) **61.** 451.)

Lead uranate, $PbUO_4$.

If ignited, very difficultly sol. in $HC_2H_3O_2$+Aq. (Wertheim, J. pr. **29.** 228.)
Insol. in $Pb(C_2H_3O_2)_2$+Aq. (Persoz.)
$3PbO$, $2UO_3$. Sol. in dil. HNO_3+Aq. (Ditte, A. ch. (6) **1.** 338.)
PbU_3O_{10}. Insol. in H_2O. Sol. in HNO_3. Insol. in KOH+Aq, NH_4OH and cold acetic acid. Sol. in hot acetic acid. (Zehenter, M. 1904, **25.** 215.)
$Pb_4U_5O_{19}+4H_2O$. Insol. in hot or cold H_2O. Sol. in HNO_3. Insol. in KOH+Aq, NH_4OH, alcohol and ether. Sl. sol. in cold, more easily sol. in hot acetic acid. (Zehenter.)

Lithium uranate, Li_2UO_4.

Insol. in H_2O, but decomp. thereby. Sol. in dil. acids.

Magnesium uranate, $MgUO_4$.

Insol. in H_2O. Nearly insol. in cold HCl+Aq. Slowly sol. in HCl+Aq on warming, and more rapidly by addition of a little HNO_3+Aq. (Ditte.)
MgU_2O_7. Ppt. (Berzelius.)

Neodymium uranate, $Nd_2(U_3O_{10})_3+18H_2O$.

Ppt. (Orloff, Ch. Z. 1907, **31.** 1119.)

Potassium uranate, K_2UO_4 (?).

Insol. in H_2O; sol. in dil. acids, etc., exactly as Na_2UO_4. (Ditte.)
$K_2U_2O_7+6H_2O$. Insol. in H_2O. Sol. in dil. acids, even acetic acid. (Zimmermann, B. **14.** 440.)
Insol. in K_2CO_3+Aq, but easily sol. in alkali hydrogen carbonates+Aq. Sol. in HCl+Aq. (Ebelmen, A. ch. (3) **5.** 220.)
K_2O, $4UO_3+5H_2O$. (Zehenter, M. 1900, **21.** 235.)
K_2O, $6UO_3+6H_2O$. Insol. in H_2O. (Drenckmann, Zeit. ges. Nat. **17.** 113.)
$+10H_2O$. Nearly insol. in cold and hot H_2O. Easily sol. in hot acetic acid, dil. H_2SO_4 HCl and HNO_3. Insol. in KOH+Aq, alcohol and ether. ((Zehenter, M. 1900, **21.** 235.)

Potassium hydroxylamine uranate, $UO_4(NH_4O)(NH_3OK)+H_2O$.

Sl. sol. in H_2O; insol. in alcohol. (Hofmann, A. 1899, **307.** 318.)

Rubidium uranate, $RbUO_4$.

Insol. in H_2O. (Ditte, A. ch. (6) **1.** 338.)

Silver uranate, $Ag_2U_2O_7$.

Insol. in H_2O. Easily sol. in acids. (Alibegoff, A. **233.** 117.)

Sodium uranate, Na_2UO_4 (?).

Insol. in H_2O; sol. in dil. acids. Sol. in alkali carbonates+Aq. (Ditte.)

$Na_2U_2O_7+6H_2O$. Insol. in H_2O. Sol. in dil. acids. (Stolba, Z. anal. **3.** 74.)

$Na_2O, 3UO_3$. Insol. in H_2O. Easily sol. in very dil. acids. (Drenckmann.)

$Na_2O, 5UO_3+5H_2O$. Insol. in H_2O, alcohol, NH_4OH, KOH+Aq. Sol. in HCl, HNO_3, H_2SO_4. Sl. sol. even on boiling in conc. acetic acid. (Zehenter, M. 1900, **21.** 235.)

Sodium hydroxylamine uranate, $UO_4(NH_4O)(NH_3ONa)+H_2O$.

Sol. in H_2O. (Hofmann, A. 1899, **307.** 319.)

$UO_4(NH_3ONa)_2+6H_2O$. Very sol. in H_2O. (Hofmann.)

Strontium uranate, $SrUO_4$.

Insol. in H_2O. Sol. in dil. acids.

SrU_2O_7. As above. (Ditte, C. R. **95.** 988.)

Very sl. sol. in H_2O. Sol. in all acids especially oxalic.

$+H_2O$. Very sl. sol. in H_2O. Sol. in all acids especially oxalic. (J, C. C. **1896,** II. 512.)

Thallous uranate.

Ppt. (Bolton, Am. Chemist, **1872, 2.** 456.)

Zinc uranate.

Insol. in H_2O; sol. in $Pb(C_2H_3O_2)_2$+Aq. (Persoz, J. pr. **3.** 216.) Sol. in HNO_3+Aq; insol. in KNO_3, and NH_4NO_3+Aq. (Ebelmen, A. ch. (3) **5.** 221.)

*Per*uranic acid.

See **Peruranic acid.**

Uranium, U.

Not attacked by H_2O. Slowly decomp. by cold dil. H_2SO_4+Aq, rapidly on warming. Easily sol. in dil. or conc. HCl+Aq. Fused U is slightly attacked by conc. or fuming HNO_3, or conc. H_2SO_4. Amorphous U, however, is easily attacked thereby. Not attacked by acetic acid, KOH, NaOH, or NH_4OH+Aq. (Zimmermann, B. **15.** 849.)

When finely divided, it is decomp. by H_2O slowly at ordinary temps. and rapidly at 100°. (Moissan, C. R. 1896, **122.** 1091.)

Uranium antimonide, U_3Sb_2.

Violently attacked by conc. HNO_3. (Colani, C. R. 1903, **137.** 383.)

Uranium arsenide, U_3As_2.

Violently attacked by conc. HNO_3. (Colani, C. R. 1903 **137.** 383.)

Uranium boride, UB_2.

Sol. in HNO_3 and HF. Decomp. by fused alkalies. (Wedekind, B. 1913, **46.** 1204.)

Uranium *tri*bromide, UBr_3.

Very hygroscopic. Sol. in H_2O with hissing. (Alibegoff, A. **233.** 117.)

Uranium *tetra*bromide, UBr_4.

Anhydrous. Very deliquescent. Sol. in H_2O with hissing. (Hermann.)

Insol. in alcohol. (v. Unruh, Dissert, **1909.**)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014); methyl acetate (Naumann, B. 1909, **42.** 3790); ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

$+8H_2O$. Very deliquescent, and sol. in H_2O. (Rammelsberg.)

Uranium carbide, UC_2.

(Ruff and Heinzelmann, Z. anorg. 1911, **71.** 72.)

Attacked slowly by H_2O. Slowly attacked by cold dil. HCl, H_2SO_4 or HNO_3+Aq. Conc. acids, except HNO_3, react sl. in the cold, violently on heating. (Moissan, Bull. Soc. 1897, (3) **17.** 12.)

Sol. in fused KNO_3 and $KClO_3$; sol. in dil. acids in the cold and in conc. acids on heating; decomp. by H_2O. (Moissan, C. R. 1896, **122.** 276.)

Uranium *tri*chloride, UCl_3.

Very sol. in H_2O. (Peligot.)

Very unstable. (Zimmermann.)

Very hygroscopic. Sol. in H_2O with decomp. Sol. in conc. HCl and solution is much more stable than aqueous one. (Rosenheim and Loebel, Z. anorg. 1908, **57.** 234.)

Uranium *tetra*chloride, UCl_4.

Anhydrous. Extremely deliquescent.

Sol. in H_2O with evolution of heat. Decomp. on boiling. Sol. in NH_4Cl+Aq without decomp.

HCl increases its solubility in H_2O. (Aloy, Dissert. **1901.**)

Sol. in alcohol, acetone, acetic ether, benzoic ether. Insol. in ether, $CHCl$ and C_6H_6. (Loebel.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37.** 3601.)

Uranium *penta*chloride, UCl_5.

Deliquescent. Sol. in H_2O with evolution of heat and decomposition. (Roscoe, B. **7.** 1131.)

Sol. in acetic acid, acetic ether, benzaldehyde, glycerine, benzyl alcohol (trace), nitrobenzene (trace), xylidine and p-toluidine (on warming).
Insol. in aniline, ligroin, pyridine, quinoline, thioethyl ether, thioamyl ether and CS_2. (Pimmer, Dissert. **1904.**)
Sol. in abs. alcohol. Insol. in ether, C_6H_6, nitrobenzene, ethylene bromide. Sl. sol. in CCl_4 and $CHCl_3$. Sol. in benzoic ether, acetone and trichloracetic acid. Best solvents are ethyl acetate and benzonitrile. Sol. in many organic compounds containing oxygen. (Loebel, Dissert. **1907.**)

Uranium *di*fluoride, UF_2+2H_2O.
Ppt (Giolitti and Agamennone, C. C **1905,** I. 1130.)

Uranium *tetra*fluoride, UF_4.
Insol. in H_2O. Very sl. sol. in dil. acids Sol. in hot conc. H_2SO_4, and slowly in warm conc. HNO_3+Aq. (Bolton, J. B. **1866.** 209.)

Uranium *hexa*fluoride, UF_6.
Very sol. in H_2O. (Ditte, A. ch. (6) **1.** 339.)
Fumes in the air.
Very hydroscopic; sol. in H_2O. (Ruff, B. 1909, **42.** 495)
Very hygroscopic. Sol. in H_2O. Nearly insol. in CS_2. Insol. in paraffine oil. Sol. in symmetrical tetrachlorethane (best solvent), $CHCl_3$, CCl_4 and nitrobenzene. (v. Unruh, Dissert. **1909.**)
Decomp. by H_2O, alcohol and ether. Nearly insol. in CS_2.
Sol. in $CHCl_3$, CCl_4, nitrobenzene and $C_2H_2Cl_4$. (Ruff, Z. anorg. 1911, **72.** 81.)

Uranium hydrogen fluoride, UF_6, 8HF (?).
Sol. in H_2O. (Ditte.)
Is UO_2F_2, HF+H_2O. (Smithells)

Uranous hydroxide, UO_2, xH_2O.
Easily sol. in dil. acids.
Insol. in alkali hydrates and carbonates +Aq. (Berzelius.)
Sol. in alkali carbonates+Aq. (Rammelsberg.)
$U(OH)_4$. Sol. in dil. acids. (Aloy, Bull. Soc. 1899, (3) **21.** 613.)

Uranouranic hydroxide, U_3O_8, $6H_2O$ (?).
Easily sol. in acids.
Decomp. by $(NH_4)_2CO_3$+Aq, which dissolves out UO_3. (Berzelius.)

Uranic hydroxide.
See **Uranic acid.**

Uranium *tetra*iodide, UI_4.
Sol. in H_2O. (Guichard, C. R. 1907, **145.** 921.)

Uranium iodide.
Sol. in ethyl acetate.. (Naumann, B. 1904 **37.** 3601.)

Uranium nitride, U_3N_4.
(Colani, C. R. 1903 **137.** 383.)

Uranium *sub*oxide, UO (?).
(Guyard, Bull. Soc. (2) **1.** 89.)
Does not exist. (Zimmermann, A. **213.** 301.)
U_2O_3(?). Ppt. Decomp. by H_2O and in the air. (Peligot.)

Uranium *dioxide* (Uranous oxide), UO_2.
Insol in dil. HCl or H_2SO_4+Aq.
Sol. in conc. H_2SO_4, and easily in HNO_3+Aq. (Peligot.)
Insol. in NH_4Cl+Aq. (Rose.)
Only sl. sol. in H_2SO_4, but a considerable amount is converted into the sulphate which is nearly insol. in H_2SO_4.
Slowly sol. in HCl, the amount dissolved in a given time varying widely with the method of preparation of the oxide. (Colani, C. R. 1912, **155.** 1251.)
Sl. more sol. in HNO_3 than in aqua regia. (Raynaud, Bull. Soc. 1912, (4) **11.** 802.)
Very sol. in conc. HNO_3; less sol. in dil. HNO_3. 1 gram is sol. in 3100 grams HCl (1.17) at 17°; 4650 grams HBr(1.52) at 17°; 2200 grams H_2SO_4(1.79) at 17°; 12,000 grams acetic acid at 19°. (Raynaud, C. R. 1911, **153.** 1481.)
Sl. attacked by liquid NH_3. (Gore, Am. Ch. J 1898, **20.** 830.)
Min. *Uraninite.* Easily sol. in warm HNO_3+Aq. Not attacked by HCl+Aq.

Uranium *tri*oxide (Uranic oxide), UO_3.
Sol. in HNO_3+Aq. (Peligot.)
Insol. in boiling K tartrate +Aq. (Kahlenberg and Hillyer, Am. Ch. J. 1894, **16.** 102.)
Sol. in oleic acid. (Gibbons, Arch. Pharm. 1883, **221.** 621.)
See **Uranic acid.**

Uranium *tet*roxide, UO_4.
Decomp. by HCl+Aq. (Fairley, Chem. Soc. **31.** 133.)
$+2H_2O$. Very hygroscopic. (Zimmermann.)
$+3H_2O$.

Uranium *pent*oxide, U_2O_5.
Sol. in acids. (Peligot.)
Mixture of UO_3 and U_3O_8. (Rammelsberg, Pogg. **59.** 5.)
Mixture of UO_2 and U_3O_8. (Zimmermann, A. **232.** 273.)

Uranouranic oxide, U_3O_8.
Green uranium oxide. Very slowly and slightly sol. in dil. HCl or H_2SO_4+Aq; more easily when conc. Completely sol. in boiling H_2SO_4. Easily sol. in HNO_3+Aq.

Uranous oxychloride, UO_2, UCl_4+H_2O.

Moderately sol. in H_2O. (Aloy, Dissert. **1901.**)

$2UO_2$, UCl_4+H_2O. Very sol. in H_2O and alcohol. (Orloff, C. C. **1903,** II. 484.)

$+13H_2O$. Very sol. in H_2O and alcohol. (Orloff.)

$4UO_2$, UCl_4. Very sol. in H_2O and alcohol. (Orloff.)

$5UO_2$, UCl_4+10H_2O. Insol. in H_2O. (Aloy, Dissert, **1901.**)

Uranous oxyfluoride, UOF_2+2H_2O.

(Giolitti and Agamennone, C. C. **1905,** I. 1130.)

Uranous oxysulphide, $U_3O_2S_4=UO_2$, $2US_2$.

Slightly attacked by dil., easily by conc. $HCl+Aq$. Sol. in cold HNO_3+Aq. (Hermann, J. B. **1861.** 258.)

Uranic oxy-compounds.

See **Uranyl compounds.**

Uranium phosphide, U_3P_2.

Violently attacked by conc. HNO_3. (Colani, C. R. 1903, **137.** 383.)

U_3P_4. Slowly attacked by H_2O, not by dil. $HCl+Aq$. More easily attacked by conc. $HCl+Aq$. Quickly decomp. by boiling conc. HNO_3 and HNO_3+HCl. (Colani, A. ch. 1907, (8) **12.** 59.)

Uranium selenide, USe.

Spontaneously inflammable. Sol. in fuming HNO_3. (Colani. C. R. 1903, **137.** 383.)

USe_2. As US_2. (Colani, C. C. **1903,** II. 707.)

U_2Se_3. (Colani.)

Uranium *di*silicide, USi_2.

Sol. in cold or hot conc. HF; insol. in HCl, HNO_3, H_2SO_4 and aqua regia. (Defacqz, C. R. 1908, **147.** 1051.)

Uranium *mono*sulphide, US.

(Alibegoff, A. **233.** 117.)

Uranium *sesqui*sulphide, U_2S_3.

Not attacked by HCl or dil. HNO_3+Aq. Oxidised by fuming H_2SO_4 or aqua regia. (Alibegoff, A. **233.** 117.)

Uranium *di*sulphide, US_2.

Insol. in cold or boiling dil. $HCl+Aq$. Sol. in cold conc. $HCl+Aq$. Decomp. by HNO_3+Aq. (Hermann, J. B. **1861.** 258.)

Uranium telluride, U_4Te_3.

Violently attacked by conc. HNO_3. (Colani, C. R. 1903, **137.** 383.)

Uranosotungstic acid.

Potassium uranosotungstate, $9K_2O$, $6UO_2$, $8WO_3+34H_2O$.

Insol. in H_2O and in HCl. (Gibbs, Am. Ch. J. 1895, **17.** 175.)

Sodium uranosotungstate, $12Na_2O$, $6UO_2$, $8WO_3+25H_2O$.

Insol. in cold H_2O. (Gibbs.)

Uranyl bromide, UO_2Br_2.

Sol. in H_2O. (de Coninck, C. C. **1903,** I. 693.)

Sol. in ether. (v. Unruh, Dissert. **1909**.)

$+7H_2O$. Deliquescent. Sol. in H_2O.

Uranyl bromide ammonia, UO_2Br_2, $2NH_3$.

(v. Unruh, Dissert. **1909.**)

UO_2Br_2, $3NH_3$. (v. Unruh.)

UO_2Br_2, $4NH_3$. (v. Unruh.)

Uranyl chloride, UO_2Cl_2.

Anhydrous. Very deliquescent. Sol. in H_2O, alcohol, and ether.

Very sol. in H_2O.

Sp. gr. of UO_2Cl_2+Aq at t°.

t°	% UO_2Cl_2	Sp. gr.
14.6	1	1.0056
16.3	2	1.0112
13.7	3	1.0161
13.1	4	1.0215
14.2	5	1.0260
15.2	6	1.0313
14.3	7	1.0366
14.5	8	1.0418
15.0	9	1.0469
14.8	10	1.0517

(de Coninck, A. ch. 1904, (8) **3.** 500.)

Sol. in conc. HCl, conc. HNO_3 and in selenic acid.

Decomp. by H_2SO_4. (de Coninck, A. ch. 1904, (8) **3.** 504.)

Sol. in methyl acetate (Naumann, B. 1909, **42.** 3790); acetone. (Naumann, B. 1904, **37.** 4328.)

$+H_2O$. Sol. in H_2O, alcohol, and ether.

$+3H_2O$. Deliquescent.

Very sol. in H_2O. 1 pt. is sol. in 0.134 pts. H_2O at 18° and solution, which is saturated, contains 76.2% UO_2Cl_2 or 88.2% $UO_2Cl_2+3H_2O$. Sp. gr. of solution = 2.740. The solubility increases with rise in temp.

Sol. in alcohol and in ether. (Mylius and Dietz, B. 1901, **34.** 2775.)

Uranyl hydrogen chloride, UO_2Cl_2, $HCl+2H_2O$.

Cryst. at −10° from sat. solution of UO_2Cl_2 in $HCl+Aq$.

Fumes in the air. (Aloy, Bull. Soc. 1901, (3) **25.** 154.)

Uranyl chloride ammonia, $UO_2(NH_3Cl)_2$.

Decomp. by H_2O. (Regelsberger, A. 227. 119.)

$UO_2(NH_3.NH_3Cl)NH_3Cl$. Decomp. by H_2O. (Regelsberger.)

$UO_2(NH_3.NH_3Cl)_2$. Decomp. by H_2O. (Regelsberger.)

Uranyl fluoride, UO_2F_2.

Very sol. in H_2O. (Smithells, Chem. Soc. **43.** 125.)

Insol. in H_2O or dil. acids. Very sl. sol. in HF+Aq. Sol. in H_2SO_4+aqua regia. (Ditte, A. ch. (6) **1.** 339.)

Insol. in ether and amyl alcohol. (v. Unruh, Dissert, **1909.**)

UOF_4 Very sol. in H_2O. (Ditte, C. R. **91.** 115.)

True composition is UO_2F_2. (Smithells.)

Uranyl hydrogen fluoride, UO_2F_2, $HF+H_2O$.

Very sol. in H_2O. (Smithells, Chem. Soc. **43.** 131.)

Uranyl fluoride ammonia, UO_2F_2, $2NH_3$.

(v. Unruh, Dissert. **1909.**)

UO_2F_2, $3NH_3$. (v. Unruh.)

UO_2F_2, $4NH_3$. (v. Unruh.)

Uranyl iodide, UO_2I_2.

Ppt. Deliquescent. (Aloy, A. ch. 1910, (7) **24.** 417.)

Deliquescent.

Sol. in alcohol, ether and benzene. (Aloy, Dissert. **1901.**)

Sol. in acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328); methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Uranyl iodide ammonia, UO_2I_2, $2NH_3$.

(Aloy, Dissert. **1901.**)

UO_2I_2, $3NH_3$. (Aloy.)

UO_2I_2, $4NH_3$. (Aloy.)

Uranyl selenide, UO_2Se.

Very slowly decomp. by H_2O.

Easily sol. in cold HCl. Violently attacked by cold HNO_3. Not attacked by dil. alkalies. (Milbauer, Z. anorg. 1904, **42.** 450.)

Uranyl sulphide, UO_2S.

Sl. sol. in pure H_2O. Sol. in dil., insol. in absolute alcohol. Sol. in conc. HCl+Aq, also in dil. acids. Decomp. by caustic alkalies +Aq. Partly sol. in $(NH_4)_2S$+Aq.

***Meta*vanadic acid,** HVO_3.

Insol. in H_2O; sol. in acids and alkalies. Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

$+\frac{1}{2}H_2O$.

See **Vanadium *pent*oxide.**

***Pyro*vanadic acid,** $H_4V_2O_7$.

Insol. in H_2O. Sol in acids and alkalies.

Vanadates.

The alkali, Ba, and Pb metavanadates are sl. sol. in H_2O, the others are more easily sol. Insol. in alcohol.

Aluminum *met*avanadate.

Very sl. sol. in H_2O. (Berzelius.)

Aluminum *di*vanadate.

Very sl. sol. in H_2O. (Berzelius.)

Ammonium *meta*vanadate, $(NH_4)VO_3$.

(a) Very slowly and sparingly sol. in cold H_2O. Easily sol. in hot H_2O. (Berzelius.)

Easily sol. in H_2O at about 70°. Very sl. sol. at above and below that temperature. (Guyard, Bull. Soc. (2) **25.** 355.)

10 g. dissolve in 1 litre cold, and 63 g. in 1 litre hot H_2O with partial decomp. (Ditte, C. R. **102.** 918.)

Solubility in H_2O at t°.

t°	Solubility, mol. per litre
18	0.03715
25	0.05189
35	0.08980
45	0.13406
55	0.17041
70	0.25994

(Meyer, Z. Elektrochem, 1909, **15.** 266.)

Solubility in NH_4OH+Aq at t°.

NH_4OH+Aq	t°	Solubility, mol. per litre
0.0677-N	18	0.04763
0.2452-N		0.06798
0.5872-N		0.1029
0.0677-N	25	0.06026
0.2452-N		0.07303
0.5872-N		0.1080

(Meyer, Z. Elektrochem, 1909, **15.** 268.)

Extremely sl. sol. in sat. NH_4Cl+Aq. (v. Hauer.)

Insol. in sat. NH_4Cl+Aq.

Solubility in salts+Aq at t°.

Salt solution	t°	Solubility, mol. per litre
0.05-N NH_4Cl+Aq	18	0.01419
	25	0.02246
	35	0.04445
	45	0.07575
	55	0.09544
0.1-N NH_4Cl+Aq	18	0.00356
	25	0.00995
	35	0.02347
	45	0.04507
	55	0.06314
0.05-N NH_4NO_3+Aq	18	0.01433
	25	0.02364
0.1-N NH_4NO_3+Aq	18	0.00497
	25	0.01050

(Meyer, Z. Elektrochem, 1909, **15.** 267.)

Insol. in alcohol. (v. Hauer.)

(*b*) Sol. in cold H_2O, from which it is pptd. by alcohol. (Berzelius.)

Ammonium *di*vanadate, $(NH_4)_2V_4O_{11}+4H_2O$.

Sol. in H_2O, from which it is precipitated by sat. NH_4Cl+Aq or alcohol. (v. Hauer, W. A. B. **21.** 337.)

Correct formula is $(NH_4)_3V_7O_{10}+2H_2O$, according to Rammelsberg (B. A. B. **1883.** 3.)

$+3H_2O$. Very sol. in H_2O. (Ditte, C. R. **102.** 918.)

Ammonium *tri*vanadate, $(NH_4)_2V_6O_{16}$.

Anhydrous. Nearly insol. in hot or cold H_2O. (Norblad, B. **8.** 126.)

1.5 g. dissolve in 1 litre of boiling H_2O. (Ditte, C. R. **102.** 918.)

$+5H_2O$. Very sl. sol. in H_2O. (Ditte.)

$+6H_2O$ (?). Very sol. in H_2O. (v. Hauer, W. A. B. **39.** 455.)

Could not be obtained. (Norblad; also Rammelsberg, B. A. B. **1883.** 3.)

Ammonium vanadate, $(NH_4)_3V_7O_{10}+2H_2O$.

Correct formula of v. Hauer's *di*vanadate, according to Rammelsberg (B. A. B. **1883.** 3). Sl. sol. in H_2O.

Ammonium *sesqui*vanadate, $(NH_4)_4V_6O_{17}+$ 4 or $6H_2O$.

Very sol. in H_2O. (Ditte, C. R. **102.** 918.)

Ammonium *penta*vanadate, $(NH_4)_4V_{10}O_{27}+10H_2O$.

Sol. in H_2O. (Rammelsberg, B. A. B. **1883.** 3.)

Ammonium hydroxylamine vanadate, $VO_6N_3H_{10}$.

Rapidly decomp. by H_2O. (Hofmann and Kohlschütter, Z. anorg. 1898, **16.** 472.)

HVO_3, $3NH_3O$, $2NH_3=VO_6N_5H_{16}$. Rapidly decomp. by H_2O. (Hofmann and Kohlschütter.)

Ammonium potassium vanadate, $K_2V_4O_{11}$, $(NH_4)_4V_6O_{17}+9H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 1844.)

Ammonium sodium vanadate, $Na_2V_4O_{11}$, $(NH_4)_4V_6O_{17}+15H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 1841.)

Ammonium uranyl vanadate, $(NH_4)_2O$, $2UO_3$, $V_2O_5+H_2O$.

Insol. in H_2O, NH_4OH+Aq, or dil. $HC_2H_3O_2$+Aq. (Carnot, C. R. **104.** 1850.)

Barium *meta*vanadate, $Ba(VO_3)_2+H_2O$.

Somewhat sol. in H_2O before ignition Sol. in conc. H_2SO_4. (Berzelius.)

Barium *pyro*vanadate, $Ba_2V_2O_7$.

Somewhat sol. in H_2O. (Roscoe.)

Barium vanadate, $Ba_2V_6O_{17}+14H_2O$.

(Ditte, C. R. **104.** 1705.)

$Ba_3V_{10}O_{28}+19H_2O$. 1 pt. is sol. in 5200 pts. H_2O at 20-25°. Much more sol. in hot, but decomp. by boiling H_2O. (v. Hauer, W. A. B. **21.** 344.)

Sol. in about 5000 pts. H_2O. (Manasse, C. C. **1886.** 773.)

$Ba_4V_{10}O_{29}+2H_2O$. (Norblad.)

Bismuth vanadate, $Bi_2(VO_4)_2$.

Min. *Pucherite.* Sol. in HCl+Aq with evolution of Cl.

Cadmium vanadate, $Cd(VO_3)_2$.

(Ditte, C. R. **102.** 918.)

$CdV_6O_{16}+24H_2O$. Sl. sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Cadmium potassium vanadate, $CdK_2V_6O_{17}+9H_2O$.

(Radau, A. **251.** 148.)

$Cd_3V_{10}O_{28}$, $K_6V_{10}O_{28}+27H_2O$. 1000 pts. H_2O dissolve 5.4 pts. at 18°. (Radau.)

Cadmium vanadate bromide, $3Cd_3(VO_4)_2$, $CdBr_2$.

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) **23.** 160.)

Cadmium vanadate chloride, $3Cd_3(VO_4)_2$, $CdCl_2$.

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) **23.** 159.)

Cæsium *meta*vanadate, $CsVO_3$.

(Chabrié, A. ch. 1902, (7) **26.** 228.)

Calcium *meta*vanadate, $Ca(VO_3)_2+4H_2O$.

Much more sol. than $Sr(VO_3)_2$, and solution is not precipitated by alcohol. (Berzelius.)

$+3H_2O$. Sol. in H_2O_2; insol. in alcohol. (Scheuer, Z. anorg. 1898, **16.** 304.)

Calcium *pyro*vanadate, $Ca_2V_2O_7+5H_2O$.

Precipitate.

$+2H_2O$. Very sol. in dil. acids. (Ditte C. R. **104.** 1705.)

$+2\frac{1}{2}H_2O$. (Roscoe.)

Calcium *di*vanadate, $CaV_4O_{11}+9H_2O$.

Easily sol. in H_2O. (v. Hauer.)

When fused is nearly insol. in H_2O. (v Hauer.)

$+6H_2O$. (Manasse, A. **240.** 23.)

Calcium *tri*vanadate, $CaV_6O_{17}+12H_2O$.

Very sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Calcium vanadate, $Ca_3V_8O_{23}+15H_2O$.

Sol. in H_2O. (Manasse, A. **204.** 23.)

$Ca_3V_{14}O_{38}+7H_2O$ (?). Sl. sol. in H_2O. Probably a mixture. (Manasse, A. **240.** 23.)

$Ca_3V_{16}O_{43}+26H_2O$. Sol. in H_2O. (Manasse, A. **240.** 23.)

Calcium copper vanadate, $(Ca, Cu)_4V_2O_9+H_2O$.

Min. *Volborthite*. Sol. in HNO_3+Aq.

Calcium potassium vanadate, $CaK_8V_{20}O_{55}+22H_2O$.

Sol. in H_2O. (Manasse, A. **240.** 23.)

Calcium vanadate chloride, $Ca_3(VO_4)_2$, $CaCl_2$.

(Hautefeuille, C. R. **77.** 896.)

Chromium vanadate, $CrVO_4$.

Absolutely insol. in H_2O containing $NH_4C_2H_3O_2$ and $HC_2H_3O_2$. (Carnot, C. R. **104.** 1850.)

Cobaltous *meta*vanadate, $Co(VO_3)_2+3H_2O$.

Easily sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Cobaltous potassium vanadate, $CoKV_5O_{14}++8H_2O$.

1000 pts. H_2O dissolve 4.8 pts. of this salt. (Radau, A. **251.** 140.)

$Co_3K_2V_{14}O_{39}+21H_2O$. (Radau.)

Cupric *meta*vanadate.

Sol. in H_2O. (Berzelius.)

Cupric *pyro*vanadate, $Cu_2V_2O_7+3H_2O$.

Sol. in hot H_2O. (Ditte, C. R. **104.** 1705.)

Could not be obtained. (Radau, A. **251.** 150.)

Cupric lead vanadate, $5(Cu, Pb)O$, $V_2O_5+2H_2O$.

Min. *Mottramite*.

$3CuO$, V_2O_5, $3(3PbO, V_2O_5)$, $6CuO_2H_2+12H_2O$. Min. *Psittacinnite*.

Cupric potassium vanadate, $CuKV_9O_{24}+17H_2O$.

Moderately sol. in warm H_2O. 100 pts. H_2O dissolve 11.1 pts. at 18°. (Radau, A. **251.** 151.)

Didymium vanadate, $Di_2(VO_4)_2$.

Precipitate. (Cleve.)

$Di_2V_{10}O_{30}+28H_2O$. Precipitate. (Cleve, Bull Soc. (2) **43.** 365.)

Glucinum *meta*vanadate (?).

Difficultly sol. in H_2O. (Berzelius.)

Glucinum *di*vanadate (?).

Difficultly sol. in H_2O. (Berzelius.)

Indium *meta*vanadate, $In(VO_3)_3+2H_2O$.

Ppt. (Renz, Dissert. **1902.**)

Iron (ferrous) *meta*vanadate.

Ppt. Sol. in HCl+Aq. (Berzelius.)

Iron (ferric) *meta*vanadate.

Somewhat sol. in H_2O. (Berzelius.)

Lead *meta*vanadate, $Pb(VO_3)_2$.

Sl. sol. in H_2O. Easily sol. in warm dil. HNO_3+Aq. Not completely decomp. by H_2SO_4 or by boiling with K_2CO_3+Aq. (Berzelius.)

Min. *Dechenite*. Easily sol. in dil. HNO_3+Aq, and decomp. by HCl+Aq.

Lead *pyro*vanadate, basic, $2Pb_2V_2O_7$, PbO.

Insol. in boiling H_2O or $HC_2H_3O_2$. Decomp. by HNO_3+Aq with separation of V_2O_5, which dissolves on warming. (Roscoe.)

Lead *pyro*vanadate, $Pb_2V_2O_7$.

Sol. in warm dil. HNO_3+Aq. (Ditte, C. R. **104.** 1705.)

Min. *Descloizite*. Sol. in cold dil. HNO_3+Aq.

Lead *di*vanadate, PbV_4O_{11}.

(Ditte, C. R. **104.** 1705.)

Lead *ortho*vanadate, $Pb_3(VO_4)_2$.

Insol. in H_2O. (Roscoe, A. suppl. **8.** 109.)

Lead zinc *ortho*vanadate, $4Pb_3(VO_4)_2$, $3Zn_3(VO_4)_2$.

Min. *Eusynchite*. Easily sol. in HNO_3+Aq.

Lead zinc vanadate, $(Pb, Zn)_4V_2O_9+H_2O$.

Min. *Descloizite.* Sol. in excess of HNO_3+Aq.

Lead vanadate chloride, $3Pb_3(VO_4)_2, PbCl_2$.

Min. *Vanadinite.* Easily sol. in HNO_3+Aq.

Lithium vanadate, basic, $Li_6V_2O_8+6H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 1168.)

$Li_8V_2O_9+H_2O$, and $14H_2O$. Sol. in H_2O. (Ditte.)

Lithium *meta*vanadate, $LiVO_3$.

Easily sol. in H_2O. (Berzelius.)

$+2H_2O$. Quite easily sol. in H_2O. (Rammelsberg, B. A. B. **1883.** 3.)

Lithium *di*vanadate, $Li_2V_4O_{11}+9H_2O$.

Very sol. in H_2O. (Norblad.)

Correct formula is $Li_3V_5O_{14}+12H_2O$. (Rammelsberg.)

+8, or $12H_2O$. (Ditte, C. R. **104.** 1168.)

Lithium *ortho*vanadate, Li_3VO_4.

Insol. in H_2O. (Rammelsberg, B. A. B. **1883.** 3.)

Lithium *pyro*vanadate, $Li_4V_2O_7+4H_2O$.

Very sol. in H_2O. (Rammelsberg, B. **16.** 1676.)

$+3H_2O$. (Ditte, C. R. **104.** 1168.)

Lithium vanadate, $Li_3V_5O_{14}+7H_2O$.

Difficultly sol. in H_2O. (Rammelsberg.)

$+12H_2O$. Very efflorescent. Correct formula for v. Hauer's *di*vanadate. (Rammelsberg.)

$Li_4V_6O_{17}+16H_2O$. Sol. in H_2O. (Ditte, C. R. **104.** 1168.)

$+15H_2O$. (Rammelsberg.)

$+11H_2O$. (R.)

$+3H_2O$. (R.)

$Li_6V_4O_{13}+15H_2O$. Not very easily sol. in H_2O. (Rammelsberg.)

$Li_6V_8O_{23}+12H_2O$. Moderately sol. in H_2O. (Rammelsberg.)

$Li_{10}V_{12}O_{35}+30H_2O$. Efflorescent. Very sol. in H_2O. (Rammelsberg.)

Magnesium *meta*vanadate, $Mg(VO_3)_2$.

Very easily sol. in H_2O. (Berzelius.)

$+6H_2O$. Very sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Magnesium *di*vanadate, $MgV_4O_{11}+8H_2O$.

Difficultly sol. in H_2O, but much more sol. than barium *di*vanadate. (v. Hauer.)

$+9H_2O$. (Ditte, C. R. **104.** 1705.)

Magnesium *tri*vanadate, $Mg_2V_6O_{17}+4\frac{1}{2}H_2O$.

Very sl. sol. in H_2O. (Manasse, A. **240.** 23.)

Magnesium vanadate, $Mg_3V_{10}O_{28}+28H_2O$.

Sol. in H_2O. (Suguira and Baker, Chem. Soc. **35.** 715.)

Manganous *meta*vanadate, $Mn(VO_3)_2+4H_2O$.

Very sl. sol. in cold, somewhat more sol. in hot H_2O. Easily sol. in dil. acids. (Radau, A. **251.** 125.)

Sl. sol. in H_2O_2; insol. in alcohol. (Scheuer, Z. anorg. 1898, **16.** 304.)

Manganous *pyro*vanadate, $Mn_2V_2O_7$.

Sl. sol. in hot dil. HNO_3+Aq. (Ditte, C. R. **96.** 1048.)

Manganous potassium vanadate, $MnKV_5O_{14}+8H_2O$.

100 pts. H_2O dissolve 1.7 pts. salt at 18°. Easily sol. in acids. (Radau, A. **251.** 129.)

$3Mn_3V_8O_{23}$, $K_6V_8O_{23}+54H_2O$. (Radau.)

$7Mn(VO_3)_2$, $2KVO_3+25H_2O$. (Radau.)

$11Mn(VO_3)_2$, $2KVO_3+48H_2O$. (Radau.)

Mercuric vanadate.

Sl. sol. in H_2O.

Nickel vanadate, $Ni(VO_3)_2$.

Sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Nickel *ortho*vanadate, $Ni_3(VO_4)_2$.

Insol. in H_2O; sol. in HNO_3+Aq. (Ditte, C. R. **96.** 1049.)

Nickel *di*vanadate, $NiV_4O_{11}+3H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Nickel potassium vanadate, $5Ni(VO_3)_2$, $2KVO_3+25H_2O$.

$Ni_3K_2V_{10}O_{29}+17H_2O$. Very sl. sol. in hot H_2O.

$NiKV_5O_4+8H_2O$.

$2Ni_4V_{14}O_{39}$, $K_8V_{14}O_{39}+69H_2O$. 1000 pts. H_2O dissolve 1.7 pts. of salt at 17.5°. (Radau, A. **251.** 137.)

Potassium vanadate, basic, $K_8V_2O_9+20H_2O$.

Sol. in H_2O. (Ditte, C. R. **104.** 902.)

Potassium *meta*vanadate, KVO_3.

Anhydrous. Slowly sol. in cold, more easily in hot H_2O. Insol. in alcohol. (Berzelius.)

Completely sol. in a little cold H_2O. (Norblad.)

$+H_2O$. Sol. in H_2O. (Rammelsberg.)

$+1\frac{1}{4}H_2O$. (Ditte.)

$+1\frac{1}{2}H_2O$. (Ditte.)

$+2H_2O$. (Ditte.)

$+3H_2O$. (Ditte, C. R. **104.** 902.)

$+7H_2O$. (Rammelsberg.)

Potassium *di*vanadate, $K_2V_4O_{11}+4H_2O$.

Sol. in cold or lukewarm H_2O. Decomp. by hot H_2O. (Rammelsberg.)

$+3H_2O$. (Berzelius.)

$+3\frac{1}{2}H_2O$. Sol. in warm H_2O. (Norblad.)

$+8$ or $10H_2O$. (Ditte, C. R. **104.** 902.)

$+6H_2O$. (Ephraim, Z. anorg. 1903, **35.** 76.)

Potassium *tri*vanadate, $K_2V_6O_{16}$.

Anhydrous. Nearly insol. in H_2O (Norblad.)

$+6H_2O$. Insol. in cold or hot H_2O. (Norblad.)

$+1$, and $5H_2O$. (Ditte, C. R. **104.** 902.)

Potassium *ortho*vanadate, $K_3VO_4+4\frac{1}{2}$ or $6H_2O$.

Deliquescent. Sol. in H_2O. (Ditte, C. R. **104.** 902.)

Decomp. by H_2O into $K_4V_2O_7$ and KOH. (Rammelsberg, B. A. B. **1883.** 3.)

Potassium *pyro*vanadate, $K_4V_2O_7+3H_2O$.

Deliquescent Easily sol. in H_2O. Insol. in alcohol. (Norblad.)

$+4H_2O$. (Ditte, C. R. **104.** 902.)

Potassium vanadate, $K_3V_5O_{14}+5H_2O$.

100 pts. H_2O dissolve 19.2 pts. at 17.5°. (Radau, A. **251.** 120.)

$+4\frac{1}{2}H_2O$. (Radau.)

$K_4V_6O_{17}+2H_2O$. Slowly sol. in H_2O. (Rammelsberg.)

$+6H_2O$. (Ditte, C. R. **104.** 902.)

$+7H_2O$. (Friedheim, B. **23.** 1526.)

$K_4V_{10}O_{27}+12H_2O$. Very sol. in H_2O. (Manasse, A. **240.** 42.)

$K_{10}V_8O_{25}+7H_2O$. Sol. in H_2O. (Rammelsberg.)

$K_2V_8O_{21}+1\frac{1}{2}H_2O$. Very sl. sol. in H_2O. (Ephraim, Z. anorg. 1903, **35.** 75.)

$K_4V_{18}O_{47}$. (Ephraim, Z. anorg. 1903, **35.** 78.)

Potassium sodium vanadate, $2(K_2O,3V_2O_5)$, $3(2Na_2O, 3V_2O_5)+30H_2O$.

(Friedheim, Z. anorg. 1894, **5.** 442.)

$2K_2O$, $3V_2O_5$, $4(2Na_2O, 3V_2O_5)+35H_2O$. Efflorescent. (Friedheim, Z. anorg. 1894, **5.** 441.)

Potassium strontium vanadate, $K_2Sr_3V_{14}O_{39}+20H_2O$.

Sol. in H_2O. (Manasse, A. **240.** 23.)

$K_2Sr_3V_{14}O_{39}+30H_2O$. As above. (Manasse.)

$K_4Sr_2V_{14}O_{39}+18H_2O$. As above. (Manasse.)

Potassium zinc vanadate, $KZnV_5O_{14}+8H_2O$.

1000 pts. H_2O dissolve 4.1 pts of the salt. (Radau, A. **251.** 145.)

$2K_8V_{14}O_{39}$, $3Zn_4V_{14}O_{39}+90H_2O$. (Radau.)

Potassium vanadate cyanide, $K_4V_2O_7$, $4KCN+14H_2O$.

Easily decomp.

Insol. in alcohol. (Petersen, Z. anorg. 1904, **38.** 343.)

Samarium vanadate, Sm_2O_3, $5V_2O_5+28H_2O$.

(Cleve.)

$+24H_2O$. (Cleve.)

Samarium *ortho*vanadate.

Precipitate.

Silver *meta*vanadate, $AgVO_3$.

Sol. in HNO_3 or dil. NH_4OH+Aq. (Berzelius.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 829.)

Silver *ortho*vanadate, Ag_3VO_4.

Ppt. Easily sol. in HNO_3 or NH_4OH+Aq. (Roscoe, Proc. Roy. Soc. **18.** 316.)

Silver *pyro*vanadate, $Ag_4V_2O_7$.

Ppt. (Roscoe.)

Sol. in NH_4OH+Aq. (Ditte, C. R. **104.** 1705.)

Silver vanadate, $Ag_6V_4O_{13}$.

Sol. in 21,414 pts. H_2O at 14°, and 13,617 pts. at 100°. (Carnelley, A. **166.** 155.)

Silver vanadate ammonia, $6AgVO_3$, $4NH_3+8H_2O$.

(Ditte, C. R. **104.** 1705.)

Sodium vanadate, basic, $Na_8V_2O_9+26$ or $30H_2O$.

Very sol. in H_2O. (Ditte.)

Sodium *meta*vanadate, $NaVO_3$.

Anhydrous. Slowly sol. in cold, very easily in hot H_2O. (Norblad.)

100 g. H_2O dissolve at:

25°	40°	60°	75°
21.10	26.23	32.97	38.83 g. $NaVO_3$.

(McAdam and Pierle, J. Am. Chem. Soc. 1912, **34.** 606.)

$+2H_2O$. Easily sol. in H_2O.

100 g. H_2O dissolve at:

25°	40°	60°
15.23	29.93	68.36 g. $NaVO_3$.

At 75° a value was obtained which showed that the solid phase had changed into the less sol. modification. (McAdam and Pierle, J. Am. Chem. Soc. 1912, **34.** 607.)

$+\frac{1}{2}H_2O$. (Ditte, C. R. **104.** 1061.)

$+3$, 4, and $5H_2O$. (Ditte.)

Sodium *di*vanadate, $Na_2V_4O_{11}$.

Anhydrous. Sl. sol. even in warm H_2O, but easily sol. on addition of acids.

$+9H_2O$. Easily sol. in cold H_2O. Insol. in alcohol. (Norblad.)
$+5H_2O$. (Ditte, C. R. **104.** 1061.)
Not obtained by Rammelsberg (B. A. B. **1883.** 3.)

Sodium *tri*vanadate, $Na_2V_6O_{16}+9H_2O$.

Insol. in cold or hot H_2O. (Norblad.)
Composition is $Na_6V_{16}O_{43}+24H_2O$. (Rammelsberg.)
$+3H_2O$. (Ditte, C. R. **104.** 1061.)

Sodium *ortho*vanadate, $Na_3VO_4+16H_2O$.

Easily sol. in H_2O, but decomp. into $Na_4V_2O_7$ and KOH. Precipitated by an excess of alcohol. (Roscoe, A. suppl. **8.** 102.)
$+7H_2O$. (Hall, Chem. Soc. **51.** 96.)
$+10.$, and $12H_2O$. Less sol. in dil. NaOH $+$Aq than in H_2O. (Baker, A. **229.** 286.)

Sodium *pyro*vanadate, $Na_4V_2O_7+18H_2O$.

Easily sol. in H_2O. Insol. in alcohol. (Norblad.)
Sol. in alcohol. (Ditte, C. R. **104.** 1061.)
$+8H_2O$. (Ditte.)

Sodium *sesqui*vanadate, $Na_4V_6O_{17}$.

Anhydrous. Insol. in H_2O or NH_4OH+Aq. (Rammelsberg.)
$+10H_2O$.. (Norblad.)
$+16H_2O$. Efflorescent. (Rammelsberg.)
$+18H_2O$. (Ditte.)

Sodium *penta*vanadate, $Na_4V_{10}O_{27}+3^1/_2H_2O$.

Scarcely sol. in H_2O. (Rammelsberg.)

Sodium vanadate, $Na_6V_4O_{13}+6H_2O$.

Difficultly sol. in cold H_2O. (Carnelley, A. **166.** 155.)
$+2H_2O$. (Carnelley.)
$Na_6V_{16}O_{43}+24H_2O$. Correct formula for Norblad's *tri*vanadate. (Rammelsberg.)
Na_2O, $4V_2O_5+7\frac{1}{2}H_2O$. (Baragiola, Dissert. **1902.**)
$+8\frac{1}{2}H_2O$. (Baragiola.)
$3Na_2O$, $5V_2O_5+22H_2O$. (Prandtl and Lustig, Z. anorg. 1907, **53.** 405.)
$4Na_2O$, $7V_2O_5+33H_2O$. (Friedheim, Z. anorg. 1894, **5.** 443.)
$5Na_2O$, $8V_2O_5+39H_2O$. Sol. in H_2O. (Friedheim, Z. anorg. 1894, **5.** 441.)

Sodium vanadate fluoride, $2Na_3VO_4$, $NaF+19H_2O$.

Sol. in H_2O. (Rammelsberg, W. Ann. **20.** 928.)

Stontium *meta*vanadate, $Sr(VO_3)_2+4H_2O$.

Difficultly sol. in cold H_2O. (Norblad.)

Strontium *di*vanadate, $SrV_4O_{11}+9H_2O$.

Sl. sol. in H_2O, but much more sol. than barium *di*vanadate. (v. Hauer.)

Sol. in H_2O_2+Aq free from H_2SO_4. Insol. in alcohol. (Scheuer, Z. anorg. 1898, **16.** 303.)

Strontium *tri*vanadate, $SrV_6O_{16}+14H_2O$.

Sol. in H_2O, but decomposes slowly on boiling. Easily sol. in hot H_2O acidified with $HC_2H_3O_2$, and crystallizes therefrom without decomp. (v. Hauer, J. pr. **76.** 156.)

Strontium *tetra*vanadate, $SrV_8O_{21}+11H_2O$.

Sol. in hot H_2O with partial decomposition. (Manasse, A. **240.** 34.)

Strontium vanadate, $Sr_3V_8O_{23}+14H_2O$.

Sol. in H_2O. (Manasse, A. **240.** 23.)
$Sr_4V_{14}O_{39}+30H_2O$. Sol. in H_2O. (Norblad.)

Thallous *meta*vanadate, $TlVO_3$.

Sol. in 11,534 pts. H_2O at 11°, and 4756 pts. at 100°. (Carnelley.)

Thallous *ortho*vanadate, Tl_3VO_4.

Sl. sol. in H_2O. Sol. in 999 pts. H_2O at 15°, and 574 p s. at 100°. (Carnelley, Chem. Soc. (2) **11.** 323.)

Thallous *pyro*vanadate, $Tl_4V_2O_7$.

Sol. in 4996 pts. H_2O at 14°, and 3840 pts. H_2O at 100°. (Carnelley.)

Thallous vanadate, $Tl_{12}V_8O_{26}$.

Sol. in 3406 pts. H_2O at 14°, and 533 pts. at 100°. (Carnelley.)
$Tl_{12}V_{10}O_{31}$. Sol. in 9372 pts. H_2O at 11°, and 3366 pts. at 100°. (Carnelley.)
$Tl_{12}V_{14}O_{41}$. Ppt. (Carnelley.)

Thorium vanadate, $Th_3O_{12}(VO)_4$, $16V_2O_5+24H_2O$ (?).

Sol. in H_2O. (Cleve.)
ThO_2, $V_2O_5+6H_2O$. Sol. in acids. (Volck, Z. anorg. 1894 **6.** 167.

Uranyl vanadate, $2UO_3$, V_2O_5, $(UO_2)_2V_2O_7$.

Insol. in H_2O. (Carnot, C. R. **104.** 1850.)

Vanadium vanadate, $2VO_2$, $V_2O_5=V_4O_9$.

Insol. in H_2O. Sol. in dil. H_2SO_4 or HNO_3 $+$Aq. (Rammeslberg.)
Slowly oxidised by HNO_3+Aq. Slowly sol. in NH_4OH+Aq. Reasily sol. in $HCl+$Aq (Ditte, C. R. **101.** 1487.)
$+2^2/_3H_2O$. (Brierley.)
$2VO_2$, $2V_2O_5+8H_2O$. Insol. in H_2O. (Brierley, Chem. Soc. **49.** 31.)

Ytterbium vanadate, $3Yb_2O_3$, $5V_2O_5+3H_2O$.

Yb_2O_3, $15V_2O_5$. Ppt. (Cleve, Z. anorg. 1902, **32.** 150.)

Yttrium vanadate.

Precipitate. (Berzelius.)

Zinc vanadate, $Zn(VO_3)_2+2H_2O$.
Sol. in H_2O. (Ditte, C. R. **104.** 1705.)

Zinc *pyro*vanadate, $Zn_2V_2O_7$.
Appreciably sol. in H_2O. (Ditte, C. R. **96.** 1048.)

*Per*vanadic acid.
See **Pervanadic acid.**

Vanadicotungstic acid.

Ammonium vanadicotungstate, $3(NH_4)_2O, V_2O_3, 8WO_3+10H_2O$.
Very sol. in H_2O.
Insol. in organic solvents. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1227.)

Vanadicovanadic acid.

Ammonium vanadicovanadate, $(NH_4)_2O, 2VO_2, 4V_2O_5+8H_2O$.
Sl. sol. in cold and warm H_2O. (Gibbs, Am. Ch. J. **7.** 209.)
$(NH_4)_2O, 2V_2O_4, 2V_2O_5+14H_2O$. Sol. in H_2O. (Brierley, Chem. Soc. **49.** 30.)
$3(NH_4)_2O, 2V_2O_4, 4V_2O_5+6H_2O$. Insol. in H_2O. (Brierley.)

Potassium ——, $2K_2O, 2V_2O_4, V_2O_5+6H_2O$.
Sol. in hot H_2O. (Brierley, Chem. Soc. **49.** 30.)
$5K_2O, 2V_2O_4, 4V_2O_5+H_2O$. Insol. in H_2O. (Brierley.)
$K_2O, V_2O_4, 8V_2O_5$. Insol. in H_2O.
Sol. in conc. H_2SO_4. (Prandtl, B. 1905, **38.** 660.)

Sodium ——, $2Na_2O, 2V_2O_4, V_2O_5+13H_2O$.
Easily sol. in H_2O. Insol. in conc. solutions of salts, especially acetate. (Brierley, Chem. Soc. **49.** 30.)
$2Na_2O, V_2O_4, 5V_2O_5$. Insol. in H_2O. Sol. in conc. H_2SO_4. Not attacked by boiling with conc. HNO_3. Slowly attacked by hot dil. NH_4OH+Aq. (Prandtl, B. 1905, **38.** 659.)

Vanadioarsenic acid.
See **Arseniovanadic acid.**

Vanadioiodic acid.
See **Iodovanadic acid.**

Vanadiomolybdic acid, $8MoO_3, V_2O_5+5H_2O$.
Very sl. sol. in H_2O, and sl. sol. in boiling HNO_3+Aq. (Ditte, C. R. **102.** 757.)
Could not be obtained. (Friedheim, B. **24.** 1173.)

Ammonium vanadiomolybdate, $(NH_4)_2O, V_2O_5, 2MoO_3+4H_2O$.
Nearly insol. in H_2O. (Friedheim and Castendyck, B. 1900, **33.** 1615.)
$(NH_4)_2O, 2V_2O_5, 2MoO_3+8H_2O$. Nearly insol. in H_2O. (Friedheim and Castendyck.)
$2(NH_4)_2O, V_2O_5, 3MoO_3+6H_2O$. (Euler-Chelpin, Dissert. **1895.**)
$(NH_4)_2O, V_2O_5, 3MoO_3+17H_2O$. (Euler-Chelpin.)
$2(NH_4)_2O, V_2O_5, 4MoO_3+7H_2O$ and $+8H_2O$. (Euler-Chelpin.)
$3(NH_4)_2O, 2V_2O_5, 4MoO_3+7H_2O$. (Milch, Dissert. Berlin, **1887.**)
$+9H_2O$. Sol. in H_2O. (Ditte, C. R. **102.** 1019.)
$+11H_2O$. Easily sol. in H_2O. Correct composition of above compounds is = $(NH_4)_2O, 2V_2O_5+2[(NH_4)_2O, 2MoO_3]+11H_2O$. (Friedheim, B. **24.** 1173.)
Moderately sol. in H_2O and can be recryst. therefrom. Euler-Chelpin, Dissert, **1895.**)
$2(NH_4)_2O, 3V_2O_5, 4MoO_3+11H_2O$. Nearly insol. in H_2O. (Friedheim and Castendyck, B. 1900, **33.** 1615.)
$2(NH_4)_2O, 2V_2O_5, 5MoO_3$. Nearly insol. in cold H_2O. (Euler-Chelpin, Dissert. **1895.**)
$+8H_2O$. Nearly insol. in H_2O. (Friedheim and Castendyck, B. 1900, **33.** 1615.)
$3(NH_4)_2O, 2V_2O_5, 5MoO_3+8\frac{1}{2}H_2O$. Very easily sol. in H_2O. (Liebert, Dissert. **1891.**)
$4(NH_4)_2O, 12V_2O_5, 5MoO_3+24H_2O$. Practically insol. in H_2O. (Friedheim and Castendyck, B. 1900, **33.** 1615.)
$2(NH_4)_2O, V_2O_5, 6MoO_3+5H_2O$. Sol. in a large amount of H_2O. (Gibbs, Am. Ch. J. **5.** 361.)
$+6H_2O$. Rather sl. sol. in H_2O.
Easily sol. in acids. (Liebert, Dissert, **1891.**)
Composition is double the above formula, or—
$4(NH_4)_2O, 2V_2O_5, 12MoO_3+12H_2O$. Rather difficultly sol. in H_2O. Composition is $(NH_4)_2O, 2V_2O_5+3[(NH_4)_2O, 4MoO_3]$. (Friedheim.)
$3(NH_4)_2O, V_2O_5, 6MoO_3+7H_2O$. (Isenburg, Dissert, **1901.**)
$5(NH_4)_2O, 4V_2O_5, 6MoO_3+12H_2O$ and $+14H_2O$. (Euler-Chelpin, Dissert, **1895.**)
$5(NH_4)_2O, 3V_2O_5, 7MoO_3+13H_2O$ and $+16H_2O$. Sol. in H_2O and can be recryst. therefrom. (Toggenburg, Dissert, **1902.**)
$5(NH_4)_2O, 3V_2O_5, 8MoO_3+14H_2O$. (Stamm, Dissert, **1905.**)
$5(NH_4)_2O, 2V_2O_5, 12MoO_3+10H_2O$. Quite easily sol. in H_2O. Composition is $(NH_4)_2O, 2V_2O_5+4[(NH_4)_2O, 3MoO_3]+10H_2O$.
$6(NH_4)_2O, 3V_2O_5, 12MoO_3+21H_2O$. Sol. in H_2O. Composition is $(NH_4)_2O, 3V_2O_5+5(NH_4)_2O, 12MoO_3$. (F.)
$8(NH_4)_2O, 4V_2O_5, 13MoO_3+21H_2O$. Sol. in H_2O. (Isenburg, Dissert, **1901.**)
$8(NH_4)_2O, V_2O_5, 18MoO_5+15H_2O$. Decomp. by hot H_2O. (Gibbs.) Could not be obtained. (Friedheim.)
$10(NH_4)_2O, 3V_2O_5, 24MoO_3+10H_2O$. Sol. in H_2O. (Milch.) Could not be obtained. (Friedheim.)

Ammonium barium vanadiomolybdate, $5(NH_4)_2O, 15BaO, 6V_2O_5, 36MoO_3$.
(Milch.)
$(NH_4)_2O, BaO, V_2O_5, MoO_3+6H_2O$. (Euler-Chelpin, Dissert, **1895.**)
$3(NH_4)_2O, BaO, 3V_2O_5, 5MoO_3+9H_2O$. Sl. sol. in cold and hot H_2O. (Euler-Chelpin.)

Ammonium potassium ——, $(NH_4)_2O, 3K_2O, 2V_2O_5, 4MoO_3+5H_2O$.
Decomp. by H_2O. (Euler-Chelpin,)
$(NH_4)_2O, 3K_2O, 3V_2O_5, 5MoO_3+9H_2O$. (Euler-Chelpin.)
$\frac{1}{2}(NH_4)_2O, 3\frac{1}{2}K_2O, 3V_2O_5, 5MoO_3+16H_2O$. Sol. in H_2O. (Jacoby, Dissert. **1900.**)

Ammonium sodium ——, $(NH_4)_2O, Na_2O, 2V_2O_5, 6MoO_3+12H_2O$.
(Euler-Chelpin, Dissert, **1895.**)

Barium ——, BaO, V_2O_5, MoO_3+7H_2O.
(Euler-Chelpin.)

Barium ——, $3BaO, 2V_2O_5, 6MoO_3$.
(Milch.)
$+8H_2O$. (Euler-Chelpin.)
$5BaO, 4V_2O_5, 6MoO_3+28H_2O$. Sol. in hot H_2O. (Euler-Chelpin.)
$3BaO, V_2O_5, 8MoO_3+2BaO, H_2O, V_2O_5, 8MoO_3+28H_2O$. Sol. in hot H_2O. (Gibbs, Am. Ch. J. **5.** 361.)
$7BaO, 3V_2O_5, 18MoO_3+16H_2O = BaO, 3V_2O_5+6(BaO, 3MoO_3)+16H_2O$. Sl. sol. in H_2O.
$+36H_2O$ and $+48H_2O$. (Liebert, Dissert. **1891.**)

Potassium ——, $K_2O, V_2O_5, 3MoO_3+15H_2O$.
Nearly insol. in cold H_2O. (Euler-Chelpin, Dissert, **1895.**)
$3K_2O, 2V_2O_5, 4MoO_3+8H_2O = K_2O, 2V_2O_5 +2(K_2O, 2MoO_3)+8H_2O$.
Very sol. in H_2O. (Friedheim.)
$+7H_2O$. Easily sol. in cold H_2O. (Euler-Chelpin.)
$+9H_2O$. Easily sol. in cold H_2O. (Euler-Chelpin.)
$2K_2O, 2V_2O_5, 5MoO_3+10H_2O$. Nearly insol. in cold, very sl. sol. in hot H_2O. (Euler-Chelpin.)
$3K_2O, V_2O_5, 6MoO_3+5H_2O$. (Euler-Chelpin.)
$2K_2O, V_2O_5, 6MoO_3+6H_2O$. Very sl. sol. in cold, easily sol. in hot H_2O. (Liebert.)
$4K_2O, 2V_2O_5, 12MoO_3+12H_2O = K_2O, 2V_2O_5+3(K_2O, 4MoO_3)+12H_2O$. Sl. sol. in H_2O. (Friedheim.)
$5K_2O, 2V_2O_5, 12MoO_3+12H_2O = K_2O, 2V_2O+4(K_2O, 3MoO_3)+12H_2O$. Rather sl. sol. in H_2O. (Friedheim.)
Sl. sol. in cold, easily sol. in hot H_2O. (Liebert, Dissert, **1891.**)
$3K_2O, V_2O_5, 12MoO_3+15H_2O$. (Liebert.)

Potassium sodium vanadiomolybdate, $K_2O, 4Na_2O, 2V_2O_5, 12MoO_3+18H_2O$.
(Euler-Chelpin, Dissert **1895.**)

Sodium ——, $2Na_2O, V_2O_5, 6MoO_3+16H_2O$.
(Euler-Chelpin, Dissert, **1895.**)

Vanadiophosphoric acid.
See **Phosphovanadic acid.**

Vanadioselenious acid, $3V_2O_5, 4SeO_2+4H_2O$.
$+6H_2O$. Difficultly sol. in H_2O. Can be cryst. from H_2O.
$+10H_2O$. Difficultly sol. in H_2O. Can be cryst. from H_2O. (Prandtl, B. 1905, **38.** 1307.)

Ammonium vanadioselenite, $4(NH_4)_2O, 6V_2O_5, 5SeO_2+13H_2O$.
Sl. sol. in H_2O. Decomp. by boiling H_2O.
$3(NH_4)_2O, 3V_2O_5, 6SeO_2+2H_2O$. Ppt. (Prandtl, B. 1905, **38.** 1309.)
$(NH_4)_3HV_6O_{17}, 12SeO_2+2H_2O$. Ppt.
$+4H_2O$. Ppt. (Prandtl, Z. anorg. 1911, **73.** 231.)

Ammonium silver——, $2^2/_3(NH_4)_2O, 1^1/_3Ag_2O, 6V_2O_5, 5SeO_2+12H_2O, +16H_2O$ and $+22H_2O$.
(Prandtl, Z. anorg. 1907, **53.** 402.)

Lithium ——, $4Li_2O, 6V_2O_5, 5SeO_2+30H_2O$.
Very sol. in H_2O. (Prandtl.)

Potassium ——, $4K_2O, 6V_2O_5, 5SeO_2+13H_2O$.
$3K_2O, 3V_2O_5, 6SeO_2$. (Prandtl, B. 1905. **38.** 1309.)

Sodium ——, $4Na_2O, 6V_2O_5, 5SeO_2+20H_2O$.
Very. sol. in H_2O. (Prandtl, Z. anorg. 1907, **53.** 403.)

Vanadiosulphuric acid, $V_2O_5, 3SO_3+3H_2O$.
Deliquescent. Sol. in H_2O, but is decomp. by boiling. (Ditte, C. R. **102.** 757.)
See **Sulphate, vanadium.**

Vanadiosulpurous acid.

Ammonium vanadiosulphite, $3(V_2O_4,SO_2), (NH_4)_2O, SO_2+4H_2O$.
(Gain, C. R. 1907, **144.** 1158.)

Cæsium ——, $(V_2O_4,SO_2), 3(Cs_2O,SO_2)+8H_2O$.
(Gain.)

Lithium ——, $(V_2O_4,SO_2), 5(Li_2O,SO_2)+8H_2O$.
(Gain.)

Potassium vanadiosulphite, $3SO_2,(V_2O_4),SO_2,(K_2O)+5H_2O$.

(Gain.)

Rubidium ——, (V_2O_4,SO_2), $2(Rb_2O,SO_2)+2H_2O$.

(Gain.)

Sodium ——, $5(V_2O_4,SO_2)$, $(Na_2O,SO_2)+2H_2O$.

(Gain.)

Thallium ——, $3(V_2O_4,SO_2)$, $(Tl_2O,SO_2)+8H_2O$.

(Gain.)

Vanadiotungstic acid, $6H_2O$, V_2O_5, $10WO_3+16H_2O$.

Very sl. sol. in cold, more easily in hot H_2O. (Gibbs, Am. Ch. J. **5.** 361.)

$6H_2O$, V_2O_5, $16WO_3+30H_2O$. Readily sol. in H_2O. (Gibbs.)

$17H_2O$, $4V_2O_5$, $16WO_3+24H_2O$. Sl sol. in cold, easily in hot H_2O. (Rosenheim, A. **251.** 228.)

Aluminum sodium vanadiotungstate, $7Al_2O_3$, $27Na_2O$, $36V_2O_5$, $144WO_3+504H_2O=3(Al_2O_3, 9Na_2O, 48WO_3)$, $4(Al_2O_3, 9V_2O_5)+504H_2O$.

Sol. in H_2O. (Rothenbach, B. **23.** 3055.)

Ammonium ——, $(NH_4)_2O$, $3V_2O_5$, WO_3+6H_2O.

Sol. in H_2O. (Rammelsberg, B. **1.** 158.)

$2(NH_4)_2O$, V_2O_5, $4WO_3+4H_2O$. (Friedheim and Löwy, Z. anorg. 1984, **6.** 24.)

$4(NH_4)_2O$, $2H_2O$, V_2O_5, $5WO_3+11H_2O$. Sol. in H_2O. (Gibbs. Am. Ch. J. **5.** 361.)

$2(NH_4)_2O$, V_2O_5, $5WO_3+10H_2O$. Sol. in H_2O. (Ditte, C. R. **102.** 1019.)

$31(NH_4)_2O$, $14V_2O_5$, $60WO_3+58H_2O=5[5(NH_4)_2O, 12WO_3]$, $2[3(NH_4)_2O, 7V_2O_5)]$. Sol. in H_2O. (Rothenbach, B. **23.** 3051.)

$7(NH_4)_2O$, $4V_2O_5$, $14WO_3+16H_2O$. Sol. in H_2O. (Rosenheim, A. **251.** 197.)

$8(NH_4)_2O$, $4V_2O_5$, $16WO_3$, $9H_2O+4H_2O$. Efflorescent. Very sol in H_2O. (Rosenheim, A. **251.** 216.)

Barium ——, $19BaO$, $10V_2O_5$, $36WO_3+94H_2O=3(5BaO, 12WO_3)$, $2(2BaO, 5V_2O_5)+94H_2O$.

Sl. sol. in H_2O. (Rothenbach, B. **23.** 3052.)

$8BaO$, $4V_2O_5$, $16WO_3$, $9H_2O+44H_2O$. Efflorescent. Not very sol. in H_2O. (Rosenheim, A. **251.** 218.)

Composition is $6BaO$, $12WO_3$, $3V_2O_5+39H_2O$. (Friedheim.)

$6BaO$, $3V_2O_5$, $12WO_3+34H_2O$. Not easily sol. in H_2O. (Friedheim and Löwy, Z. anorg. 1894, **6.** 18.)

$4BaO$, $4V_2O_5$, $12WO_3+41H_2O$. Less sol. than preceding salt. Decomp. by boiling or by mineral acids. (Rosenheim.)

Composition is $4BaO$, $12WO_3$, $3V_2O_5+30H_2O$. (Friedheim.)

Calcium vanadiotungstate, $2CaO$, V_2O_5, $2WO_3+12H_2O$.

(Friedheim and Löwy, Z. anorg. 1894, **6.** 20.)

Magnesium sodium ——, MgO, $6Na_2O$, $3V_2O_5$, $12WO_3+42H_2O=5Na_2O$, $12WO_3+MgO$, Na_2O, $3V_2O_5+42H_2O$.

Sol. in H_2O. (Rothenbach, B. **23.** 3054.

Potassium ——, $4K_2O$, $3V_2O_5$, $12WO_3+30H_2O$.

Sol. in H_2O.

Composition is potassium *meta*tungstate vanadate, $3(K_2O, 4WO_3)+K_2O$, $3V_2O_5+30H_2O$. (Friedheim, B. **23.** 1515.)

$8K_2O$, $4V_2O_5$, $16WO_3$, $9H_2O+24H_2O$. Very efflorescent. Easily sol. in H_2O, (Rosenheim, A. **251.** 214.)

Formula is $6K_2O$, $12WO_3$, $3V_2O_5+24H_2O$, which is a double salt, $5K_2O$, $12WO_3+K_2O$, $3V_2O_5$. (Friedheim, B. **23.** 1505.)

Potassium sodium ——, $(5Na_2O, 3V_2O_5, 6WO_3+22H_2O)$, $4(5K_2O, 3V_2O_5, 6WO_3+22H_2O)$ or Na_2O, $4K_2O$, $3V_2O_5$, $6WO_3+22H_2O$.

(Friedheim and Löwy, Z. anorg. 1894, **6.** 22.)

$4(5Na_2O, 3V_2O_5, 6WO_3+24H_2O)$, $3(5K_2O, 3V_2O_5, 6WO_3+24H_2O.)$ (Friedheim and Löwy.)

$5(5Na_2O, 3V_2O_5, 6WO_3+24H_2O)$, $5K_2O$, $3V_2O_5$, $6WO_3+24H_2O$. (Friedheim and Löwy.)

Silver ——, $8Ag_2O$, $4V_2O_5$, $16WO_3$, $9H_2O$.

Somewhat sol. in cold H_2O, more easily upon addition of little HNO_3. Decomp. by warm H_2O. (Rosenheim, A. **251.** 224.)

$3Ag_2O$, $2V_2O_5$, $6WO_3+3H_2O$. Nearly insol. in cold H_2O. Decomp. by addition of HNO_3 or upon warming. (Rosenheim.)

Sodium ——, $5Na_2O$, $3V_2O_5$, $6WO_3+36H_2O$.

Sol. in H_2O.

Composition is $3(Na_2O, 2WO_3)+2(Na_2O, 3V_2O_5)+36H_2O$. (Friedheim, B. **23.** 1527.)

$+38H_2O$. Sol. in 1.25 pts. H_2O at 13.8°. (Friedheim and Löwy.)

$2Na_2O$, $2V_2O_5$, $3WO_3+20H_2O$. Very sol. in H_2O.

Composition is Na_2O, $3WO_3+Na_2O$, $2V_2O_5+20H_2O$, double salt of sodium *tri*tungstate and *di*vanadate. (Friedheim, B. **23.** 1523.)

$4Na_2O$, $3V_2O_5$, $12WO_3+38H_2O=3(Na_2O, 4WO_3)+Na_2O$, $3V_2O_5+38H_2O$. Sol. in H_2O. (Rothenbach, B. **23.** 3050.)

$8Na_2O$, $4V_2O_5$, $16WO_3$, $9H_2O+48H_2O$.

Efflorescent. Easily sol. in H_2O. (Rosenheim, A. **251.** 210.)

Formula is $6Na_2O, 12WO_3, 3V_2O_5+42H_2O$, and is a double salt of sodium *para*tungstate, $5Na_2O, 12WO_3$, and sodium *tri*vanadate, $Na_2O, 3V_2O_5$. (Friedheim, B. **23.** 1505.)

$7Na_2O, V_2O_5, 12WO_3+29H_2O$. Easily sol. in H_2O. (Friedheim and Löwy, Z. anorg. 1894, **6.** 15.)

$8Na_2O, V_2O_5, 14WO_3+60H_2O$ and $+66H_2O$ (Friedheim and Löwy.)

Strontium vanadiotungstate, $19SrO, 36WO_3, 10V_2O_5+122H_2O=3(5SrO, 12WO_3), 2(2SrO, 5V_2O_5)+122H_2O$.

Sol. in H_2O. (Rothenbach, B. **23.** 3053.)

Vanadious acid.

See **Hypovanadic acid.**

Vanadiovanadicomolybdic acid.

Ammonium vanadiovanadicomolybdate, $11(NH_4)_2O, 4V_2O_5, VO_2, 28MoO_3+48H_2O$.

Sl. sol. in cold, sol. in hot H_2O without decomp. (Gibbs, Am. Ch. J. **5.** 391.)

Barium ——, $14BaO, 2V_2O_5, 3VO_2, 30MoO_3+48H_2O$.

Precipitate. Very sl. sol. in cold, decomp. by hot H_2O. (Gibbs.)

Vanadiovanadicotungstic acid.

Ammonium vanadiovanadicotungstate, $6(NH_4)_2O, 2V_2O_5, 3VO_2, 12WO_3+12H_2O$.

Sol. in H_2O. (Gibbs, Am. Ch. J. **5.** 391.)

Silver ——, $6Ag_2O, 2V_2O_5, 3VO_2, 12WO_3+8H_2O$.

Precipitate. Very sl. sol. in cold, sol. in much warm H_2O. (Gibbs.)

Sodium ——, $6Na_2O, 2V_2O_5, 3VO_2, 12WO_3$.

Very sol. in H_2O. (Gibbs.)

Vanadium, V.

Insol. in H_2O, HCl, dil. H_2SO_4+Aq, and cold conc. H_2SO_4. Sol. in hot conc. H_2SO_4. Slowly sol. in HF+Aq. Easily sol. in dil. or conc. HNO_3+Aq. Not attacked by hot or cold NaOH or KOH+Aq. (Roscoe, A. suppl. **7.** 85.)

Does not alter in the air; not acted upon by HCl and very slowly by H_2SO_4. (Moissan, C. R. 1896, **122.** 1299.)

Vanadium boride, VB.

Sol. in HF and HNO_3. Decomp. by fused alkalies. (Wedekind, B. 1913, **46.** 1203.)

Vanadium *tri*bromide, VBr_3.

Very deliquescent; quickly decomposes. (Roscoe, A. suppl. **8.** 99.)

$+6H_2O$. Sol. in H_2O with decomp. (Locke and Edwards, Am. Ch. J. 1898, **20.** 600.)

Sol. in H_2O, alcohol and ether. Insol. in HBr. (Piccini, Z. anorg. 1899, **19.** 398.)

Vanadium carbide, VC.

Insol. in HCl and H_2SO_4.

Sol. in HNO_3 in the cold, and in fused KNO_3 and $KClO_3$. (Moissan, C. R. 1896, **122.** 1300.)

Vanadium *di*chloride, VCl_2.

Very deliquescent. Sol. in H_2O, alcohol, and ether. (Roscoe, A. suppl. **7.** 79.)

Vanadium *tri*chloride, VCl_3.

Deliquescent. Sol. in H_2O, absolute alcohol, and ether.

$+6H_2O$. Sol. in H_2O; sl. sol. in conc. HCl+Aq.

Sol. in alcohol and ether. (Piccini, Z. anorg. 1899, **19.** 395.)

Vanadium *tetra*chloride, VCl_4.

Sol. with decomp. in H_2O, alcohol, and ether. (Roscoe.)

Sol. in H_2O with decomp.

Sol. in fuming HCl with decomp.

Sol. in anhydrous $CHCl_3$ or glacial acetic acid apparently without chemical change. (Koppel, Z. anorg. 1905, **45.** 346.)

Vanadium *di*fluoride, VF_2.

Sol. in HF with evolution of H_2 and formation of VF_3. (Manchot, A. 1907, **357.** 135.)

Vanadium *tri*fluoride, VF_3.

Nearly insol. in H_2O and organic solvents. (Ruff, B. 1911, **44.** 2544.)

$+3H_2O$. Efflorescent. Easily sol. in cold, extremely sol. in hot H_2O with decomp. Can be recryst. from HF+Aq. Insol. in strong alcohol. (Petersen, J. pr. (2) **40.** 48.)

Vanadium *tetra*fluoride, VF_4.

Very hydroscopic.
Easily sol. in H_2O.
Difficultly sol. in SO_2Cl_2 and $SiCl_4$.
Sol. in $POCl_3$ with evolution of gas.
Sol. in acetone and acetic acid.
Difficultly sol. in alcohol and $CHCl_3$. (Ruff, B. 1911, **44.** 2545.)

Vanadium *penta*fluoride, VF_5.

Easily sol. in H_2O.

Easily sol. in alcohol, $CHCl_3$, acetone, and ligroin. Insol. in CS_2. Decomp. toluene and ether. (Ruff, B. 1911, **44.** 2549.)

Vanadium *tri*fluoride *with* MF.

See **Fluovanadate, M.**

Vanadium hydride,

Stable. Does not react with boiling H_2O. Not attacked by boiling HCl, but oxidized by hot H_2SO_4.

Sol. in boiling HNO_3. (Muthmann, A. 1907, **355.** 86.)

Vanadium *di*hydroxide, VO, xH_2O.

Insol. in KOH or NaOH+Aq.

$V(OH)_2$. Sol. in HCl. (Locke and Edwards, Am. Ch. J. 1898, **20.** 598.)

Vanadium *tri*hydroxide, V_2O_3, xH_2O.

Easily sol. in all acids (Petersen, J. pr. (2) **40.** 49.)

Vanadium *tetra*hydroxide (Hypovanadic hydroxide), $V_2O_2(OH)_4+5H_2O$.

Easily sol. in acids or alkalies. (Crow, Chem. Soc. **30.** 453.)

Vanadium *tri*iodide, VI_3+6H_2O.

Very hydroscopic; sol. in H_2O. Only sl. sol. in cold conc. HI+Aq.

Sol. in alcohol. (Piccini, Z. anorg. 1899, **19.** 399.)

Vanadium nitride, V_2N.

Insol. in H_2O, HCl, and KOH+Aq. Sol. in $HNO_3+H_2SO_4$.

Decomp. by fusing with KOH. (Muthmann, A. 1907, **355.** 93.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

VN. (Roscoe, A. suppl. **6.** 114.)

VN_2. Not attacked by cold HNO_3+Aq. (Uhrlaub, Pogg. **103.** 134.)

Vanadium *di*oxide, VO.

Insol. in H_2O; easily sol. in dil. acids. (Roscoe, A. suppl. **6.** 95.)

Vanadium *tri*oxide, V_2O_3.

Oxidized in H_2O in contact with air and then dissolves. Insol. in acids, except HNO_3, and in alkalies+Aq. (Roscoe, A. suppl. **6.** 99.)

Easily sol. in HF. (Petersen, J. pr. (2) **40.** 48.)

Vanadium *tet*roxide, VO_2.

Sol. in acids and alkalies+Aq.

Vanadium *pent*oxide, V_2O_5.

Sol. in about 1000 pts. H_2O. (Berzelius.)

Sol. in acids, alkali hydrates, and carbonates +Aq. Insol. in absolute, very sl. sol. in dil. alcohol.

Insol. in glacial $HC_2H_3O_2$.

Sol. in conc. KF+Aq. (Ditte, C. R. **105.** 1067.)

Sol. in $H_2C_2O_4$+Aq and alkali oxalates+Aq. (Halberstadt, Z. anal. **22.** 1.)

Three modifications.—(α) Forms hydrates with 2, and $5H_2O$. Sol. in H_2O. 1 l. of sat. solution contains 8 g. V_2O_5.

(β) V_2O_5, $2H_2O$. Very sl. sol. in H_2O. 1 l. of sat. solution contains 0.5 g. V_2O_5.

(γ) V_2O_5, $5H_2O$. Less sol. in H_2O than β 1 l. H_2O contain 0.05 g. V_2O_5 when saturated. (Ditte, C. R. **101.** 698.)

See **Vanadic acid.**

Vanadium oxide. $V_4O_9=2VO_2$, V_2O_5.

See **Vanadate, vanadium.**

VO_4, $V_2O_5+?H_2O$. (Brierley, Chem. Soc. **49.** 30.)

See also **Vanadiovanadic acid.**

V_2O_4, $2V_2O_5+8H_2O$

See **Vanadate, vanadium.**

Vanadium *pent*oxide *with* MF.

See **Fluoxyvanadate, M.**

Vanadium oxy compounds.

See **Vanadyl compounds.**

Vanadium silicide, V_2Si.

Insol. in H_2O.

Not attacked by HCl, HNO_3 or H_2SO_4. Readily attacked by HF.

Not attacked by KOH+Aq, NaOH+Aq or NH_4OH. Decomp. by fused KOH.

Insol. in alcohol, ether and benzene. (Moissan, C. R. 1902, **135.** 496.)

VSi_2. Sol. in HF; insol. in acids and alkalies.

Decomp. by fused KOH. (Moissan, C. R. 1902, **135.** 78.)

Vanadium *di*sulphide, V_2S_2.

Insol. in boiling dil. or conc. HCl, dil. H_2SO_4+Aq, or cold conc. H_2SO_4. Easily sol. in hot dil. or conc. HNO_3+Aq, or in boiling conc. H_2SO_4. Insol. in alkalies+Aq. Sl. sol. in KSH+Aq; sol. in NH_4SH+Aq. (Kay, Chem. Soc. **37.** 728.)

Vanadium *tri*sulphide, V_2S_3.

Insol. in cold HCl or dil. H_2SO_4+Aq. Very sl. sol. in hot HCl or dil. H_2SO_4+Aq. More sol. in HNO_3+Aq or conc. H_2SO_4. Sl. sol. in NaOH or NH_4OH+Aq. Easily sol. in $(NH_4)_2S$ or NH_4SH+Aq, also in K_2S+Aq. (Kay, Chem. Soc. **37.** 728.)

Vanadium *penta*sulphide, V_2S_5.

Sl. attacked by hot conc. HCl or hot dil. H_2SO_4+Aq; sol. in hot conc. H_2SO_4. Sol. in hot dil. HNO_3+Aq. Sl. sol. in NH_4OH+Aq, but easily dissolved by NaOH+Aq. Sl. sol in Na_2S+Aq. Sol. in NH_4SH+Aq. (Kay.)

Vanadium sulphochloride sulphur chloride, $4VSCl_3$, S_2Cl_2.

Decomp. in the air. (Koppel, Z. anorg. 1905, **45.** 357.)

Vanadous acid.

Ammonium vanadite, basic, $2(NH_4)_2O, V_2O_4$.

Sl. sol. in cold, easily in hot H_2O. (Ditte, C. R. **102.** 1310.)

Ammonium vanadite, $(NH_4)_2V_4O_9+3H_2O$.

Sol. in H_2O. (Crow, Chem. Soc. **30.** 460.)
$+xH_2O$. Sol. in H_2O.
Insol. in alcohol, ether and ammonia. (Koppel, Z. anorg. 1903, **36.** 297.)
$+3H_2O$. Easily sol. in H_2O. (Mawrow, Z. anorg. 1907, **55.** 150.)

Barium vanadite, $BaV_4O_9+4H_2O$.

Ppt. (Koppell, Z. anorg. 1903, **36.** 300.)
$+5H_2O$. Precipitate. Easily sol. in HNO_3, or HCl+Aq. (Crow, Chem. Soc. **30.** 460.)

Lead vanadite, PbV_4O_9.

Ppt. (Crow.)

Potassium vanadite, $K_2V_4O_9+4H_2O$.

Sol. in H_2O.
Insol. in alcohol, ether and ammonia (Koppel, Z. anorg. 1903, **36.** 300.)
$+7H_2O$. Easily sol. in H_2O. Insol. in cold, sol. in hot KOH+Aq. Insol. in alcohol. (Crow.)
$+H_2O$. (Ditte, C. R. **102.** 1310.)

Silver vanadite, $Ag_2V_4O_9$.

Ppt. (Crow.)

Sodium vanadite, $Na_2V_4O_9+4H_2O$.

Sol. in H_2O.
Insol. in alcohol, ether and ammonia. (Koppel, Z. anorg. 1903, **36.** 299.)
$+7H_2O$. Easily sol. in H_2O. (Crow, Chem. Soc. **30.** 459.)

Vanadosotungstic acid.

Ammonium vanadosotungstate, $5(NH_4)_2O, 2V_2O_4, 14WO_3+13H_2O$.

Very sol. in H_2O. (E. F. Smith, J. Am. Chem. Soc. 1903, **25.** 1228.)

Vanadous acid.

See **Hypovanadic acid.**

Vanadovanadic acid.

See **Vanadicovanadic acid.**

Vanadyl bromide, $VOBr$.

Very sl. sol. in H_2O, acetic anhydride, ethyl acetate, and acetone.
Insol. in alcohol, ether, acetic acid, $CHCl_3$, toluene and CCl_4. (Ruff, B. 1911, **44.** 2537.)

Vanadyl *di*bromide, $VOBr_3$.

Very deliquescent, and sol. in H_2O. (Roscoe.)

Vanadyl *tri*bromide, $VOBr_3$.

Very deliquescent, and quickly decomposes in moist air. Sol. in H_2O. (Roscoe.)

Vanadyl bromide, $V_2O_3Br_2, 2HBr+7H_2O$.

Very deliquescent. (Ditte, C. R. **102.** 1310.)

Vanadyl *semi*chloride, V_2O_2Cl.

Insol. in H_2O. Easily sol. in HNO_3+Aq. (Roscoe, A. suppl. **6.** 114.)

Vanadyl *mono*chloride, $VOCl$.

Insol. in H_2O. Easily sol. in HNO_3+Aq. (Roscoe.)

Vanadyl *di*chloride, $VOCl_2$.

Deliquescent. Slowly decomp. by H_2O. Easily sol. in HNO_3+Aq. (Roscoe.)

Vanadyl *tri*chloride, $VOCl_3$.

Deliquescent. Sol. in H_2O and alcohol with decomp. (Bedson, A. **180.** 235.)
Sol. in ether with combination.

***Di*vanadyl chloride,** $V_2O_4Cl_2+5H_2O$.

Deliquescent, and sol. in H_2O, fuming HCl, or alcohol. (Crow, Chem. Soc. **30.** 457.)

Vanadyl chloride, $V_2O_3Cl_2+4H_2O$.

Very deliquescent. (Ditte, C. R. **102.** 1310.)

Vanadyl platinum chloride.

See **Chloroplatinate, vanadyl.**

Vanadyl *tri*chloride ammonia, $VOCl_3, xNH_3$.

Decomp. by H_2O. (Roscoe.)

Vanadyl *di*fluoride, VOF_2.

Insol. in H_2O. Insol. in alcohol, ether, $CHCl_3$. Sl. sol. in acetone. (Ruff, B. 1911, **44.** 2546.)

Vanadyl *tri*fluoride, VOF_3.

Very hydroscopic. Easily sol. in H_2O. Sol. in $POCl_3$ with evolution of gas. Difficultly sol. in PCl_3 and $AsCl_3$. Sol. in hot $CHCl_3$ and acetic anhydride. (Ruff, B. 1911, **44.** 2547.)

Vanadyl fluoride *with* **MF.**

See **Fluoxyvanadate,** *and* **Fluoxhypovanadate, M.**

Vanadyl iodide, $V_2O_3I_2, 3HI+10H_2O$.

Very deliquescent, and sol. in H_2O. (Ditte, C. R. **102.** 1310.)
$V_2O_3I_2, 2HI+8H_2O$. As above.

Vanadyl sulphide, VOS (?).

(*a*) Insol. in H_2O, alkalies, alkali sulphides +Aq. Sol. in acids, except nitric acid and aqua regia. (Berzelius.)

(b) Sol. in alkalies, alkali carbonates, and sulphides+Aq. Insol. in acids. (Berzelius.)

Water, H_2O.

Water is the most universal solvent It absorbs all gases, usually with an increase of volume, seldom, as in the case of NH_3, with a diminution of volume. It dissolves almost all solids in greater or less quantity, and mixes with or dissolves considerable amounts of many liquids.

Miscible with alcohol. Sol. in 36 pts. ether.
Sol. in 30–33 vols ethyl acetate. (Becker.)
Sol. in 5 vols. iodhydrin.
Sl. sol. in most of the fatty oils.

Solubility in organic solvents at t°.

Solvent	t°	G. H_2O in 100 g. of the solution
Benzene	+3	0.030
	23	0.060
	40	0.114
	55	0.184
	66	0.255
	77	0.337
Petroleum bpt. 190-250° at atmos. pressure	−2	0.0012
	+18	0.005
	23	0.007
	30	0.008
	36	0.012
	53	0.026
	59	0.031
	61	0.035
	66	0.043
	79	0.063
	85	0.075
	94	0.097
Paraffin oil bpt. 200-300° at 10 mm. pressur	+16	0.003
	50	0.013
	65	0.022
	73	0.030
	77	0.035
	94	0.055

(Groschuff, Z. Elektrochem, 1911, **17.** 350.)

White precipitate, fusible.
See **Mercuri*di*ammonium chloride.**

White precipitate, infusible.
See **Mercuric chloramide.**

Xanthochromium bromide, $Cr(NO_2)(NH_3)_5Br_2$.

Sol. in H_2O. Resembles the chloride. (Christensen, J. pr. (2) **24.** 74.)

—— **carbonate,** $Cr(NO_2)(NH_3)_5CO_3$.

Easily sol. in H_2O. (Christensen.)

Xanthochromium chloride, $Cr(NO_2)(NH_3)_5Cl_2$.

More sol. in H_2O than the roseo, but less than the purpureo salt.

Solution decomp. by light or boiling. Decomp. by dil. acids. Sol. in NaOH+Aq and in NH_4OH+Aq (sp. gr. 0.91). Insol. in alcohol. (Christensen, J. pr. (2) **24.** 74.)

—— **chloroplatinate,** $Cr(NO_2)(NH_3)_5PtCl_6$.

Insol. in pure H_2O, but sol. when warmed with H_2O containing HCl, with formation of a new double salt. (Christensen.)

—— **mercuric chloride,** $Cr(NO_2)(NH_3)_5Cl_2$, $2HgCl_2$.

Precipitate. Decomp. by long contact with H_2O. (Christensen.)

—— **chromate,** $Cr(NO_2)(NH_3)_5CrO_4$.

Difficultly sol. in H_2O. (Christensen.)

—— ***di*chromate,** $Cr(NO_2)(NH_3)_5Cr_2O_7$.

Difficultly sol. in H_2O. (Christensen.)

—— **dithionate,** $Cr(NO_2)(NH_3)_5S_2O_6$.

Insol. in cold H_2O. (Christensen.)

—— **hydroxide,** $Cr(NO_2)(NH_3)_5(OH)_2$.

Known only in solution. (Christensen.)

—— **iodide,** $Cr(NO_2)(NH_3)_5I_2$.

Quite difficultly sol. in H_2O. (Christensen.)

—— **nitrate,** $Cr(NO_2)(NH_3)_5(NO_3)_2$.

Sol. in about 150 pts. H_2O. (Christensen.)

—— **sulphate,** $Cr(NO_2)(NH_3)_5SO_4+H_2O$.

Sol. in H_2O and $(NH_4)_2SO_4$+Aq. (Christensen.)

Xanthocobaltic bromide, $Co(NH_3)_5(NO_2)Br_2$.

Easily sol. in cold H_2O. (Werner and Miolati, Gazz. ch. it. **23, 2.** 140.)

—— **bromonitrate,** $Co(NO_2)(NH_3)_5(NO_3)Br$.

Sl. sol. in cold, more easily in hot H_2O. (Gibbs.)

—— **chloride,** $Co(NO_2)(NH_3)_5Cl_2$.

Sl. sol. in cold H_2O, and decomp. by boiling therewith. Insol. in HCl+Aq and alkali chlorides+Aq. Easily decomp. by boiling with acids, even dilute. (Gibbs and Genth.)

Sol. in 50 pts. cold H_2O. (Jörgensen, Z. anorg. **5.** 172.)

—— **mercuric chloride,** $Co(NO_2)(NH_3)_5Cl_2$, $2HgCl_2+H_2O$.

Insol. in cold, sl. sol. in hot H_2O without decomp. More sol. in acidified H_2O. (Gibbs and Genth.)

Xanthocobaltic chloraurate, $Co(NO_2)(NH_3)_5Cl_2$, $AuCl_3+H_2O$.

Can be easily crystallised out of hot H_2O. (Gibbs and Genth, Sill. Am. J. (2) **24.** 90.)

—— **chloronitrate,** $Co(NO_2)(NH_3)_5(NO_3)Cl$.

Sl. sol. in cold, more easily in hot H_2O.

—— **chloronitrate gold chloride,** $Co(NO_2)(NH_3)_5(NO_3)Cl$, $AuCl_3$.

—— **chloronitrate platinic chloride,** $2Co(NO_2)(NH_3)_5(NO_3)Cl$, $PtCl_4$.

—— **chloroplatinate,** $Co(NO_2)(NH_3)_5Cl_2$, $PtCl_4+H_2O$.

Scarcely sol. in hot or cold H_2O. Can be recryst. from dil. HNO_3+Aq. Sol. in hot dil. HCl+Aq. (Gibbs and Genth, Sill. Am. J. (2) **24.** 91.)

—— **chromate,** $Co(NO_2)(NH_3)_5CrO_4+H_2O$.

Very sl. sol. in cold, and but slightly sol. in hot H_2O. (Gibbs.)

—— ***di*chromate,** $Co(NO_2)(NH_3)_5Cr_2O_7$.

Easily sol. in hot H_2O.

—— **ferrocyanide,** $[Co(NO_2)(NH_3)_5]_2Fe(CN)_6+7H_2O$.

Nearly insol. in cold, decomp. by warm H_2O.

$+6H_2O$. (Braun, A. **132.** 47.)

—— **iodide,** $Co(NO_2)(NH_3)_5I_2$.

Sol. in H_2O. (Gibbs.)

—— **iodosulphate,** $[Co(NO_2)(NH_3)_5]_2(SO_4)I_2$.

Sol. in H_2O.

—— ***per*iodosulphate,** $[Co(NO_2)(NH_3)_5]_2(SO_4)I_4$.

Easily decomp. by hot H_2O.

—— **nitrate,** $Co(NO_2)(NH_3)_5(NO_3)_2$.

Sl. sol. in cold, moderately sol. in hot H_2O. Decomp. by boiling. Much less sol. than NH_4Cl or $(NH_4)_2SO_4$ in cold H_2O. Insol. in HNO_3. (Gibbs and Genth.)

—— **nitrite,** $Co(NO_2)(NH_3)_5(NO_2)_2+2H_2O$.

Sol. in H_2O. (Gibbs.)

—— **cobaltic nitrite,** $Co(NO_2)(NH_3)_5(NO_2)_2+2H_2O$.

Sl. sol. in H_2O. (Gibbs, Proc. Am. Acad. **11.** 8.)

Is nitratopurpureocobaltic cobaltic nitrite, $[(NO_3)Co(NH_3)_5]_3[Co(NO_2)_6]_2+2H_2O$. (Jörgensen, Z. anorg. **5.** 175.)

$[Co(NO_2)(NH_3)_5]_3[Co(NO_2)_6]_2$. Not so difficultly sol. as the luteo salt. (Jörgensen.)

Xanthocobaltic *tetr*amine cobaltic nitrite, $Co_2(NO_2)_2(NH_3)_{10}[Co_2(NH_3)_4(NO_2)_8]_2$.

Can be recryst. from hot H_2O. (Gibbs, Proc. Am. Acad. **11.** 8.)

$=(NO_2)Co(NH_3)_5[(NO_2)_2(NH_3)_2Co(NO_2)_2]_2$. Xanthocobaltic *di*amine cobaltic nitrite. Very sl. sol. in cold H_2O. (Jörgensen, Z. anorg. **5.** 180.)

—— **oxalate,** $Co(NO_2)(NH_3)_5C_2O_4$.

Nearly insol. in cold, sl. sol. in hot H_2O.

—— **sulphate,** $Co(NO_2)(NH_3)_5SO_4$.

Moderately sol. in hot, much less in cold H_2O. Sol. without decomp. in H_2SO_4+Aq. (Gibbs and Genth.)

Sol. in 25 pts. hot H_2O acidified with $HC_2H_3O_2$. (Jörgensen, Z. anorg. **5.** 172.)

$4Co(NO_2)(NH_3)_5SO_4$, $3H_2SO_4$. Decomp. by H_2O, not by absolute alcohol. (Jörgensen.)

Xanthorhodium bromide, $(NO_2)Rh(NH_3)_5Br_2$.

Moderately sol. in H_2O. (Jörgensen, J. pr. (2) **34.** 394.)

—— **chloride,** $(NO_2)Rh(NH_3)_5Cl_2$.

Much more sol. in H_2O than the nitrate.

—— **chloroplatinate,** $(NO_2)Rh(NH_3)_5PtCl_6$.

Ppt. Extremely sl. sol. in cold H_2O.

—— **dithionate,** $(NO_2)Rh(NH_3)_5S_2O_6+H_2O$.

Nearly insol. in H_2O.

—— **fluosilicate,** $(NO_2)Rh(NH_3)_5SiF_6$.

Ppt.

—— **hydroxide,** $(NO_2)Rh(NH_3)_5(OH)_2$.

—— **nitrate,** $(NO_2)Rh(NH_3)_5(NO_3)_2$.

Moderately sol. in cold, easily in hot H_2O. Insol. in alcohol. Less sol. in conc. NH_4OH+Aq than in H_2O.

Insol. in dil. HNO_3+Aq; sol. in HNO_3+Aq of 1.4 sp. gr.

—— **oxalate,** $(NO_2)Rh(NH_3)_5C_2O_4$.

Nearly insol. in cold H_2O. Very sl. sol. in warm H_2O. Easily sol. in dil. $HC_2H_3O_2$+Aq.

—— **sulphate,** $(NO_2)Rh(NH_3)_5SO_4$.

Slowly sol. in cold, quite easily in hot H_2O.

$4(NO_2)Rh(NH_3)_5SO_4$, $3H_2SO_4$. Sl. sol. in cold, easily in hot H_2O. Can be recrystallized from dil. H_2SO_4+Aq.

Xenon, Xe.

Absorption by H_2O at t°.

t°	Absorption coefficient
0	0.2189
10	0.1500
20	0.1109
30	0.0900
40	0.0812
50	0.0878

(Antropoff, Roy. Soc. Proc. 1910, **83.** A, 480.)

Ytterbium, Yb.

Ytterbium bromide, $YbBr_3+8H_2O$.

Very sol. in H_2O. Hydroscopic. (Cleve, Z. anorg. 1902, **32.** 135.)

Ytterbium chloride, $YbCl_3+6H_2O$.

Very sol. in H_2O. (Cleve, Z. anorg. 1902, **32.** 134.)

Mpt. 150-155°. Anhydrous salt is sol. in H_2O and in alcohol. (Matignon, A. ch. 1906, (8) **8.** 442.)

Ytterbium oxide, Yb_2O_3.

Slowly attacked by cold or warm acids, but easily sol. at 100°.

Ytterbium oxychloride, YbOCl.

Ppt. (Cleve, Z. anorg. 1902, **32.** 135.)

Yttrium, Y.

Decomposes H_2O. (Cleve, Bull. Soc. (2) **21.** 344.) Decomp. H_2O slightly at ord. temp., more rapidly by boiling. Easily sol. in dil. acids, even acetic acid. Slightly acted upon by conc. H_2SO_4. Decomposes hot KOH+Aq and cold NH_4Cl+Aq. Not attacked by NH_4OH+Aq. (Popp, A. **131.** 179.)

Popp's yttrium contained erbium.

Yttrium bromide, YBr_3.

Sol. in H_2O with evolution of heat. (Duboin, C. R. **107.** 243.)

$+9H_2O$. Deliquescent. Easily sol. in H_2O and alcohol. Insol. in ether. (Cleve.)

Yttrium carbide, YC_2.

Decomp. by H_2O and by dil acids; very slowly attacked by conc. acids. (Moissan, C. R. 1896, **122.** 575.)

Decomp. by H_2O and dil. acids. (Pettersson, B. 1895, **28.** 2421.)

Yttrium chloride, YCl_3.

Anhydrous. Sol. in H_2O with evolution of heat. (Cleve.)

$+6H_2O$. Deliquescent. Very sol. in H_2O. Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Mpt. 156-160°; sol. in alcohol.

60.1 grams anhydrous salt are sol. in 100 grams of abs. alcohol at 15°.

6.5 grams are sol. in 100 grams pyridine. (Matignon, A. ch. 1906, (8) **8.** 437.)

Yttrium fluoride, $YF_3+\frac{1}{2}H_2O$.

Nearly insol. in dil. acids. (Cleve.)

Yttrium hydroxide, Y_2O_3, $6H_2O$ or $Y_2O_6H_6+3H_2O$.

Insol. in H_2O.

Insol. in KOH or NaOH+Aq. Easily sol. in acids. Sol. in alkali carbonates+Aq. When freshly pptd., easily sol. in NH_4Cl+Aq.

Yttrium iodide, YI_3.

Very deliquescent. Easily sol. in H_2O and alcohol.

Sl. sol. in ether. (Cleve.)

Yttrium oxide, Y_2O_3.

Insol. in H_2O. Sl. sol. in cold HCl, HNO_3, or dil. H_2SO_4+Aq, but gradually completely sol. on warming. Insol. in NH_4OH and sl. sol. in KOH+Aq. Sol. in $HC_2H_3O_2$+Aq. Somewhat sol. in K_2CO_3+Aq.

Yttrium *per*oxide, Y_4O_9.

(Cleve, Bull. Soc. (2) **43.** 53.)

Yttrium oxychloride, $Y_2O_2Cl_2$.

Insol. in H_2O. (Popp.)

Yttrium sulphide, Y_2S_3.

Not prepared in pure state. Impure is insol. in H_2O, and partially decomp. thereby. Easily sol. in acids with decomp. (Popp.)

Zinc, Zn.

Not attacked by pure cold H_2O. Slowly oxidised by boiling H_2O. Pure H_2O free from O dissolved nothing from 2500 sq. mm. Zn. Presence of air containing CO_2 caused a solution of 3.5 mg. Zn, which maximum was reached in 2 days. Air without CO_2 also caused a slight action. (Snyders, B. **11.** 936.)

100 ccm. distilled H_2O dissolved 14 mg. Zn from 11.8 sq. cm. in one week, during which air free from CO_2 was passed through the liquid, and 19 mg. when air containing CO_2 was used. (Wagner, Dingl. **221.** 260.)

Filtered rain water was found to contain 20 mg. Zn per l. (Burg, Isis, **1873.** 119.)

Very pure H_2O, when conducted through a great length of galvanized iron pipe, contained 1.7 pts. Zn to 100,000 pts. H_2O. (Davies, J. Soc. Chem. Ind. 1899, **18.** 102.)

Action of H_2O on Zn in galvanized pipes is caused by electrolysis. (Smetham, C. N. 1879, **39.** 236.)

All kinds of H_2O attack Zn, rain water the least.

In distilled H_2O exposed to air Zn is abun-

dantly coated with $ZnCO_3$, $2ZnO+3H_2O$. By allowing 32 g. Zn to stand in 270 cc. distilled H_2O in a flask loosely stoppered with filter paper, 1.2 pts. Zn to 100,000 pts. H_2O was found in solution in 1-2 days. (Smith, J. Soc. Chem. Ind. 1904, **23.** 475.)

Sol. in all acids. Very slowly sol. in dil. HCl or H_2SO_4+Aq in glass vessels if Zn is pure. According to Jacquelain, 24 hours were necessary to dissolve 6 g. pure zinc. When fused at the lowest possible temperature, it is much more slowly sol. than when heated to a red heat. In both cases it is much more rapidly dissolved if cooled quickly. (Bolley, A. **95.** 294; Rammelsberg.)

Dil. H_2SO_4+Aq dissolves given % zinc in the same length of time (B = according to Bolley, R = according to Rammelsberg):

	Slowly cooled		Rapidly cooled	
	B	R	B	R
Cast at the melting point	42.5	74.1	13.0	0.9
Cast at a red heat	100.0	69.4	85.5	9.5

50 ccm. H_2SO_4+Aq dissolved in 2 hours the following amts. from 1 sq. cm. Zn at t°.

t°	Strength of acid	Grms. dissolved
20	H_2SO_4	0.000
130	"	0.075
150	"	0.232
20	$H_2SO_4+H_2O$	0.002
130	"	0.142
150	"	0.345
20	$H_2SO_4+2H_2O$	0.002
130	"	4.916
150	"	5.450
20	$H_2SO_4+3H_2O$	0.005
130	"	3.080
20	$H_2SO_4+4H_2O$	0.049
130	"	0.456
20	$H_2SO_4+5H_2O$	0.027
130	"	0.337
20	$H_2SO_4+6H_2O$	0.018
100	"	3.16

(Calvert and Johnson, Chem. Soc. **19.** 437.)

C. P. zinc is more quickly sol. in dil. acids in vacuo than under normal pressure, the ratio being about 1:6.5. The rate of solubility increases slowly with rise of temp. from 0° to 98°, when it amounts to about 4 times that at 0°, but from 98°–100° the increase is thirteenfold. Thus, as an average of 6 experiments, dil. H_2SO_4+Aq (1:20) dissolves in 30 minutes 2.1 mg. Zn at 0°; 4.9 mg. at 20°; 7.4 mg. at 60°; 9.3 mg. at 98°; but 122.1 mg. at 100°. If, however, the acid was prevented from boiling by increasing the pressure, the sudden increase between 98° and 100° does not take place.

The rate of solubility in dil. H_2SO_4+Aq (1:20) is also increased 175 times by the addition of CrO_3 and 306 times by the addition of H_2O_2. The above phenomena are explained by assuming the formation of a condensed hydrogen atmosphere around the metal, which prevents the further action of the acid. (Weeren, B. **24.** 1785.)

Not attacked by HNO_3+Aq of 1.512 to 1.419 sp. gr. at a temp. of −18° or less, but violently attacked if temp. is raised. HNO_3+Aq of 1.419–1.401 sp. gr. does not attack Zn at temp. of a freezing mixture, but violently at 0°. More dil. HNO_3+Aq attacks Zn even at −20°. (Millon, A. ch. (3) **6.** 99.)

Sol. in H_2CO_3+Aq. (Berzelius.)

Solubility of Zn in acids is very much affected by the presence of small quantities of various metallic salts. Small amts. of $PtCl_4$+Aq accelerated the action of H_2SO_4+Aq 149 times, and As_2O_3 123 times. $HgCl_2$ has a strong retarding action owing to pptn. of Hg on the Zn.

The rate of solution of Zn in acids and the effect of changes in concentration and temperature and of the presence of inorganic salts and organic substances on this rate has been studied. 26 Tables are given. (Ericson-Aurén, Z. anorg. 1901, **27.** 209-253.)

Speed of solution in H_2SO_4 and in HCl. (Centnerszwer, Z. phys. Ch. 1914, **87.** 692.)

Various saline solutions have a strong solvent power in presence of $PtCl_4$, *i.e.* KCl, NaCl, Na_2SO_4, K_2SO_4, $MgSO_4$+Aq. $PtCl_4$ also causes Zn to decompose distilled H_2O. $CuSO_4$ has a similar but less energetic effect.

In all the above cases the disengagement of hydrogen is slower in the dark than in the light. (Millon, C. R. **21.** 37.)

According to Barreswill (C. R. **21.** 292) the above reactions are all caused by galvanic action due to pptd. metal, and a piece of Pt in contact with the Zn causes the same action as the $PtCl_4$ in solution.

Easily sol. in alkalies+Aq, even NH_4OH+Aq, especially when the Zn is in contact with Fe. Sol. in NaCl+Aq with pptn. of ZnO. (Siersch, J. B. **1867.** 257.)

Sol. in sat. alkali and alkali-earth chlorides +Aq. (Post, **1872.**)

Sol. in NH_4 salts+Aq. (Lorin, J. B. **1865.** 124.)

Sol. in sat. Na_2SO_4, K_2SO_4, $MgSO_4$, $NaNO_3$, KNO_3, $Ba(NO_3)_2$, $CaCl_2$, $MgCl_2$, and NH_4NO_3+Aq. Chlorides and sulphates (especially Na_2SO_4 and $MgCl_2$) have strongest action, $MgSO_4$ and nitrates the least. The action was greatly increased by heat. (Snyders, B. **11.** 936.)

Sol. in boiling NH_4Cl+Aq. Sol. in neutral $FeCl_2$+Aq with pptn. of Fe, especially easily at 100°. (Capitaine, C. R. **9.** 737.)

Sol. in $NiSO_4$+Aq with pptn. of NiO. (Tupputi.)

Sol. in conc. hot $ZnCl_2$+Aq, but Zn oxy-

chloride is pptd. on diluting. (Ordway, Am. J. Sci. (2) **23.** 222.)
Sol. in $GlSO_4$+Aq. (Debray.)

Solubility of Zn in dilute solutions of salts: 100 ccm. of solutions of the given salts were allowed to act one week on 11.8 sq. cm. Zn while a current of air with or without CO_2 was passed through the solution.

Salt	G. salt in 100 ccm solution	Mg. Zn dissolved without CO_2	Mg. Zn dissolved with CO_2
NaCl or KCl	0.5	7	38
NH_4Cl	1.0	51	36
$MgCl_2$	0.83	18	54
K_2SO_4	1.0	30	53
KNO_3	1.0	9	37
Na_2CO_3	1.0	13	..
NaOH	0.923	60	..
CaO_2H_2	Sat	3	..

(Wagner, Dingl. **221.** 260.)

Action of dil. salt solutions (1%) on Zn. The following amts. of Zn in mg. were dissolved from 2500 sq. mm. Zn in 14 days by 400 ccm. 1% solution of the given salts:

Salt	Mg. Zn	Salt	Mg. Zn
NaCl	11.2	$NaNO_3$	6
KCl	14.8	$Ba(NO_3)_2$	8
$CaCl_2$	15.2	NH_4Cl	24.0
$MgCl_2$	17.2	$(NH_4)_2SO_4$	31.6
$BaCl_2$	13.2	NH_4NO_3	26.0
K_2SO_4	12.0	$NaHCO_3$	0
$MgSO_4$	8.8	K_2CO_3	0
KNO_3	6.8	Na_2CO_3	0

Sl. attacked by H_2O at 80°, by hot conc. NH_4OH; attacked by H_3PO_4 or NaCl+Aq; very sl. attacked by $NaNO_3$+Aq or KNO_3+Aq at 100°. (Smith, J. Soc. Chem. Ind. 1904, **23.** 476.)

½ ccm. oleic acid dissolves 0.0240 g. Zn in 6 days. (Gates, J. phys. Chem. 1911, **15.** 143.)

Attacked by cane sugar+Aq at 115°. (Klein and Berg, C. R. **102.** 1170.)

Zinc amide, $Zn(NH_2)_2$.

Decomp. by H_2O and alcohol. Insol. in ether. (Frankland, Phil. Mag. (4) **15.** 149.)

Zinc antimonide, ZnSb.

Does not decomp. boiling H_2O except slightly. Not attacked by dil. mineral acids, but decomp. by conc. HCl or HNO_3+Aq. (Cooke, Proc. Am. Acad. **5.** 348.)

Zn_3Sb_2. Decomp. H_2O rapidly at 100°. Violently decomp. by dil. HCl or H_2SO_4+Aq, also by HNO_3+Aq. Completely sol. in HCl +Aq mixed with a little HNO_3. (Cooke.)

Zinc azoimide, basic, $Zn(OH)N_3$.

Very sl. sol. in H_2O. Decomp. by hot H_2O. (Curtius, J. pr. 1898, (2) **58.** 293.)

Zinc azoimide ammonia, ZnN_6, $2NH_3$.

Insol. in H_2O, but gradually decomp. thereby. (Dennis, J. Am. Chem. Soc. 1907 **29.** 20.)

Zinc bromide, $ZnBr_2$.

Very deliquescent, and sol. in H_2O.
Sat. $ZnBr_2$+Aq contains at:

−20°	+4°	22°	97°	
66.3	68.8	77.5	83.6	% $ZnBr_2$,
107°	170°	210°	375° (mpt.)	
83.8	85.0	89.3	100	% $ZnBr_2$.

(Étard, A. ch. 1894, (7) **2.** 541.)

Solubility in H_2O.
100 g. of the sat. solution contain at:

35°	40°	60°	80°	100°	
85.45	85.53	86.08	86.57	87.05	g. $ZnBr_2$.

(Dietz, Z. anorg. 1899, **20.** 250.)

See also below under hydrated salts.

Sp. gr. of $ZnBr_2$+Aq at 19.5° containing

18.3	31.7	43.2	% $ZnBr_2$,
1.1849	1.3519	1.5276	
52.6	59.1	68	% $ZnBr_2$.
1.7082	1.8525	2.1027	

(Kremers, Pogg. **108.** 117.)

Sp. gr. of $ZnBr_2$+Aq at 19.5°.

% $ZnBr_2$	Sp. gr.	% $ZnBr_2$	Sp. gr.	% $ZnBr_2$	Sp. gr.
5	1.045	25	1.265	45	1.560
10	1.093	30	1.330	50	1.650
15	1.196	35	1.400	55	1.755
20	1.204	40	1.475	60	1.875

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sol. in conc. HCl or $HC_2H_3O_2$+Aq, also in NH_4OH+Aq.

Sol. in $AlBr_3$. (Isbekow, Z. anorg. 1913. **84.** 27.)

Very sl. sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Sol. in alcohol and ether. (Berthemot, J. Pharm. **14.** 610.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43.** 314.)

More sol. in anhydrous ether than in abs. alcohol. Insol. in CS_2. (Hampe, Ch. Z. 1887, **11.** 846.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, **15.** 22.)

$+H_2O$. (Lescoeur, A. ch. 1894, (7) **2.** 78.)

$+2H_2O$. Very hygroscopic.

Solubility in H_2O.

100 g. of the sat. solution contain at:

—8°	0°	13°	25°	30°	37° (mpt.)
79.06	79.55	80.76	82.46	84.08	86.20 g. $ZnBr_2$.

(Dietz, Z. anorg. 1899, **20.** 250.)

$+3H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

—15°	—10°	—5° (mpt.)
77.13	78.45	80.64 g. $ZnBr_2$.

(Dietz, Z. anorg. 1899, **20.** 250.)

Zinc bromide ammonia, $ZnBr_2$, $2NH_3$.

Decomp. by H_2O. Sl. sol. in cold, more easily in warm NH_4OH+Aq. (Rammelsberg, Pogg. **55.** 240.)

$+{}^1/_3H_2O$. Decomp. by H_2O with separation of ZnO. (André, C. R. **96.** 703.)

$+H_2O$. Above salt of Rammelsberg's has this composition. (André.)

$3ZnBr_2$, $8NH_3+2H_2O$. Decomp. by H_2O. (André.)

$3ZnBr_2$, $10NH_3+H_2O$. Decomp. by H_2O. (André.)

$2ZnBr_2$, $10NH_3$. Efflorescent. Decomp. by H_2O. (André.)

Zinc bromide cupric oxide, $ZnBr_2$, $3CuO+2H_2O$.

$+4H_2O$. (Mailhe, C. R. 1901, **133.** 227.)

Zinc bromide hydrazine, $ZnBr_2$, $2N_2H_4$.

Decomp. by H_2O.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 277.)

Zinc chloride, $ZnCl_2$.

Very deliquescent, and sol. in H_2O.

Sol. in 0.333 pt. H_2O at 18.75°. Abl.)

$ZnCl_2$+Aq sat. at 12.5° contains 78.5% $ZnCl_2$. (Hassenfratz, A. ch. **28.** 291.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

15°	20°	41°	60°	100°
79.12	81.19	82.21	83.51	86.01 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

$ZnCl_2$+Aq containing 1 pt $ZnCl_2$ in 1.8205 pts. H_2O at 18° has sp. gr. = 1.3666. (Hittorf, Z. phys. Ch. 1902, **39.** 628.)

Solubility in H_2O at t°.

100 g. H_2O dissolve g. $ZnCl_2$.

t°	Solid phase	g. $ZnCl_2$	
−5	ice	14	
−10	"	25	
−40	"	83	
−62	ice:4aq	104	cryohydrate point
−50	$ZnCl_2+4H_2O$	113	
−40	"	127	
−30	4aq:3aq	160	transition point
−10	$ZnCl_2+3H_2O$	189	
0	"	208	
+5	"	230	
6 5	"	252	mpt.
5	"	282	
0	3aq:1½aq	309	eutectic point
0	$ZnCl_2+2½H_2O$	235	
6.5	2½aq:3aq	252	transition point
10	$ZnCl_2+2½H_2O$	272	
12.5	"	303	mpt.
11.5	2½aq:1½aq	335	eutectic point
9	2½aq:1aq	360	eutectic point
6	$ZnCl_2+2½H_2O$	385	
−6	$ZnCl_2+1½H_2O$	298	
+10	"	330	
20	"	368	
26	1½aq:1aq	423	transition point
26 3	1½aq:$ZnCl_2$	433	transition point
0	$ZnCl_2+H_2O$	342	
10	"	364	
20	"	396	
28	1aq·$ZnCl_2$	436	transition point
31	$ZnCl_2+H_2O$	477	
25	$ZnCl_2$	432	
40	"	452	
60	"	488	
80	"	543	
100	"	615	
262	"		mpt.

(Mylius and Dietz, Z. anorg. 1905, **44.** 217.)

See also below under hydrated salts.

Sp. gr. of $ZnCl_2$+Aq at 19.5°.

% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.
13.8	1.1275	37.5	1.3859
25.8	1.2466	49.2	1.5551

(Kremers, Pogg. **105.** 360.)

Sp. gr. of $ZnCl_2$+Aq at 19.5°.

% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.	% $ZnCl_2$	Sp. gr.
1	1.010	25	1.238	45	1.488
5	1.045	30	1.291	50	1.566
10	1.091	35	1.352	55	1.650
15	1.137	40	1.420	60	1.740
20	1.186	..	...	..	..

(Gerlach, Z. anal. **8.** 283, calculated from Kremers.)

Sp. gr. of $ZnCl_2$+Aq at t°.

t°	15°	15°	15°	15°
% $ZnCl_2$	2.5	4.89	10.0	20.0
Sp. gr.	1.024	1.046	1.094	1.190

t°	15°	15°	15°
% $ZnCl_2$	29.86	40.0	58.88
Sp. gr.	1.297	1.423	1.728

(Long, W. Ann. 1880, **11.** 38.)

Sp. gr. of $ZnCl_2$+Aq at room temp. containing:

15.334	23.487	33.752% $ZnCl_2$.
1.1459	1.2288	1.3431

(Wagner, W. Ann. 1883, **18.** 267.)

Sp. gr. of $ZnCl_2$+Aq at 25°.

Concentration of $ZnCl_2$ +Aq	Sp. gr.
1—normal	1.0590
1/2— "	1.0302
1/4— "	1.0152
1/8— "	1.0077

(Wagner, Z. phys. Ch. 1890, **5.** 40.)

Sp. gr. of $ZnCl_2$+Aq.

½ $ZnCl_2$ g. in 1000 g of solution	Sp. gr. 16°/16°
0	1.000000
0.5994	1.000560
2.3163	1.002163
5.0406	1.004708
9.8988	1.009243
19.4914	1.018228

(Dijken, Z. phys. Ch. 1897, **24.** 108.)

Insol. in $SbCl_3$. (Klemensiewicz, C. C. **1908,** II. 1850.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Easily sol. in hot absolute alcohol, and ether. Sol. in 1 pt. strong alcohol at 12.5°. (Wenzel.)

Sol. in 0.35 pt. absolute alcohol. (Graham.)

Sol. in butyl (Wurtz), and hexyl (Bouis) alcohol at ord. temp., but decomp. on heating.

Very sol. in acetic ether with evolution of heat. (Cann, C. R. **102.** 363.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. **6.** 184.)

1 g. $ZnCl_2$ is sol. in 2.3 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 1.14. (Naumann, B. 1904, **37.** 4338.)

Sol. in acetone and in methylal. (Eidmann, C. C. **1899,** II. 1014.)

Sol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Sol. in hot benzonitrile, also in other aromatic nitriles.

Sol. in methyl sulphide and in ethyl sulphide. Very sol. in piperidine. (Werner, Z. anorg. 1897, **15.** 7.)

Sol. in benzyl alcohol, furfurol, methylpropylketone, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl acetoacetate, ethyl benzoate, ethyl oxalate, amyl nitrite, pyridine, piperidine, and quinoline.

Insol. in salicylic aldehyde, ethyl nitrate, and nitrobenzene. (Lincoln, J. phys. Chem. 1899, **3.** 460.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Sol. in 2 pts. glycerine at ord. temp. (Clever, Bull. Soc. 1872, (2) **18.** 372.)

100 g. glycerol dissolve 50 g. $ZnCl_2$ at 15.5°. (Ossendowski, Pharm. J. **1907,** **79.** 575.)

Insol. in CS_2. (Arctowski, Z. anorg. 1894, **6.** 257.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20.** 61.)

Mol. weight determined in piperidine; pyridine and methyl sulphide. (Werner, Z. anorg. 1897, **15.** 18.)

+H_2O. Very deliquescent. Contains 1½ H_2O (Engel, C. R. **102.** 1111.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	11°	27° (mpt.)
74.33	78.25	84.61 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

+1½H_2O.

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	10°	20°	26° (mpt.)
67.45	73.65	80.08	83.43 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

+2H_2O. Sat. aq. solution contains at:

−20°	−14°	−10°	−4°	−1°
54.7	55.4	56.5	57.4	57.9% salt,
+5°	9°	15°	33°	42°
59.1	60.2	62.0	66.8	68.3% salt.

(Étard, A. ch. 1894, (7) **2.** 536.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	10°	19° (mpt.)
67.56	73.70	79.07 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

+2½H_2O. Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	8°	13° (mpt.)
67.42	71.96	75.14 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

+3H_2O. Sol. in 12.5 pts. H_2O at 0°. (Engel.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

−5°	0°	+7° (mpt.)
64.5	67.58	71.57 g. $ZnCl_2$.

(Dietz, Z. anorg. 1899, **20.** 245.)

Zinc hydrogen chloride, $2ZnCl_2$, $HCl+2H_2O$.

Deliquescent. (Engel, C. R. **102.** 1068.)

$ZnCl_2$, $HCl+2H_2O$. (Engel.)

Zinc hydrazine chloride, $ZnCl_2$, N_2H_4, HCl.

Very hydroscopic.

Sol. in H_2O. (Curtius, J. pr. 1894, (2) **50.** 338.)

$ZnCl_2$, $2(N_2H_4, HCl.)$ Hydroscopic; very sol. in H_2O.

Sol. in hot alcohol and NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 338.)

Zinc chloride ammonia, $ZnCl_2$, $5NH_3+H_2O$.

Easily sol. in little, but decomp. by much H_2O. Still more sol. in $ZnCl_2$+Aq with decomp. (Divers, C. N. **18.** 13.)

$ZnCl_2$, $4NH_3+H_2O$. (Kane.)

$ZnCl_2$, $2NH_3$. Not completely sol. in H_2O; can be recryst. from hot NH_4Cl+Aq. (Ritthausen, J. pr. **60.** 473.)

Insol. in H_2O. Sol. in NH_4Cl or NH_4OH+Aq. (Thomas, B. **20.** 743.)

$\left.\begin{array}{l}+{}^1/_4H_2O.\\+{}^2/_3H_2O.\\+{}^1/_2H_2O.\\+H_2O.\end{array}\right\}$ Decomp. by H_2O.

(André, C. R. 1882, **94.** 964.)

$ZnCl_2$, NH_3. Decomp. by H_2O. (Kane, A. ch. **72.** 290.)

Zinc chloride cupric oxide, $ZnCl_2$, $3CuO+4H_2O$.

(Mailhe, C. R. 1901, **134.** 226.)

Zinc chloride hydrazine, $ZnCl_2$, $2N_2H_4$.

Ppt. (Franzen, Z. anorg. 1908, **60.** 275.)

$ZnCl_2$, $2N_2H_4$. Insol. in H_2O.

Easily sol. in NH_4OH+Aq. (Curtius, J. pr. 1894, (2) **50.** 345.)

Zinc chloride hydroxylamine, $ZnCl_2$, $2NH_2OH$.

Sl. sol. in cold, somewhat more in warm H_2O. Very sol. in NH_2OH+Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) **3.** 116.)

1 pt. is dissolved in 100 pts aq. solution sat. at 20°. (Antonoff, C. C. **1905,** II. 810.)

Zinc fluoride, ZnF_2.

Sl. sol. in cold, more easily in hot H_2O. Insol. in 95% alcohol. Sol. in boiling HNO_3, HCl, or H_2SO_4. (Poulenc, C. R. **116.** 581.)

Contrary to older statements, ZnF_2 is quite sol. in H_2O. (Kohlrausch, Z. phys. Ch. 1903, **44.** 213.)

Insol. in liquid NH_3. (Gore, Am. Ch. J. 1898, **20.** 830.)

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

$+4H_2O$. Difficultly sol. in H_2O. Somewhat more sol. in H_2O containing HF, HCl, or HNO_3. Easily sol. in NH_4OH+Aq. (Berzelius, Pogg. **1.** 26.)

1 l. H_2O dissolves 16 g. at 18°. (Dietz)

Zinc hydrogen fluoride.

Known only in solution.

Zinc zirconium fluoride.

See **Fluozirconate, zinc.**

Zinc hydrophosphide, $Zn_2H_2P_2$.

Decomp. by cold H_2O and by dil. HCl+Aq. (Drechsel and Finkelstein, B. 1871, **4.** 353.)

Zinc hydroxide, ZnO_2H_2.

Insol. in H_2O. Sol. in acids. Sol. in KOH, NaOH, NH_4OH, or $(NH_4)_2CO_3$+Aq.

1 l. H_2O dissolve 0.01 g. ZnO_2H_2 at 25°. (Bodländer, Z. phys. Ch. 1898, **27.** 66.)

Solubility in H_2O is calculated to be 2.6×10^{-5} g. mols. per l. (Herz, Z. anorg. 1900, **23.** 227.)

1 l. H_2O dissolves 0.0042 g. ZnO_2H_2 at 18°. (Dupre and Bialas, Z. angew. Ch. 1903, **16.** 55.)

See also **Zinc oxide.**

Solubility in NH_4OH+Aq at 25°.

ZnO_2H_2 used	NH_3 norm.	G. ZnO per l.
prepared from $ZnSO_4$	1.287	7.28
	0.825	3.84
	0.311	0.85
prepared from $Zn(NO_3)_2$	0.321	0.34
	0.643	0.845
	1.215	2.70
	1.928	5.07
	2.570	7.01
	3.213	10.16

(Bonsdorff, Z. anorg. 1904, **41.** 189.)

Solubility of ZnO_2H_2 in NH_4OH and ammonium bases+Aq at 17°–19°.

Normality of the base	G. ZnO in 20 cc. of the solution
0.0942 NH_3	0.00185
0.236 NH_3	0.01795
0.707 NH_3	0.0959
0.0944 NH_2CH_3	0.0008
0.472 NH_2CH_3	0.01325
0.944 NH_2CH_3	0.0484
0.068 $NH_2C_2H_5$	0.0005
0.51 $NH_2C_2H_5$	0.0074
0.68 $NH_2C_2H_5$	0.01605
$NH(C_2H_5)_2$	insol.
$NH(CH_3)_2$	"

(Herz, Z. anorg. 1902, **30.** 280.)

Solubility in NH_4OH+Aq increases with increasing concentration of NH_4OH. (Euler, B. 1903, **36.** 3401.)

2 pts. ZnO_2H_2 dissolve in 5 pts. KOH+Aq. (sp. gr.=1.3.) (Bonnet.)

Solubility of ZnO_2H_2 in NaOH+Aq.

G. Na in 20 ccm.	G. Zn in 20 ccm.
0.1012	0.0040
0.1978	0.0150
0.4278	0.0442
0.6670	0.1771
0.9660	0.9630
1.4951	0.2481
2.9901	0.3700

When zinc hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less zinc hydroxide according to the concentration. (Rubenbauer, Z. anorg. 1902, **30.** 333.)

Solubility of ZnO_2H_2 in NaOH+Aq at 25°.

G. mol. per l.	
Na	Zn
0.2636	0.00311
0.3871	0.0057
0.5414	0.0129
0.9280	0.0425

(Wood, Chem. Soc. 1910, **97.** 884.)

Freshly pptd. ZnO_2H_2 is easily sol. in KOH+Aq, but it gradually goes over into a stable form which is difficultly sol. in KOH+Aq. (Herz, Z. anorg. 1901, **28.** 474.)

Freshly pptd. ZnO_2H_2 is sol. in dil. salt solutions (1 %) as follows. The given amts. in mg. (calculated as Zn) were disolved per l. at t°.

Salt	Mg. Zn	t°
NaCl	51	18
KCl	43	20
$CaCl_2$	57.5	16
$MgCl_2$	65	16
$BaCl_2$	38	18
K_2SO_4	37.5	20
$MgSO_4$	27	21
KNO_3	17.5	15
$NaNO_3$	22	15
$Ba(NO_3)_2$	25	21
K_2CO_3	0	15
NH_4Cl	95	20
NH_4NO_3	77	20
$(NH_4)_2SO_4$	88	20

(Snyders, B. **11.** 936.)

$+H_2O$.

See also **Zinc oxide.**

Zinc hydrosulphide, $Zn(SH)_2$.

Very unstable. Decomp. by H_2O. (Zotta, M. **10.** 807.)

Sol. in NaSH+Aq. (Thomsen, B. **11.** 2044.)

$Zn_3H_2S_4$. (Zotta.)

Zinc iodide, ZnI_2.

Deliquescent. Easily sol. in H_2O.

Sat. ZnI_2+Aq contains at:

−18°	−5°	+17°	47°	62°	73°	
70.9	74.0	80.4	80.3	81.3	81.2% ZnI_2,	

97°	100°	107°	138°	140°
82.1	83.0	82.6	83.8% ZnI_2.	

(Étard, A. ch. 1894, (7) **2.** 544.)

Solubility in H_2O.

100 g. of the sat. solution contain at:

0°	18°	40°	60°	80°	100°
81.11	81.20	81.66	82.37	83.05	83.62 g. ZnI_2.

(Dietz, Z. anorg. 1899, **20.** 251.)

See also under $+2H_2O$.

Sp. gr. of ZnI_2+Aq at 19.5° containing:

23.1	42.6	56.3	63.5	76.0% ZnI_2.
1.2340	1.5121	1.7871	1.9746	2.3976

(Kremers, Pogg. **111.** 61.)

Sp. gr. of ZnI_2+Aq at 19.5° containing:

5	10	15	20	25 % ZnI_2,
1.045	1.091	1.140	1.196	1.255
30	35	40	45	50 % ZnI_2,
1.368	1.390	1.420	1.560	1.650
55	60	65	70	75 % ZnI_2.
1.754	1.875	2.020	2.180	2.360

(Kremers, calculated by Gerlach, Z. anal. **8.** 285.)

Sol. in $(NH_4)_2CO_3$+Aq.

Moderately sol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Sol. in alcohol.

100 pts. glycerine disolve 40 pts. at ord. temp. (Klever, Bull. Soc. 1872, (2) **18.** 372.)

100 g. glycerol dissolve 40 g. ZnI_2 at 15.5°. (Ossendowski, Pharm. J. 1907, **79.** 575.)

More sol. in anhydrous ether than in abs. alcohol. Insol. in CS_2. (Hampe, Ch. Z. 1887, **11.** 846.)

Sol. in methyl acetate (Naumann, B. 1909, **42.** 3790); acetone. (Eidmann, C. C. **1899,** II. 1014; Naumann, B. 1904, **37.** 4328.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, **51.** 236.)

Mol. weight determined in methyl sulphate. (Werner, Z. anorg. 1897, **15.** 25.)

$+2H_2O$. Solubility in H_2O.

100 g. of the sat. solution contain at:

−10°	−5°	0°	+10°	22°	27°(mpt.)
80.50	80.77	81.16	82.06	83.12	89.52 g. ZnI_2.

(Dietz, Z. anorg. 1899, **20.** 251.)

$+4H_2O$. (Lubarski, Z. anorg. 1898, **18.** 387.)

Zinc *tetra*iodide, ZnI_4.

Known only in aqueous solution. (Baup, Repert. **14.** 412.)

Sol. in fenchone. (Rimini and Olivari, C. C. **1907,** II. 241.)

Zinc iodide ammonia, $ZnI_2, 4NH_3$.

Decomp. by cold H_2O. Easily sol. in acids and NH_4OH+Aq. (Rammelsberg, Pogg. **48.** 152.)

$ZnI_2, 5NH_3$. Decomp. by cold H_2O. Sol. in NH_4OH+Aq. (Rammelsberg.)

$3ZnI_2, 5NH_3+3H_2O$. (Tassily, C. R. 1896, **122.** 324.)

Zinc iodide hydrazine, $ZnI_2, 2N_2H_4$.

Decomp. by H_2O.

Sol. in NH_4OH+Aq. (Franzen, Z. anorg. 1908, **60.** 277.)

Zinc nitride, Zn_3N_2.

Decomp. by H_2O with the greatest violence. (Frankland, Phil. Mag. (4) **15.** 149.)

Easily decomp. by H_2O when finely powdered. (Rossel, C. R. 1895, **121.** 942.)

Sol. in HCl. (Fischer, B. 1910, **43.** 1468.)

Zinc oxide, ZnO.

Insol. in H_2O. Some preparations of ZnO are sl. sol. in H_2O, never, however, in less than 1 million pts. H_2O. (Bineau, C. R. **41.** 510.)

Calculated from electrical conductivity of ZnO+Aq. 1 pt. ZnO is sol. in 236,000 pts. H_2O at 18°. (Dupre and Bialas, Zeit. angew. Ch. 1903, **16.** 55.)

See also **Zinc hydroxide.**

Easily sol. in acids, even after ignition. Easily sol. in acids, even H_2SO_3, or H_2CO_3+Aq.

Solubility of ZnO in CrO_3+Aq at 25°.

1 l. of the solution contains:

G. CrO_3	G. ZnO	G. CrO_3	G. ZnO
0.010	0.013	101	44.9
0.010	0.013	151	66.1
0.010	0.013	192	83.8
0.604	0.409	192	83.6
2.14	1.16	285	123
4.19	2.24	392	168
11.4	5.84	450	193
11.5	5.89	461	196
22.2	10.7	463	197
31.4	14.9	475	202
43.1	20.1	574	240
57.5	26.7	660	274
66.5	30.3	769	318
66.7	30.4	879	354
70.6	32.2	970	389
93.3	41.5	...	...

(Gröger, Z. anorg. 1911, **70.** 136.)

When moist is easily sol. in KOH, NaOH, and NH_4OH+Aq, but only sl. sol. therein after ignition. Partially repptd. from solution in NH_4OH+Aq by dilution with H_2O.

Anhydrous ZnO is insol. in dil., but sol. in conc. alkali hydrates+Aq, but the hydroxide is easily sol., even in dil. alkalies+Aq. (Fremy, A. ch. (3) **23.** 390.)

Very sl. sol. in NH_4OH+Aq. After ignition its solubility is greatly increased by traces of K and NH_4 salts. Phosphates have the strongest action, then, in the following order: arsenates, chlorides, sulphites, nitrates, acetates, carbonates, tartrates, citrates, and sulphates. Succinates and benzoates increase the solubility in NH_4OH+Aq, only when it is very dil.; borates, iodides, chlorates, arsenites, gallates, and oxalates do not increase the solubility. (Schindler.)

ZnO is sol. in NH_4OH+Aq. only in presence of NH_4 salts. (Brandhorst, Zeit. angew. Ch. 1904, **17.** 513.)

Solubility in KOH, NaOH, and NH_4OH+Aq.

An excess over 4 mols. KOH to 1 mol. ZnO is necessary for solution, but that excess may be neutralised after solution, until only 4 mols. are left, without pptn. of ZnO. Solution is pptd. by addition of 12 vols. H_2O. KOH+Aq containing 16.5 g. KOH to a litre H_2O is the weakest solution which will dissolve ZnO. Three times as much alkali are necessary for solution at 50° as at 16–17°. Less excess of NaOH than of KOH is necessary. 3 mols. NH_4OH will dissolve 1 mol. ZnO, and the temp. and dilution are in this case of little influence. (Prescott.)

100 cc. of 20% NaOH+Aq dissolve in many hours at most 2.97 g. ignited ZnO. Pptd. ZnO is more quickly dissolved but the action becomes very slow after 100 cc. of the solution contain 3.87 g. of Zn. (Förster and Günther, Z. Elektrochem. 1900, **6.** 301.)

Solubility of ignited ZnO in NaOH+Aq gradually decreases. (Kunschert, Z. anorg. 1904, **41.** 343.)

Sol. in hot NH_4Cl+Aq, either when moist or dry.

Somewhat less sol. in NH_4NO_3+Aq.

Somewhat sol. in water glass+Aq. (Ordway.)

Slowly sol. in cold, easily in hot NaCl+Aq. (Siersch, J. B. **1867.** 255.)

Solubility of ZnO in $ZnCl_2$+Aq at room temp.

G. $ZnCl_2$ per 100 g. H_2O	G. ZnO per 100 g. H_2O
8.22	0.0137
23.24	0.138
45.95	0.497
51.50	0.604
56.90	0.723
62.85	0.884
96.00	1.792
124.70	3.213
144.80	2.640
203.00	1.590

The solubility curve has a maximum at a point corresponding to about 125 g. $ZnCl_2$ per 100 g. H_2O. On the first branch of the curve the solid phase in equilibrium with the solution is $ZnCl_2, 4ZnO, 6H_2O$; on the second branch it is $ZnCl_2, ZnO, 1.5H_2O$.

(Driot, C. R. 1910, **150.** 1427.)

Sol. in boiling $Fe(NO_3)_3$, and $Pb(NO_3)_2$+Aq with pptn. of oxides. Not attacked by $Co(NO_3)_2$, $Ni(NO_3)_2$, and $Ce(NO_3)_3$+Aq. (Persoz.)

Sol. in boiling KCN+Aq.

Insol. in boiling K tartrate +Aq. (Kahlenberg and Hillyer, Am. Ch. J. 1894, **16.** 101.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

Tartaric acid somewhat hinders the pptn. of ZnO_2H_2.

Insol. in methyl acetate. (Naumann, B. 1909, **42.** 3790.)

Insol. in acetone. (Naumann, B. 1904, **37.** 4329; Eidmann, C. C. **1899,** II. 1014.)

Sol. in methyl amine, but insol in amyl amine+Aq. (Wurtz.)

1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissoolves 0.24 g. ZnO. (Bodenbender, J. B. **1865,** 600.)

Min. *Zincite.* Sol. in acids.

Zinc *peroxide*.

1 pt. sol. in 45,000 pts. H_2O.

Very sol. in acids. (Foregger and Philipp, J. Soc. Chem. Ind. 1906, **25.** 300.)

ZnO_2 (?). Ppt. Decomp. by acids with evolution of H_2O_2. (Haass, B. **17.** 2249.)

ZnO, H_2O, H_2O_2. (de Forcrand, A. ch. 1902, (7) **27.** 58.)

$3ZnO, 2H_2O_2$. (de Forcrand.)

$3ZnO, H_2O, 2H_2O_2$. (de Forcrand.)

$4ZnO, H_2O, 3H_2O_2$. (de Forcrand.)

ZnO_2, ZnO_2H_2. Insol. in NH_4OH+Aq. (Kouriloff, A. ch. (6) **23.** 431.)

$3ZnO_2, Zn(OH)_2$. Sol. in NaOH+Aq with evolution of O. (Eijkman, C. C. **1905,** I. 1628.)

$Zn_4O_7, 3ZnO+4H_2O$. Completely sol. in dil. H_2SO_4. (de Forcrand.)

$10ZnO_2, 4ZnO+5H_2O$. Ppt. (Teletow, C. C. **1911,** I. 1799.)

Zinc oxybromide, $ZnBr_2, ZnO+13H_2O$.

$ZnBr_2, 4ZnO+10$, 13, and $19H_2O$. Decomp. by H_2O into—

$ZnBr_2, 6ZnO+35H_2O$. (André.)

$ZnBr_2, 5ZnO+6H_2O$. (André.)

All oxybromides are sol. in KOH and NH_4OH+Aq. (André, C. R. **96.** 703.)

Zinc oxybromide ammonia, $ZnBr_2, 3ZnO, 2NH_3+5H_2O$.

Decomp. by H_2O. (André, C. R. **96.** 703.)

Zinc oxychloride, $ZnO, 3ZnCl_2+H_2O$.

Decomp. by H_2O.

Very sol. in dil. acids. (Ephraim, Z. anorg. 1908, **59.** 67.)

$+4H_2O$. Sl. sol. in H_2O; more sol. in $ZnCl_2$+Aq.

Easily sol. in acids, or NH_4OH, or KOH+Aq. (Schindler, Mag. Pharm. **36.** 45.)

$+5H_2O$ and $8H_2O$. (André, A. ch. (6) **3.** 94.)

$ZnO, ZnCl_2+1\frac{1}{2}H_2O$. (Driot, C. R. 1910, **150.** 1427.)

$3ZnO, ZnCl_2+2H_2O$. Sl. sol. in H_2O, more easily sol. in $ZnCl_2$+Aq. Easily sol. in acids and in NH_4OH or KOH+Aq. (Schindler, Mag. Pharm. **36.** 45.)

$+3H_2O$. (Werner, B 1907, **40.** 4443.)

$+5H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 367.)

$3ZnO, 2ZnCl_2+11H_2O$. (André, C. R. 1888, **106.** 854.)

$4ZnO, ZnCl_2+6H_2O$. (André, C. R. 1888, **106.** 854.)

$+11H_2O$. (André, A. ch. (6) **3.** 94.)

$5ZnO, ZnCl_2+6H_2O$. (Perrot, Bull. Soc. 1895, (3) **13.** 976.)

$+8H_2O$. (André, C. R. 1882, **94.** 1524.)

$5ZnO, 2ZnCl_2+26H_2O$. Sol. in KOH or NH_4OH+Aq. Decomp. by H_2O into—

$5ZnO, ZnCl_2+26H_2O$. Sol. in KOH or NH_4OH+Aq. Decomp. by H_2O into—

$6ZnO, ZnCl_2+6H_2O$. Insol. in H_2O. (Kane, A. ch. **72.** 296.)

$8ZnO, ZnCl_2+10H_2O$. (Mailhe, A. ch. 1902, (7) **27.** 367.)

$9ZnO, ZnCl_2+3H_2O$. Insol. in H_2O. Less sol. in NH_4OH+Aq than $ZnCl_2, 3ZnO+2H_2O$, but easily sol. in $+14H_2O$.

$9ZnO, 2ZnCl_2+12H_2O$. Insol. in hot or cold H_2O. (Habermann, M. **5.** 432.)

Zinc oxychloride ammonia, $6ZnCl_2, ZnO, 12NH_3+4H_2O$.

Decomp. by H_2O and boiling alcohol. (André, A. ch. (6) **3.** 90.)

$ZnCl_2, 3ZnO, 2NH_3+5H_2O$. Decomp. by H_2O. (André.)

$ZnCl_2, 2ZnO, 2NH_3+3H_2O$. (André.)

$6ZnCl_2, 3ZnO, 10NH_3+13H_2O$. (André.)

$4ZnCl_2, ZnO, 8NH_3+2H_2O$. (André.)

Zinc oxyiodide, $ZnI_2, 3ZnO+2H_2O$.

Insol. in cold, sl. sol. in boiling H_2O. (Müller, J. pr. **26.** 441.)

$ZnI_2, 9ZnO+24H_2O$. Insol. in cold H_2O.

$ZnI_2, 5ZnO+11H_2O$. Decomp. by H_2O. (Tassilly, C. R. 1896, **122.** 324.)

Zinc oxyphosphide, ZnP_2O.

(Renault, A. ch. (4) **9.** 162.)

Probably is a mixture of zinc phosphate and phosphorus. (Vigier, Bull. Soc. **1861.** 5.)

Zinc oxysulphide, ZnO, ZnS.

Sol. in HCl+Aq. (Arfvedson, Pogg. **1.** 59.)

4ZnS, ZnO. Not decomp. by boiling $HC_2H_3O_2$+Aq. (Kersten, Schw. J. **57.** 186.)

Min. *Volzite.* Sol. in HCl+Aq.

Zinc phosphide, ZnP.

Less easily attacked by HCl+Aq than Zn_3P_2.

ZnP_2. Not attacked by hot HCl+Aq. (Hvoslef, A. **100.** 99.)

ZnP_4. Insol. in dil. HCl+Aq. (Renault.)

Zn_3P_2. Insol. in H_2O. Sol. in dil. HCl, H_2SO_4, or HNO_3+Aq, with evolution of PH_3. (Renault, A. ch. (4) **9.** 162.)

Zn_3P_4. Insol. in HCl+Aq. (Renault.)

Zinc selenide, ZnSe.

Cold dil. HNO_3+Aq dissolves out Zn, and Se separates out, which dissolves on warming as H_2SeO_3. (Berzelius.)

+$x H_2O$. Insol. in H_2O. (Berzelius.)

Zinc sulphide, ZnS.

Anhydrous. Insol. in H_2O. Sol. in HCl+Aq; insol. in $HC_2H_3O_2$+Aq. (Ebelmen, A. ch. (3) **25.** 97.)

Sol. in H_2S+Aq under pressure in a sealed tube. (Senarmont, A. ch. (3) **32.** 168.)

Min. *Blende, Sphalerite.* Sl. attacked by acids, expecting aqua regia.

1 l. H_2O dissolves 6.65×10^{-6} mols. zinc blende at 18°.

1 l. H_2O dissolves 6.63×10^{-6} mols. artificial cryst. ZnS at 18°. (Wiegel, Z. phys. Ch. 1907, **58.** 294.)

Sol. in an alkaline solution of NaClO. (Sadtler, Trans. Am. Electrochem. Soc. 1902, **1.** 142.)

Insol. in liquid NH_3. (Franklin, Am. Ch. J. 1898, **20.** 830.)

+$^1/_2$, $^2/_3$, or $1H_2O$.

Pptd. ZnS.

1 l. H_2O dissolves 70.60×10^{-6} mols. pptd. ZnS at 18°. (Wiegel, Z. phys. Ch. 1907, **58.** 294.)

Insol. in alkali hydrates, carbonates, and sulphides+Aq. Insol. in NH_4OH, HCl, or $(NH_4)_2CO_3$+Aq. Easily sol. in very dil. HCl and HNO_3+Aq, but H_2S ppts. ZnS in presence of very dil. HCl+Aq, or H_2SO_4+Aq. (Eliot and Storer.)

More easily sol. in HNO_3+Aq than in HCl+Aq. (Fresenius.)

Only sl. sol. in acetic acid. (Wackenroder.)

When still moist is sol. in H_2SO_3+Aq.

Insol. in NH_4Cl or NH_4NO_3+Aq.

K_2S+Aq when added to $ZnSO_4$+Aq produces a ppt. in presence of 10,000 pts. H_2O, and a slight opalescence with 20,000 pts. (Lassaigne.)

Slowly sol. in conc. KCN+Aq. (Halm, J. B. **1870.** 1008.)

Sl. sol. in Na_2S+Aq; sol. in NaSH+Aq. (Becker, Sill. Am. J. (3) **33.** 199.)

Zinc *penta*sulphide, ZnS_5.

Sol. in acids, with separation of S. (Schiff, A. **115.** 74.)

Zinc sulphosilicide, ZnSiS.

Decomp. by acids and by alkalies. (Fraenkel, Metall, 1909, **6.** 683.)

Zinc telluride, ZnTe.

Decomp. by acids. Sol. in Br_2+Aq. (Fabre, C. R. **105.** 277.)

Zincic acid.

Zinc hydroxide shows weak acid properties, and forms the following salts.

Ammonium zincate, $3ZnO, 4NH_3+12H_2O = 3ZnO, 2(NH_4)_2O+10H_2O$.

Decomp. by much H_2O.

Barium zincate, $BaH_2Zn_2O_4+7H_2O$.

Decomp. by H_2O. (Bertrand, C. R. **115.** 939.)

Calcium zincate, $CaH_2Zn_2O_4+4H_2O$.

Decomp. by H_2O. Sol. in NH_4OH+Aq. (Bertrand, C. R. **115.** 939.)

Cobaltous zincate, xCoO, yZnO.

Rinman's green. Sol. in acids. H_2CO_3+Aq dissolves out ZnO. (Comey.)

Potassium zincate, ZnO, K_2O.

Easily sol. in H_2O, but decomp. by boiling. (Laux, A. **9.** 183.)

2ZnO, K_2O. Decomp. immediately by cold H_2O. (Fremy, C. R. **15.** 1106.)

Sodic zincate, $Na_2O, 2ZnO+8H_2O$, or $2NaHZnO_2+7H_2O$.

Decomp. by H_2O or alcohol. (Comey and Jackson, Am. Ch. J. **11.** 145.)

+$7H_2O$. (Förster and Günther, Z. Elektrochem, 1899, **6.** 301.)

$2Na_2O, 3ZnO+18H_2O$ or $Zn_3O_6Na_4H_2+17H_2O$. Decomp. by H_2O or alcohol. Insol. in ether. (Comey and Jackson.)

Strontium zincate, $SrH_2Zn_2O_4+7H_2O$.

Decomp. by H_2O. (Bertrand.)

Zirconic acid.

See **Zirconium hydroxide.**

Barium zirconate, $BaZrO_3$.

Insol. in acids. (Ouvrard, C. R. **113.** 80.)

Calcium zirconate, $CaZrO_3$.

Insol. in acids. (Ouvrard, C. R. **113.** 80.)

Calcium zirconate, acid.

Insol. in H_2O or HCl+Aq. (Hiordthal, A. **137.** 237.)

Calcium potassium zirconate, $(Ca,K)LaO_3$ (small quantity of CaO substituted by K_2O).

Sol. in HCl. (Venable, J. Am. Chem. Soc. 1896, **18.** 444.)

Cupric zirconate.

(Berthier, A. ch. **59.** 195.)

Lithium zirconate, Li_2ZrO_3.

Easily attacked by acids. (Ouvrard, C. R. **112.** 1444.)

Magnesium zirconate.

Insol. in H_2O or HCl+Aq. (Hiordthal, C. R. **61.** 215.)

Potassium zirconate.

Decomp. by HCl+Aq. (Knop, A **159.** 44.)

Sodium zirconate, Na_2ZrO_3.

Decomp. by H_2O.

Na_4ZrO_4. Decomp. by HCl+Aq, and is dissolved by subsequent addition of H_2O.

Na_2O, $8ZrO_2+12H_2O$. (Hiordthal.)

Strontium zirconate, $SrZrO_3$.

As $CaZrO_3$. (Ouvrard.)

Zirconium, Zr.

Crystallized. Attacked by conc. HCl+Aq above 50°, but very slowly even at 100°; rapidly by hot aqua regia. Sol. in cold conc. HF+Aq. (Troost, C. R. **61.** 109.)

Very violently attacked by a mixture of HNO_3 and HF. (Berzelius, Pogg. **4.** 117.)

Amorphous. Slowly attacked by boiling aqua regia, H_2SO_4, or conc. HCl+Aq. (Berzelius.)

Easily sol. in HF or HNO_3+HF.

Zirconium bromide, $ZrBr_4$.

Very hygroscopic. Violently decomp. by H_2O to form oxybromide. (Melliss, Zeit. Ch. (2) **6.** 296.)

Sl. sol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, **20.** 840.)

Zirconium bromide ammonia, $ZrBr_4$, $4NH_3$.

Ppt. Insol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, **20.** 840.)

$ZrBr_4$, $10NH_3$. Very hydroscopic.

Decomp. by H_2O. (Stähler, B. 1905, **38.** 2612.)

Zirconium carbide, ZrC.

Insol. in H_2O and NH_4OH+Aq and HCl Aq even when heated. Sol. in HNO_3, H_2SO_4 and fused alkali nitrates, chlorates, or hydroxides. (Moissan, C. R. 1896, **122.** 653.)

Zirconium chloride, $ZrCl_4$.

Sol. in H_2O with evolution of much heat to form $ZrOCl_2$. Sol. in alcohol. (Hinsberg, A. **239.** 253.)

Very unstable.

Probably substances so described in the literature by Nylander and others were oxychlorides. (Venable, J. Am. Chem. Soc. 1894, **16.** 471.)

Sol. in ether. (Matthews, J. Am. Chem. Soc. 1898, **20.** 821.)

Zirconium chloride ammonia, $ZrCl_4$, $2NH_3$.

Fumes in the air. Decomp. by H_2O. (Matthews, J. Am. Chem. Soc. 1898, **20.** 821.)

$ZrCl_4$, $3NH_3$. (Stähler, B. 1905, **38.** 2611.)

$ZrCl_4$, $4NH_3$. Decomp. by H_2O. (Paykull.)

Unstable. Decomp. by H_2O. (Matthews, J. Am. Chem. Soc. 1898, **20.** 821.)

$ZrCl_4$, $8NH_3$. Stable in the air. Decomp. by H_2O. Insol. in ether. (Matthews, J. Am. Chem. Soc. 1898, **20.** 821.)

Very hydroscopic. Decomp. by H_2O. (Stähler, B. 1905, **38.** 2611.)

Zirconium fluoride, ZrF_4.

Anhydrous. Insol. in H_2O and acids. (Deville, A. ch. (3) **49.** 84.)

Only sl. sol. in H_2O.

1.388 g. dissolve in 100 cc. H_2O without hydrolysis. On warming the solution, zirconium hydrate begins to ppt. out at about 50°. (Wolter, Ch. Z. 1908, **32.** 606.)

$+3H_2O$. Sol. in H_2O, but solution decomposes on diluting, with pptn. of an insol. basic salt. Sol. in dil. HF+Aq. (Berzelius.)

Zirconium fluoride ammonia, $5ZrF_4$, $2NH_3$.

(Wolter, Ch. Z. 1908, **32.** 607.)

Zirconium hydride, ZrH_2.

Not attacked by acids. (Winkler, B. **24.** 873.)

Zirconium hydroxide, $Zr(OH)_4$.

Insol. in H_2O or alcohol. Sol. in 5000 pts. H_2O. (Melliss.)

Sol. in acids, even oxalic or tartaric acid, when precipitated cold. If precipitated hot, it is slowly dissolved upon heating with conc. acids.

Sol. in dil. or conc. min. acids except HI. Readily sol. in oxalic, only sl. sol. in acetic acid.

Much less sol. when pptd. from hot solution than when pptd. from cold solution. (Venable, J. Am. Chem. Soc. 1898, **20.** 274.)

Sl. sol. in $(NH_4)_2CO_3$+Aq. Insol. in K_2CO_3 and Na_2CO_3+Aq. Insol. in NaOH, KOH, and NH_4OH+Aq.

Sol. in $(NH_4)_2C_4H_4O_6+NH_4OH$+Aq. Insol. in NH_4 salts+Aq.

Zirconium iodide, ZrI_4.

Fumes in the air.

Sol. in H_2O and acids with violent reaction.

Decomp. by alcohol. Sol. in abs. ether.

Sl. sol. in benzene and CS_2. (Stähler, B. 1904, **37.** 1137.)

Insol. in H_2O, HNO_3, HCl, aqua regia, and CS_2.

Sol. in H_2SO_4 with decomp; unchanged by boiling H_2O. (Dennis, J. Am. Chem. Soc. 1896, **18.** 678.)

Zirconium iodide ammonia, ZrI_4, $6NH_3$; ZrI_4, $7NH_3$; ZrI_4, $8NH_3$; ZrI_4, $10NH_3$.

All above comps. are hydroscopic and lose NH_3 in the air. (Stähler, B. 1905, **38.** 2615.)

Zirconium nitride.

Scarcely attacked by acids, aqua regia, and caustic alkalies. Slowly decomp. by long contact with H_2O. (Mallet, Sill. Am. J. (2) **28.** 346.)

Zr_3N_8. Decomp. when heated in the air; sol. in HF; insol. in other min. acids. (Matthews, J. Am. Chem. Soc. 1898, **20.** 844.)

Zr_3N_8. Decomp. when heated in the air. Sol. in HF; insol. in other min. acids. (Matthews, J. Am. Chem. Soc. 1898, **20.** 844.)

Zirconium oxide, ZrO_2.

When ignited, is insol. in all acids except HF and H_2SO_4. Sl. sol. in HF; sol. in H_2SO_4 only when very finely powdered and heated with a mixture of 2 pts. H_2SO_4 and 1 pt. H_2O until the H_2SO_4 volatilises. (Berzelius.)

Zirconium ***per*****oxide,** ZrO_3.

(Cleve, Bull. Soc. (2) **43.** 53), or Zr_2O_5 according to Bailey (Chem. Soc. **49.** 150).

Not attacked by cold dil. H_2SO_4+Aq. (Bailey.)

Zirconium silicon oxide.

Min. *Zircon.* *See* **Silicate, zirconium.**

Zirconium oxy-compounds.

See **Zirconyl compounds.**

Zirconium phosphide, ZrP_2.

Insol. in dil. or conc. acids and alkalies.

Sl. sol. in aqua regia. (Gewecke, A. 1908, **361.** 85.)

Zirconium silicide, $ZrSi_2$.

Sol. in HF, insol. in other min. acids.

Not acted upon by 10% KOH+Aq or NaOH+Aq.

Decomp. by fusion with KOH. (Hönigschmid, C. R. 1906, **143.** 225.)

Zirconium sulphide.

Insol. in H_2O. Sol. in HF; slowly sol. in aqua regia. Insol. in HNO_3, HCl, H_2SO_4, or KOH+Aq. (Berzelius.)

Insol. in dil. acids. Sol. in conc. HNO_3+Aq (perhaps an oxysulphide). (Fremy.)

Zirconomolybdic acid.

Ammonium zirconomolybdate, $2(NH_4)_2O$, ZrO_2, $12MoO_3+10H_2O$.

Sol. in H_2O. (Pechard, C. R. 1893, **117.** 790.)

Potassium zirconomolybdate, $2K_2O$, ZrO_2, $12MoO_3+18H_2O$.

Sol. in H_2O. (Pechard.)

Zirconotungstic acid.

Ammonium zircono*deca*tungstate, $3(NH_4)_2O$, ZrO_2, $10WO_3+13H_2O$.

Very sol. in H_2O.

Efflorescent. (Hallopeau, Bull. Soc. 1896, (3) **15.** 921.)

$3(NH_4)_2O$, H_2O, ZrO_2, $10WO_3+13H_2O$. Sol. in H_2O; unstable; effloresces in the air. (Hallopeau.)

Potassium zirconotungstate, $4K_2O$, ZrO_2, WO_3+20H_2O.

Sol. in hot H_2O. (Hallopeau.)

$4K_2O$, ZrO_2, $10WO_3+15H_2O$. More sol. in hot than in cold H_2O.

Sol. in fused alkali carbonates. (Hallopeau.)

Potassium *di*zircono*deca*tungstate, $4K_2O$, $2ZrO_2$, $10WO_3+20H_2O$.

More sol. in hot than in cold H_2O.

Sol. in fused alkali carbonates. (Hallopeau.)

Zirconyl bromide, $ZrOBr_2+3H_2O$.

Deliquescent. Decomp. in moist air. Very sol. in H_2O. (Venable, J. Am. Chem. Soc. 1898, **20.** 324.)

$+7H_2O$. Sol. in H_2O. (Melliss.)

$+8H_2O$. Deliquescent. Decomp. in moist air. Very sol. in H_2O. (Venable, J. Am. Chem. Soc. 1898, **20.** 324.)

$+13H_2O$. Deliquescent. Decomp. in moist air.

Very sol. in H_2O. (Venable.)

$+14H_2O$. Deliquescent. Decomp. in moist air. (Venable.)

Very sol. in H_2O. (Venable.)

$ZrBr(OH)_3+H_2O$, and $+2H_2O$. Deliquescent, and decomp. in moist air. (Venable.)

Zirconyl chloride, $ZrOCl_2$.

Sol. in H_2O; insol. in HCl. (Venable, J. Am. Chem. Soc. 1894, **16.** 475.)

$+2H_2O$. (Chauvenet, C. R. 1912, **154.** 822.)

$+3H_2O$. Sol. in H_2O. (Venable.)

$+3.5H_2O$. (Chauvenet, C. R. 1912, **154.** 822.)

$+6H_2O$. (Chauvenet.)

Sol. in H_2O.

Insol. in HCl. (Venable.)

$+4\frac{1}{2}H_2O$, $6\frac{1}{2}H_2O$, and $8H_2O$.

Efflorescent. Easily sol. in H_2O and alcohol. Very sl. sol. in conc. HCl+Aq. (Berzelius.)

$+8H_2O$. Sol. in H_2O. (Venable, J. Am. Chem. Soc. 1898, **20.** 321.)

Effloresces in the air.

Sol. in H_2O. Less sol. in HCl+Aq. and nearly insol. in conc. HCl. (Chauvenet, C. R. 1912, **154.** 822.)

Zr_2OCl_2. Sol. in H_2O and alcohol. (Endemann, J. pr. (2) **11.** 219.)

Not decomp. by H_2O.

Sol. in dil. HCl. (Chauvenet, C. R. 1912, **154.** 1236.)

$+H_2O$. (Chauvenet, C. R. 1912, **154.** 1236.)

$+3H_2O$. Decomp. by H_2O. Sol. in dil HCl. (Chauvenet.)

$8ZrO_2$, 7HCl. Sol. in H_2O. (E.)

Zr_2OCl_6. (Troost and Hautefeuille, C. R. **73.** 563.)

$Zr_3OCl_4=ZrCl_4$, $2ZrO_2$. Insol. in H_2O. (Hermann.)

Zirconyl iodide, $ZrOI_2+8H_2O$.

Very sol. in H_2O and alcohol.

Very hydroscopic. ((Stähler, B. 1904, **37.** 1138.)

$Zr_2I(OH)_3+3H_2O$. Easily sol. in H_2O. (Hinsberg, A. **239.** 253.)

Ppt. Sl. sol in HI+Aq. (Venable, J. Am. Chem. Soc. 1898, **20.** 328.)

Zirconyl sulphide (?)

Decomp by HNO_3 with separation of S. (Fremy, A. ch. (2) **38.** 326.)

APPENDIX

FORMULÆ FOR CONVERTING AREOMETER DEGREES INTO SPECIFIC GRAVITY.

n = no. of degrees on the areometer scale, sp. gr. = specific gravity.

Areometer	Temp.	Liquids heavier than H_2O	Liquids lighter than H_2O
1. Baumé.			
(*a*) *According to Baumé's original directions.* For liquids heavier than H_2O. Sp. gr. of a solution of 15 pts. NaCl dissolved in 85 pts. H_2O at 12.5° $\left(d\frac{12.5°}{12.5°}=1.1118988\right)$ = 15°; H_2O = 0°. For liquids lighter than H_2O. Sp. gr. of 10% NaCl+Aq at 12.5° $\left(d\frac{12.5°}{12.5°}=1.0737665\right)$ = 0°; H_2O = 10°.	15°	Sp. gr. $=\frac{149.05}{149.05-n}$	Sp. gr. $=\frac{145.56}{135.56+n}$
(*b*) *Old Form.* Liquids heavier than H_2O, 10% NaCl +Aq at 15° $\left(d\frac{15°}{15°}=1.073350\right)$ = 10°; H_2O = 0°. Liquids lighter than H_2O, 10% NaCl +Aq = 0°; H_2O = 10°.	12.5°	Sp. gr. $=\frac{145.88}{145.88-n}$	Sp. gr. $=\frac{145.88}{135.88+n}$
	15°	Sp. gr. $=\frac{146.3}{146.3-n}$	Sp. gr. $=\frac{146.3}{136.3+n}$
	17.5°	Sp. gr. $=\frac{146.78}{146.78-n}$	Sp. gr. $=\frac{146.78}{136.78+n}$
(*c*) *New Form.* So-called "Rational Scale." Liquids heavier than H_2O, H_2SO_4+ Aq$\frac{15°}{15°}$ = 1.842 = 66°; H_2O = 0°.	15°	Sp. gr. $=\frac{144.3}{144.3-n}$	
2. Beck. H_2O = 0°; liquid of 0.850 sp. gr. $\left(\frac{12.5°}{12.5°}\right)$ = 30°. Scale continued above and below.	12.5°	Sp. gr. $=\frac{170}{170-n}$	Sp. gr. $=\frac{170}{170+n}$
3. Twaddle. H_2O = 0°. Each degree corresponds to an increase of 0.005 in the sp. gr.	Given on the instrument	Sp. gr. = $1.000+0.005n$	

TABLES FOR THE CONVERSION OF BAUMÉ DEGREES INTO SP. GR.

Since the original directions of Baumé there have been many slight modifications suggested, so that there are several varieties of Baumé hydrometers with somewhat varying readings, tables for the two principal ones of which are here given.

1. According to Baumé's original directions.

For liquids heavier than H_2O. Sp. gr. of 15 % NaCl+

$$\mathrm{Aq}\left(\frac{12.5^\circ}{12.5^\circ}\right)=1.1118988=15^\circ;\ H_2O=0^\circ.$$

Calculated according to the formula, sp. gr. $=\dfrac{149.05}{149.05-n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
0	1.00000	20	1.15497	39	1.35438	58	1.63701
1	1.00675	21	1.16399	40	1.36680	59	1.65519
2	1.01360	22	1.17316	41	1.37945	60	1.67378
3	1.02054	23	1.18246	42	1.39234	61	1.69279
4	1.02757	24	1.19192	43	1.40547	62	1.71223
5	1.03471	25	1.20153	44	1.41885	63	1.73213
6	1.04194	26	1.21129	45	1.43248	64	1.75250
7	1.04927	27	1.22122	46	1.44638	65	1.77335
8	1.05671	28	1.23131	47	1.46056	66	1.79470
9	1.06426	29	1.24156	48	1.47501	67	1.81657
10	1.07191	30	1.25199	49	1.48971	68	1.83899
11	1.07968	31	1.26260	50	1.50479	69	1.86196
12	1.08755	32	1.27338	51	1.52014	70	1.88551
13	1.09555	33	1.28436	52	1.53580	71	1.90967
14	1.10366	34	1.29522	53	1.55179	72	1.93446
15	1.11189	35	1.30688	54	1.56812	73	1.95989
16	1.12025	36	1.31844	55	1.58471	74	1.98601
17	1.12873	37	1.33621	56	1.60182	75	2.01283
18	1.13735	38	1.34218	57	1.61923	76	2.04038
19	1.14609	..	...	..	...	..	...

For liquids lighter than H_2O. Sp. gr. of 10 % NaCl

$$\text{Aq}\left(\frac{12.5^\circ}{12.5^\circ}\right)=1.0737665=0^\circ;\ H_2O=10^\circ.$$

Calculated according to the formula, sp. gr. $=\dfrac{145.56}{135.56+n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr	Deg. Baumé	Sp. gr.
10	1.00000	30	0.87919	50	0.78443	65	0.72577
15	0.96679	35	0.85342	55	0.76385	70	0.70811
20	0.93571	40	0.82912	60	0.74432	75	0.69130
25	0.90657	45	0.80616	..	...	..	...

2. According to the so-called Rational Scale.

$$\text{Sp. gr. of } H_2SO_4+\text{Aq}\left(\frac{15^\circ}{15^\circ}\right)=1.842=66^\circ\ ;\ H_2O=0^\circ.$$

Calculated according to the formula, sp. gr. $=\dfrac{144.3}{144.3-n}$.

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
1	1.007	18	1.142	35	1.320	51	1.547
2	1.014	19	1.152	36	1.332	52	1.563
3	1.021	20	1.161	37	1.345	53	1.580
4	1.029	21	1.170	38	1.357	54	1.598
5	1.036	22	1.180	39	1.370	55	1.616
6	1.043	23	1.190	40	1.384	56	1.634
7	1.051	24	1.200	41	1.397	57	1.653
8	1.059	25	1.210	42	1.411	58	1.672
9	1.066	26	1.220	43	1.424	59	1.692
10	1.074	27	1.230	44	1.439	60	1.712
11	1.082	28	1.241	45	1.453	61	1.732
12	1.091	29	1.251	46	1.468	62	1.753
13	1.099	30	1.262	47	1.483	63	1.775
14	1.107	31	1.274	48	1.498	64	1.797
15	1.116	32	1.285	49	1.514	65	1.820
16	1.125	33	1.296	50	1.530	66	1.842
17	1.133	34	1.308	..	...	..	...

SYNCHRONISTIC TABLE OF CHEMICAL

Year	A.	A. ch.	Am. J. Sci.	Ann. Min.	Ann. Phil.	Arch. Pharm.	Ch. Gaz.	C. R.	Dingl.
1800	...	(1) 32–34	...	...	...	...	..	...	...
1801	...	35–39	...	...	...	...	..	...	...
1802	...	40–43	...	...	...	...	..	...	...
1803	...	44–47	...	...	...	...	..	...	...
1804	...	48–51	...	...	...	...	..	...	...
1805	...	52–55	...	...	...	...	..	...	...
1806	...	56–60	...	...	...	...	..	...	...
1807	...	61–64	...	...	...	...	..	...	
1808	...	65–68	...	...	...	...	..	...	...
1809	...	69–72	...	...	...	...	..	...	...
1810	...	73–76	...	...	...	...	..	...	...
1811	...	77–80	...	...	...	...	..	...	...
1812	...	81–84	...	...	...	...	..	...	...
1813	...	85–88	...	...	(1) 1, 2	...	..	...	...
1814	...	89–92	...	...	3, 4	...	..	...	...
1815	...	93–96	...	...	5, 6	...	..	...	...
1816	...	(2) 1–3	...	...	7, 8	...	..	...	...
1817	...	4–6	...	1, 2	9, 10	...	..	...	...
1818	...	7–9	...	3	11, 12	...	..	...	...
1819	...	10–12	(1) 1	4	13, 14	...	..	...	...
1820	...	13–15	2	5	15, 16	...	..	...	1–3
1821	...	16–18	3	6	(2) 1, 2	...	..	...	4–6
1822	...	19–21	4, 5	7	3, 4	1, 2	..	...	7–9
1823	...	22–24	6	8	5, 6	3–6	..	...	10–12
1824	...	25–27	7, 8	9	7, 8	7–10	..	...	13–15
1825	...	28–30	9	10, 11	9, 10	11–14	..	...	16–18
1826	...	31–33	10, 11	12, 13	11, 12	16–19	..	...	19–22
1827	...	34–36	12	(2) 1, 2	...	20–23	..	...	23–26
1828	...	37–39	13, 14	3, 4	...	24–26	..	...	27–30
1829	...	40–42	15, 16	5, 6	...	27–30	..	...	31–34
1830	...	43–45	17, 18	7, 8	...	31–34	..	...	35–38
1831	...	46–48	19, 20	...	...	35–39	..	...	39–42
1832	1–4	49–51	21, 22	(3) 1, 2	...	40–43	..	...	43–47
1833	5–8	52–55	23, 24	3, 4	...	44–47	..	...	48–50
1834	9–12	56–57	25–27	5, 6	...	48–50	..	...	51–54
1835	13–16	58–60	28, 29	7, 8	...	(2) 1–4	..	1	55–58
1836	17–20	61–63	30, 31	9, 10	...	5–8	..	2, 3	59–62
1837	21–24	64–66	32, 33	11, 12	...	9–12	..	4, 5	63–66
1838	25–28	67–69	35, 35	13, 14	...	13–16	..	6, 7	67–70
1839	29–32	70–72	36, 37	15, 16	...	17–20	..	8, 9	71–74
1840	33–36	73–75	38, 39	17, 18	...	21–24	..	10, 11	75–78
1841	37–40	(3) 1–3	40, 41	19, 20	...	25–28	..	12, 13	79–82
1842	41–44	4–6	42, 43	(4) 1, 2	...	29–32	..	14, 15	83–86
1843	45–48	7–9	44, 45	3, 4	...	33–36	1	16, 17	87–90
1844	49–52	10–12	46, 47	5, 6	...	37–40	2	18, 19	91–94
1845	53–56	13–15	48–50	7, 8	...	41–44	..	20, 21	95–98
1846	57–60	16–18	(2) 1, 2	9, 10	...	45–48	3	22, 23	99–102
1847	61–64	19–21	3, 4	11, 12	...	49–52	4	24, 25	103–106

AND OTHER SCIENTIFIC PERIODICALS—Part I.

Gilb. Ann.	J. Chim. med.	J. Pharm.	J. pr.	Phil. Mag.	Pogg.	Proc. Am. Acad.	Proc. Roy. Soc.	J. Sci.	Scher. J.	Schw. J.
4–6	...	...	...	6–8	...	...	...	...	3,4	...
7–9	...	...	...	9–11	...	...	...	...	5, 6	...
10–12	...	...	...	12–14	...	...	...	...	7, 8	...
13–15	...	...	...	15–17	...	...	...	...	9, 10	...
16–18	...	...	...	18–20	...	...	...	...	11, 12	...
19–21	...	...	...	21–23	...	...	...	...	13, 14	...
22–24	...	...	...	24–26	...	...	...	...	15, 16	...
25–27	...	...	...	27–29	...	...	...	...	17, 18	...
28–30	...	...	...	30–32	...	...	...	...	19, 20	...
31–33	...	(1) 1	...	33, 34	...	...	...	...	21, 22	...
34–36	...	2	...	35, 36	...	...	...	...	23, 24	...
37–39	...	3	...	37, 38	...	...	...	...	Cont. as	(1) 1–3
40–42	...	4	...	39, 40	...	...	...	...	Schw. J.	4–6
43–45	...	5	...	41, 42	...	...	...	...	...	7–9
46–48	...	6	...	43, 44	...	...	...	...	...	10–12
49–51	...	(2) 1	...	45, 46	...	...	...	...	...	13–15
52–54	...	2	...	47, 48	...	...	...	1	...	16–18
55–57	...	3	...	49, 50	...	...	...	2, 3	...	19–21
58–60	...	4	...	51, 52	...	...	...	4, 5	...	22–24
61–63	...	5	...	53, 54	...	...	...	6, 7	...	25–27
64–66	...	6	...	55, 56	...	...	...	8, 9	...	28–30
67–69	...	7	...	57, 58	...	...	...	10, 11	...	(2) 1–3
70–72	...	8	...	59, 60	...	...	...	12, 13	...	4–6
73–75	...	9	...	61, 62	...	...	...	14, 15	...	7–9
76	...	10	...	63, 64	1, 2	...	...	16, 17	...	10–12
Cont. as	(1) 1	11	...	65, 66	3–5	...	...	18, 19	...	13–15
Pogg.	2	12	...	67, 68	6–8	...	...	20, 21	...	16–18
...	3	13	...	(2) 1, 2	9–11	...	...	...	...	19–21
...	4	14	...	3, 4	12–14	...	...	...	...	22–24
...	5	15	...	5, 6	15–17	...	...	...	...	25–27
...	6	16	...	7, 8	18–20	...	...	...	...	28–30
...	7	17	...	9, 10	21–23	...	...	...	...	(3) 1–3
...	8	18	...	11, (3) 1	24–26	...	1	...	...	4–6
...	9	19	...	2, 3	27–30	1	2	...	...	7–9
...	10	20	1–3	4, 5	31–33	...	...	...	...	Cont. as
...	(2) 1	21	4–6	6, 7	34–36	...	...	...	...	J. pr.
...	2	22	7–9	8, 9	37–39	...	...	...	...	...
...	3	23	10–12	10, 11	40–42	...	3	...	...	...
...	4	24	13–15	12, 13	43–45	...	...	...	...	...
...	5	25	16–18	14, 15	46–48	...	...	...	...	...
...	6	26	19–21	16, 17	49–51	...	...	...	...	...
...	7	27	22–24	18, 19	52–54	...	...	...	...	...
...	8	(3) 1, 2	25–27	20, 21	55–57	...	4	...	...	...
...	9	3, 4	28–30	22, 23	58–60	...	...	...	...	...
...	10	5, 6	31–33	24, 25	61–63	...	...	...	...	...
...	(3) 1	7, 8	34–36	26, 27	64–66	...	...	...	...	...
...	2	9, 10	37–39	28, 29	67–69	2	...	...	...	...
...	3	11, 12	40–42	30, 31	70–72	...	...	...	...	...

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Year	A.	A. ch.	Am. Ch. J.	Am. J. Sci.	Analyst.	Ann. Min.	Arch. Pharm.	A. suppl.	B.	Bull. Soc.
1848	65–68	22–24	...	5, 6	...	13, 14	53–56	...	...	...
1849	69–72	25–27	...	7, 8	...	15, 16	57–60	...	...	...
1850	73–76	28–30	...	9, 10	...	17, 18	61–64	...	...	...
1851	77–80	31–33	...	11, 12	...	19, 20	65–68	...	...	...
1852	81–84	34–36	...	13, 14	...	(5) 1, 2	69–72	...	...	...
1853	85–88	37–39	...	15, 16	...	3, 4	73–76	...	...	...
1854	89–92	40–42	...	17, 18	...	5, 6	77–80	...	...	...
1855	93–96	43–45	...	19, 20	...	7, 8	81–84	...	...	...
1856	97–100	46–48	...	21, 22	...	9, 10	85–88	...	...	...
1857	101–104	49–51	...	23, 24	...	11, 12	89–92	...	...	...
1858	105–108	52–54	...	25, 26	...	13, 14	93–96	...	...	...
1859	109–112	55–57	...	27, 28	...	15, 16	97–100	...	...	1
1860	113–116	58–60	...	29, 30	...	17, 18	101–104	...	...	2
1861	117–120	61–63	...	31, 32	...	19, 20	105–108	1	...	3
1862	121–124	64–66	...	33, 34	...	(6) 1, 2	109–112	2	...	4
1863	125–128	67–69	...	35, 36	...	3, 4	113–116	...	...	5
1864	129–132	(4) 1–3	...	37, 38	...	5, 6	117–120	3	...	(2) 1, 2
1865	133–136	4–6	...	39, 40	...	7, 8	121–124	4	...	3, 4
1866	137–140	7–9	...	41, 42	...	9, 10	125–128	...	...	5, 6
1867	141–144	10–12	...	43, 44	...	11, 12	129–132	5	...	7, 8
1868	145–148	13–16	...	45, 56	...	13, 14	133–136	6	1	9, 10
1869	149–152	16–18	...	47, 48	...	15, 16	137–140	...	2	11, 12
1870	153–156	19–21	...	49, 50	...	17, 18	141–144	7	3	13, 14
1871	157–160	22–24	...	(3) 1, 2*	...	19, 20	145–148	...	4	15, 16
1872	161–164	25–27	...	3, 4	...	(7) 1, 2	149, 150	8	5	17, 18
							(3) 1†			
1873	165–170	28–30	...	5, 6	...	3, 4	2, 3	...	6	19, 20
1874	171–174	(5) 1–3	...	7, 8	...	5, 6	4, 5	...	7	21, 22
1875	175–179	4–6	...	9, 10	...	7, 8	6, 7	...	8	23, 24
1876	180–183	7–9	...	11, 12	0	9, 10	8, 9	...	9	25, 26
1877	184–189	10–12	...	13, 14	2	11, 12	10, 11	...	10	27, 28
1878	190–194	13–15	...	15, 16	3	13, 14	12, 13	...	11	29, 30
1879	195–199	16–18	1	17, 18	4	15, 16	14, 15	...	12	31, 32
1880	200–205	19–21	2	19, 20	5	17, 18	16, 17	...	13	33, 34
1881	206–210	22–24	3	21, 22	6	19, 20	18, 19	...	14	35, 36
1882	211–215	25–27	4	23, 24	7	(8) 1, 2	20	...	15	37, 38
1883	216–221	28–30	5	25, 26	8	3, 4	21	...	16	39, 40
1884	222–226	(6) 1–3	6	27, 28	9	5, 6	22	...	17	41, 42
1885	227–231	4–6	7	29, 30	10	7, 8	23	...	18	43, 44
1886	232–236	7–9	8	31, 32	–11	9, 10	24	...	19	45, 46
1887	237–242	10–12	9	33, 34	12	11, 12	25	...	20	47, 48
1888	243–249	13–15	10	35, 36	13, 14	13, 14	26	...	21	49, 50
1889	250–255	16–18	11	37, 38	15, 16	15, 16	27	...	22	(3) 1, 2
1890	256–260	19–21	12	39, 40	17, 18	17, 18	228	...	23	3, 4
1891	261–266	22–24	13	41, 42	19, 20	19, 20	229	...	24	5, 6
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1895	284–289	4–6	17	49, 50	27, 28	7, 8	233	...	28	13, 14

* Also cited as whole series, 101, 102, 103, etc. † Also cited as 201, 202, etc.

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1878	...	12	27, 28	17, 18	10	...	...	20	...	...	8	5, 6
1879	...	13	29, 30	19, 20	11	...	...	21	...	...	9	7, 8
1880	...	14	(5)1, 2	21, 22	12	...	1	22	...	...	10	9, 10
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1882	...	...	5, 6	25, 26	14	1	3	24	...	...	12	13, 14
1883	...	16	7, 8	27, 28	15	2	4	25	...	...	13	15, 16
1884	...	17	9, 10	29, 30	16	3	5	26	...	...	14	17, 18
1885	...	18	11, 12	31, 32	17	4	6	27	...	...	15	19, 20
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1887	...	20	15, 16	35, 36	19	6	8	29	...	...	17	23, 24
1888	...	21	17, 18	37, 38	20	7	9	30	...	...	18	25, 26
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1890	...	23	21, 22	41, 42	22	9	11	32	...	...	20	29, 30
1891	...	24	23, 24	43, 44	23	10	12	33	...	...	21	31, 32
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1896	289–293	(7)7–9	18	(4)1, 2	234	29	(2)15, 16	..	69, 70	..	122, 123	26	18
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